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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 7: Operational Systems Development	R-1 Program Element (Number/Name) PE 0708045A / End Item Industrial Preparedness Activities
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	105.885	130.785	61.720	-	61.720	-	-	-	-	-	-
E25: Mfg Science & Tech	-	105.885	58.785	61.720	-	61.720	-	-	-	-	-	-
EA2: MANTECH INITIATIVES (CA)	-	-	72.000	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Program Element (PE) develops, demonstrates, and transitions manufacturing technologies and processes that enable improvements in producibility and affordability of emerging and enabling components and subsystems of Army ground and air platforms, Soldier systems, weapons systems, air & missile defense systems, as well as sensors and electronics. Initiatives within the PE result in cost savings and reduced risk of transitioning military-unique manufacturing processes into production. Project E25 fosters the transfer of new/improved manufacturing technologies to the industrial base, including manufacturing efforts that have potential for high payoff across the spectrum of Army systems.

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

Work in this PE is performed by the United States (U.S.) Army laboratories and research centers, U.S. Army Program Executive Offices and Program Management Offices, and U.S. Army depots and arsenals.

B. Program Change Summary (\$ in Millions)

	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>
Previous President's Budget	108.348	61.012	62.484	-	62.484
Current President's Budget	105.885	130.785	61.720	-	61.720
Total Adjustments	-2.463	69.773	-0.764	-	-0.764
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	72.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.463	-2.227			
• Adjustments to Budget Years	-	-	-0.764	-	-0.764

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

Project: E25: Mfg Science & Tech

FY 2020	FY 2021

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Congressional Add Details (\$ in Millions, and Includes General Reductions)		FY 2020	FY 2021
Congressional Add: <i>FY 2020 Congressional Add - Technical Textiles</i>		5.000	-
Congressional Add: <i>FY 2020 Congressional Add - Nanoscale Materials Manufacturing</i>		12.500	-
Congressional Add: <i>FY 2020 Congressional Add - Glass Separators for Lithium Batteries</i>		5.000	-
Congressional Add: <i>FY 2020 Congressional Add - Additive Manufacturing Technology Insertion</i>		5.000	-
Congressional Add: <i>FY 2020 Congressional Add - Power Take-off Hybridization</i>		7.000	-
Congressional Add: <i>FY 2020 Congressional Add - Tungsten Manufacturing Affordability Initiative for Armaments</i>		5.000	-
Congressional Add: <i>FY 2020 Congressional Add - Manufacturing Technology Program</i>		5.000	-
Congressional Add: <i>FY 2020 Congressional Add - Transparent Armor</i>		4.000	-
Congressional Add Subtotals for Project: E25		48.500	-
Project: EA2: MANTECH INITIATIVES (CA)			
Congressional Add: <i>Functional Fabrics and Smart Textiles- Continued</i>		-	10.000
Congressional Add: <i>Smart Manufacturing of Engineered Fabrics - Continued</i>		-	7.000
Congressional Add: <i>Scalability of Functional Fabric Manufacturing - Continued</i>		-	5.000
Congressional Add: <i>Nanoscale Materials Manufacturing- Continued</i>		-	10.000
Congressional Add: <i>Compact Efficient Rotary Engine</i>		-	10.000
Congressional Add: <i>Lightweight High Efficiency Generators</i>		-	10.000
Congressional Add: <i>Glass Separators for Lithium Bateries- Continued</i>		-	5.000
Congressional Add: <i>Advanced Manufacturing Cell for Missile Fins</i>		-	5.000
Congressional Add: <i>Advanced Manufacturing Technology</i>		-	5.000
Congressional Add: <i>Tungsten Manufacturing Affordability Initiative for Armaments - Continued</i>		-	5.000
Congressional Add Subtotals for Project: EA2		-	72.000
Congressional Add Totals for all Projects		48.500	72.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 7	R-1 Program Element (Number/Name) PE 0708045A / End Item Industrial Preparedness Activities	Project (Number/Name) E25 / Mfg Science & Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
E25: Mfg Science & Tech	-	105.885	58.785	61.720	-	61.720	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project develops and demonstrates manufacturing technologies and processes that enable improvements in producibility and affordability of emerging and enabling components and subsystems of Army ground and air platforms, Soldier systems, weapons systems, air & missile defense systems, and sensors and electronics. Work is performed to advance the state of the art in manufacturing processing and fabrication techniques for coatings, multifunctional materials, and structural elements for Army specific applications.

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

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

	FY 2020	FY 2021	FY 2022
<p>Title: Long Range Precision Fires</p> <p>Description: The effort funds manufacturing improvements to support areas that enable hypersonics, cannons, and missiles. Efforts focus on reduction in cost and time for manufacturing.</p> <p>FY 2021 Plans: Demonstrate reduced cost and time in manufacturing activities of advanced material, advanced processes, and new tooling to enable long range precision fires. Decrease the use of multiple tools and eliminate long lead times on repairing and replacing items for Long Range Precision Fires.</p> <p>FY 2022 Plans: Develop and advance manufacturing processes and capabilities supporting long range precision fires resulting in the affordability and producibility of advanced energetics, warheads, propulsion, guidance and navigation technology.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Increase in FY22 is due to investments in efforts for enhanced explosives propellant manufacturing and hypersonic system/ component manufacturing.</p>	5.289	2.962	7.744
<p>Title: Next Generation Combat Vehicle</p> <p>Description: This effort funds manufacturing technology advances needed for more affordable and reliable components and subsystems for tactical and combat vehicles and weapons systems. This effort focuses on addressing challenges in areas such as</p>	24.731	19.953	6.005

