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**Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army** **Date:** April 2022

<b>Appropriation/Budget Activity</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army / BA 2: Applied Research</i>	<b>R-1 Program Element (Number/Name)</b> PE 0602181A / <i>All Domain Convergence Applied Research</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	-	25.967	27.399	-	27.399	25.884	15.752	10.639	10.376	0.000	116.017
CM7: <i>Collaborative Convergence Applied Research</i>	-	-	25.967	27.399	-	27.399	25.884	15.752	10.639	10.376	0.000	116.017

**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>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2021</b>	<b>FY 2022</b>	<b>FY 2023 Base</b>	<b>FY 2023 OCO</b>	<b>FY 2023 Total</b>
Previous President's Budget	0.000	25.967	0.000	-	0.000
Current President's Budget	0.000	25.967	27.399	-	27.399
Total Adjustments	0.000	0.000	27.399	-	27.399
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	27.399	-	27.399

**Change Summary Explanation**

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.

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**Exhibit R-2A, RDT&E Project Justification:** PB 2023 Army **Date:** April 2022

<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602181A / All Domain Convergence A plied Research	<b>Project (Number/Name)</b> CM7 / Collaborative Convergence Applied Research
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CM7: Collaborative Convergence Applied Research	-	-	25.967	27.399	-	27.399	25.884	15.752	10.639	10.376	0.000	116.017

**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.

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 effort is performed by the United States (US) Army Futures Command.

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

This work is done in coordination with PE 0603041A (All Domain Convergence Advanced Technology).

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

	FY 2021	FY 2022	FY 2023
<b>Title:</b> AI-Enabled Decision Support in Distributed Networks	-	5.390	3.627
<b>Description:</b> 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.			
<b>FY 2022 Plans:</b> Will collect Machine Learning (ML) training data such as imagery, quantitative confidence, speed, accuracy, and process data from sensor to shooter experimental tactical engagements for curation and distribution; develop tactical engagement models and training data sets for AI-enabled decision support tools in complex, multi-domain tactical networks.			
<b>FY 2023 Plans:</b> Will 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			

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2021</b>	<b>FY 2022</b>	<b>FY 2023</b>
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  <b>FY 2022 to FY 2023 Increase/Decrease Statement:</b> Funding reduced due to decrease in synthetic training data being decrease in experiments with synthetic training data with tactical network engagement models.				
<b>Title:</b> Synthetic Data for AI-Enabled Decision Support  <b>Description:</b> 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.  <b>FY 2022 Plans:</b> Will investigate techniques to develop and characterize state-of-the-art synthetic data sets; research methods to incorporate synthetic data into target classification algorithm training sets and understand its effects on target classification performance against uncommon high priority MDO targets; experiment with artificially augmented data sets to enable classification of rare targets and cost-effective enterprise-level data generation.  <b>FY 2023 Plans:</b> Will 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.  <b>FY 2022 to FY 2023 Increase/Decrease Statement:</b> Funding reduced due to decrease in experiments with artificially augmented data sets.		-	6.065	5.326
<b>Title:</b> Data Characterization for AI-Enabled Decision Support  <b>Description:</b> 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 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.		-	5.193	4.663

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2021</b>	<b>FY 2022</b>	<b>FY 2023</b>
<p><b>FY 2022 Plans:</b> Will explore and assess methodologies for efficient, effective training data set development, characterization, and curation; develop and deploy Army?s curated training data sets on network-enabled development platforms for joint collaborative research on training methods for object classifiers, AI-enabled decision support tools, and autonomy.</p> <p><b>FY 2023 Plans:</b> Will 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><b>FY 2022 to FY 2023 Increase/Decrease Statement:</b> Funding reduced due to decrease in training data set methodology research.</p>			
<p><b>Title:</b> Lethality Architecture</p> <p><b>Description:</b> 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><b>FY 2022 Plans:</b> Will develop an architecture to support time and space synchronization of fires and distributed lethality. Will determine required communications, data interfaces, and digital sensor to shooter planning for fires execution. Will also de-conflict between various sensors and weapon systems in combined arms maneuver to reduce sensor to shooter timelines. Will develop methods to use local distributed world model coordinates for input to decision aids when network is degraded and when network bandwidth is optimal.</p> <p><b>FY 2023 Plans:</b> Will validate time and space synchronization of fires and distributed lethality capabilities in role-based architecture. Will continue to develop architecture to interface with additional Joint and international partner systems. Will conduct experiments to validate de-confliction between various sensors and weapons systems to achieve reduced sensor to shooter timelines. Will mature methods and algorithms for decision aids to operate in degraded environments.</p> <p><b>FY 2022 to FY 2023 Increase/Decrease Statement:</b> Funding increase to support research of sensor architectures and interfaces to reduce kill chain in order to meet planned program requirements.</p>	-	6.022	8.083
<p><b>Title:</b> Algorithms and Environment</p>	-	0.482	2.073

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2021</b>	<b>FY 2022</b>	<b>FY 2023</b>
<p><b>Description:</b> Designs and develops a data model for commander decision aided algorithms to support integrated direct &amp; indirect fires; defines the process and data structure to automate decision aids and target handoff for simultaneous engagements to air/ground platforms; and designs decentralized data structures and hybrid databases that can scale to echelons and user selectable input.</p> <p><b>FY 2022 Plans:</b> Will investigate simulation requirements for tactical fires of multiple company formations, which will include coordinating decentralized operations in different terrain models.</p> <p><b>FY 2023 Plans:</b> Will design simulation capability for integrated direct and indirect fires decision aids, including coordinating decentralized operations. Will conduct experiments for automated decision aids and target handoff capability for simultaneous engagement to air/ground platforms.</p> <p><b>FY 2022 to FY 2023 Increase/Decrease Statement:</b> Funding increase to support maturation of data models to study commander decision aid algorithms applicable in multi-domain operations in order to meet planned program requirements.</p>				
<p><b>Title:</b> Fires Coordination</p> <p><b>Description:</b> 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><b>FY 2022 Plans:</b> Will investigate and validate AI based algorithms process design for Fires synchronization. Will design and validate courses of analysis integrated capability using AI based approaches. Will investigate algorithms for predicting adversary behaviors and investigate how these patterns can impact recommendations for optimal shooter scenarios.</p> <p><b>FY 2023 Plans:</b> Will design and develop Fires coordination measures integrated at the platform level for both air and ground platforms. Will design and develop enhanced decision aids and effects coordination algorithms capability to execute Fires synchronization. Will conduct experiments for course of action analysis integrated capability using enemy intel data. Will design and develop enhanced algorithms for predicting adversary behaviors to optimize recommendations to the commander.</p> <p><b>FY 2022 to FY 2023 Increase/Decrease Statement:</b></p>		-	1.867	3.627

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2021</b>	<b>FY 2022</b>	<b>FY 2023</b>
Funding increase to support research and experimentation of enhanced algorithms to support fires synchronization and coordination in multi-domain operations in order to meet planned program requirements.			
<b>Title:</b> FY2022 SBIR/STTR Transfer <b>Description:</b> Funding transferred in accordance with Title 15 USC ?638 <b>FY 2022 Plans:</b> Funding transferred in accordance with Title 15 USC ?638 <b>FY 2022 to FY 2023 Increase/Decrease Statement:</b> Funding transferred in accordance with Title 15 USC ?638	-	0.948	-
<b>Accomplishments/Planned Programs Subtotals</b>	-	25.967	27.399

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

**Remarks**

**D. Acquisition Strategy**  
N/A