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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602181A / <i>All Domain Convergence Applied Research</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	25.019	27.360	14.297	-	14.297	22.613	20.651	17.232	9.988	0.000	137.160
CM1: <i>Collab Battlefield Networked Leth Sys App Tech*</i>	-	-	-	-	-	-	8.569	10.516	7.358	-	0.000	26.443
CM7: <i>Collaborative Convergence Applied Research</i>	-	25.019	27.360	14.297	-	14.297	14.044	10.135	9.874	9.988	0.000	110.717

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2024

A. Mission Description and Budget Item Justification

The Program Element (PE) executes research as part of a campaign of learning to assess feasibility of technologies in an operational environment, learning from early failure and re-scope research to improve speed of response, scalability, interoperability and range of engagement. This program element will deliver integration of technologies from sensor to shooter in near real-time, from tactical to strategic level, taking a system design approach in support of All Domain Situational Awareness (CJADC2). It will enable optimal lethal and non-lethal effects across all domains using artificial intelligence and machine learning to improve how we recognize threats, augment and enhance leader decision-making, replicate tactical behaviors to enable autonomous capabilities, and design system engineering architectures to validate interoperability of technologies.

Work in this PE complements PE 0602145A (Next Generation Combat Vehicle Technology).

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

Work is performed by the United States Army Futures Command.

B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	25.967	27.399	25.884	-	25.884
Current President's Budget	25.019	27.360	14.297	-	14.297
Total Adjustments	-0.948	-0.039	-11.587	-	-11.587
• Congressional General Reductions	-	-	-	-	-
• Congressional Directed Reductions	-	-	-	-	-
• Congressional Rescissions	-	-	-	-	-
• Congressional Adds	-	-	-	-	-
• Congressional Directed Transfers	-	-	-	-	-
• Reprogrammings	-0.948	-	-	-	-
• SBIR/STTR Transfer	-	-	-	-	-
• Adjustments to Budget Years	-	-	-11.587	-	-11.587

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Appropriation/Budget Activity	R-1 Program Element (Number/Name)
2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	PE 0602181A / All Domain Convergence Applied Research

• FFRDC Transfer	-	-0.039	-	-
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Change Summary Explanation

Funding decrease is due to realignment of funding to Program Element 0602141A (Lethality Technology) / Project CIB (Sensor to Shooter (STS) Applied Research) for designing and developing advanced algorithms for sensor to shooter decision aids.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602181A / All Domain Convergence A plied Research				Project (Number/Name) CM7 / Collaborative Convergence Applied Research			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CM7: Collaborative Convergence Applied Research	-	25.019	27.360	14.297	-	14.297	14.044	10.135	9.874	9.988	0.000	110.717

A. Mission Description and Budget Item Justification

This Project supports research required to oppose adversary technologies in the threat based early operational environment. Focus is on those technologies that will aid in reducing the sensors to shooters timelines. This is accomplished using Artificial Intelligence (AI) algorithm decision agent design architectures, advanced methods for processing data, and improved AI performance. Additionally, this Project will research technologies and solutions necessary to enable mission command in multi-domain operations. The project will accelerate emerging research to achieve sensor to shooter dominance.

Work in this Project compliments Program Element (PE) 0603041A (All Domain Convergence Advanced Technology).

Work in this Project supports Next Generation Combat Vehicle, Network, Future Vertical Lift, and Long Range Precision Fires Army Modernization Priorities.

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

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

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

	FY 2022	FY 2023	FY 2024
Title: AI-Enabled Decision Support in Distributed Networks	5.390	3.488	3.641
Description: This effort researches techniques to understand and model complex multi-platform tactical networks in Multi-Domain Operational environments to develop training data sets for AI-enabled tactical decision support capabilities. This effort leverages Army research informed by Army Doctrine on data value, consensus, uncertainty, human-agent teaming and network science to optimize decision support training data production. Supports AI-enabled decision support capabilities for Next Generation Combat Vehicle, Network, Future Vertical Lift, and Long Range Precision Fires Army Modernization Priorities.			
FY 2023 Plans: Increase complexity and number of elements in tactical network engagement models and integrate synthetic training data with ongoing real-world engagement data (imagery, quantitative confidence, speed, etc) from training centers and exercises; develop cost and reward functions that collectively approximate doctrine and mission success for basic fire and maneuver missions; assess generalized performance and adaptability of decision models			
FY 2024 Plans:			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will research real-time human-in-the-loop (HITL) feedback process to improve target detection and decision support for multi-platform networks; explore techniques to modify in real-time HITL for improved accuracy and efficiency; conduct experiments to assess performance improvements from hardware-software co-design; investigate multi-agent reinforcement learning (MARL) on Capability Graph Networks (CGN) for basic fire and maneuver missions.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>				
<p>Title: Synthetic Data for AI-Enabled Decision Support</p> <p>Description: This effort researches approaches to incorporate synthetic data to augment Army training data sets and optimize AI performance for uncommon Multi-Domain Operations (MDO) targets and environments. This effort investigates efficacy and optimal application of synthetic training data developed using multiple technical methods, including physics-based models and generative adversarial techniques. This effort will experiment with artificially augmented data sets to enable classification of rare targets and cost-effective enterprise-level training data generation. Supports AI-enabled decision support capabilities for Next Generation Combat Vehicle, Network, Future Vertical Lift, and Long Range Precision Fires Army Modernization Priorities.</p> <p>FY 2023 Plans: Research techniques to develop and characterize synthetic data sets that include novel synthetic objects and backgrounds; experiment with larger and more varied synthetic augmentations to traditional training data sets; identify and correlate effects of synthetic training data augmentation to trained object classifier performance; develop methodologies to enhance classification performance against uncommon targets with synthetic training data augmentation.</p> <p>FY 2024 Plans: Will mature synthetic data generation pipelines in both the electro-optical/visible and infrared spectral bands, consisting of physics based and generative adversarial based data-driven approaches, for both target signatures and background scenes to optimize machine learning detection/classification accuracy on targets while reducing false alarms in the background; develop synthetic environments/simulation testbeds for assessment of deep reinforcement learning based course of action generation as a command and control decision aid; conduct experiments in Army-relevant environments and field assessments to validate synthetic data methodology.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>		6.065	5.125	5.974
<p>Title: Data Characterization for AI-Enabled Decision Support</p> <p>Description: This effort will investigate techniques for data management, characterization, curation, labeling, and classification to enable repeatable, robust performance of trained AI-enabled decision support capabilities for complex, multi-platform tactical</p>		5.193	4.486	4.682

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
networks in varied tactical Multi-Domain Operations (MDO) environments. Supports AI-enabled decision support capabilities for Next Generation Combat Vehicle, Network, Future Vertical Lift, and Long Range Precision Fires Army Modernization Priorities.				
<p>FY 2023 Plans: Research training data assessment techniques that correlate statistical content of training data selected with performance and adaptability of resulting trained algorithms; revise and improve training data sets to accommodate findings and improve generalized algorithm performance; deploy training data set characterization and algorithm performance tools on Army development platform to support collaborative object classifier, AI-enabled decision support tool, and autonomy training.</p> <p>FY 2024 Plans: Will support systematic data collection and curation for continuous AI algorithm development; research and implement techniques for ingesting large, diverse data sets relevant to broad AI algorithm development across the Army; formalize methods for including synthetic data to augment real data.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort</p>				
<p>Title: Lethality Architecture</p> <p>Description: Designs networked lethality role-based architecture to support automated decision aids and target handoff capability for combined arms operations. Designs a hybrid distributed architecture that will ingest real-time, prioritized data for decision agents to support scalable operations with reduced processing time.</p> <p>FY 2023 Plans: Validate time and space synchronization of fires and distributed lethality capabilities in role-based architecture. Continue to develop architecture to interface with additional Joint and international partner systems. Conduct experiments to validate de-confliction between various sensors and weapons systems to achieve reduced sensor to shooter timelines. Mature methods and algorithms for decision aids to operate in degraded environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Work has been administratively realigned in FY24 to Program Element 0602141 Lethality Technology / Project CIB (Sensor to Shooter (STS) Applied Research).</p>		6.022	7.782	-
<p>Title: Algorithms and Environment</p> <p>Description: Designs and develops a data model for commander decision aided algorithms to support integrated direct & indirect fires; defines the process and data structure to automate decision aids and target handoff for simultaneous engagements to air/</p>		0.482	1.992	-

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
ground platforms; and designs decentralized data structures and hybrid databases that can scale to echelons and user selectable input.				
<p>FY 2023 Plans: Design simulation capability for integrated direct and indirect fires decision aids, including coordinating decentralized operations. Conduct experiments for automated decision aids and target handoff capability for simultaneous engagement to air/ground platforms.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Work has been administratively realigned in FY24 to Program Element 0602141 Lethality Technology / Project CIB (Sensor to Shooter (STS) Applied Research).</p>				
<p>Title: Fires Coordination</p> <p>Description: Designs and develops integrated direct/indirect effects coordination and execution. Investigates autonomous cooperative engagement methods by modeling adversary behavior to determine the optimal shooter(s) for a large number of targets to achieve tactical overmatch. Design learning behaviors capable of incorporating commander's guidance and based on enemy data and historic performance.</p> <p>FY 2023 Plans: Design and develop Fires coordination measures integrated at the platform level for both air and ground platforms. Design and develop enhanced decision aids and effects coordination algorithms capability to execute Fires synchronization. Conduct experiments for course of action analysis integrated capability using enemy intel data. Design and develop enhanced algorithms for predicting adversary behaviors to optimize recommendations to the commander.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Work has been administratively realigned in FY24 to Program Element 0602141 Lethality Technology / Project CIB (Sensor to Shooter (STS) Applied Research).</p>		1.867	3.488	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		-	0.999	-

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	25.019	27.360	14.297

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

N/A

Remarks

D. Acquisition Strategy

N/A