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
advanced armor, protection systems, lighter weight components, insensitive propellants, armament systems, precision munitions, engines, sensor systems, and vehicle power devices for current and future systems.				
<p>FY 2021 Plans: Use additive manufacturing advanced practices to reduce transition time and cost in replacement parts to increase in-theatre readiness. Develop manufacturing processes to produce lighter weight armor protection and evaluate advanced welding practices.</p> <p>FY 2022 Plans: Develop and advance manufacturing processes and capabilities supporting the ground vehicles that results in dependable technology with an emphasis on providing affordable and timely solutions.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Decrease in FY22 is due to completion of manufacturing efforts supporting combat engines.</p>				
<p>Title: Future Vertical Lift</p> <p>Description: This effort funds manufacturing technology advances supporting future vertical lift platforms to increase operational reach and capabilities with a concentration on affordability and producibility through manufacturing solutions.</p> <p>FY 2021 Plans: Develop manufacturing processes to increase performance and increase process automation with more reliable materials; develop novel approaches to reduce acquisition cost of materials, reduce component costs and reduce weight of overall components.</p> <p>FY 2022 Plans: Develop and advance manufacturing processes and capabilities supporting future vertical lift platforms for future attack, reconnaissance and long range assault capabilities, and air launched effects.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Increase in FY22 is due to increased investments in materials processing.</p>		4.602	6.290	11.677
<p>Title: Networks and Command, Control, Communications and Intelligence</p> <p>Description: This effort funds manufacturing technology advances needed for more affordable components and subsystems for communications; reconnaissance surveillance and target acquisition (RSTA) / intelligence, surveillance, and reconnaissance (ISR); positioning, navigation, and timing (PNT) systems; Cyber, Electronic Warfare, and Mission Command systems; and Command Post Survivability systems.</p> <p>FY 2021 Plans:</p>		12.917	12.440	10.918

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Improve manufacturing processes for digital sensors for aviation and pilotage; will demonstrate manufacturing of high dynamic range digital pixel images for aviation; develop manufacturing processes of dual band optical coatings.</p> <p>FY 2022 Plans: Develop and advance manufacturing processes and capabilities supporting command and control systems/subsystems and position, navigation, and timing systems.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Decrease in FY22 is due to completion of advanced manufacturing for digital sensors.</p>				
<p>Title: Air & Missile Defense</p> <p>Description: This effort funds advance manufacturing processes and capabilities supporting air and missile defense efforts. Efforts include manufacturing improvements to missile systems, directed energy systems, propulsion, and radar technologies.</p> <p>FY 2021 Plans: Develop high energy lasers that reduce manufacturing and supply chain costs and provide engagement capability against rockets, artillery, mortars and Unmanned Aerial Vehicles (UAVs); Produce manufacturing processes that adapt to eliminate co-site, jamming and other electromagnetic spectrum threats; optimize production processes to manufacture large precision optics.</p> <p>FY 2022 Plans: Develop and advance manufacturing processes and capabilities supporting air and missile defense efforts. This effort focuses on affordability and producibility of directed energy systems, advanced missiles and seekers, guidance and control, advanced aerostructures/propulsion, and air defense radar technologies.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Increase in FY22 is due to increased investments in directed energy manufacturing.</p>		3.767	8.000	12.784
<p>Title: Soldier Lethality</p> <p>Description: This effort funds manufacturing technology and processes in support of individual Soldier weapons, provide Soldiers with enhanced capabilities, and increase their ability to respond to emerging situations through advanced manufacturing processes with a concentration affordability and producibility. Work focuses on addressing challenges in areas such as multifunctional fabrics for shelters, uniforms and portage equipment; lightweight materials for body armor; and medical technologies such as biotechnology.</p> <p>FY 2021 Plans:</p>		4.365	9.140	12.592

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Continue to develop manufacturing techniques for low next generation hand grenades and advance soldier protection with Chemical, Biological, Radiological, and Nuclear (CBRN) filters. FY 2022 Plans: Increase the capability of individual Soldier weapons, provide Soldiers with enhanced capabilities, and increase their protection and ability to respond to emerging situations through advanced manufacturing technology and processes. Efforts will result in greater affordability and producibility with a concentration on next generation squad weapons and ammunition, Soldier borne power, enhanced protective materials and systems, and sensor development. FY 2021 to FY 2022 Increase/Decrease Statement: Increase in FY22 is due to increased investments in Soldier borne power.				
Title: Cross-cutting Description: This effort funds manufacturing technology advances with impact across processes or platforms of Army interest. Work focuses on addressing challenges in areas such as advanced additive manufacturing technologies for fabrication of weapons systems, platforms, and munitions; and novel manufacturing techniques for expedient and cost effective repair of worn or damaged platform components.		1.714	-	-
Accomplishments/Planned Programs Subtotals		57.385	58.785	61.720
		FY 2020	FY 2021	
Congressional Add: FY 2020 Congressional Add - Technical Textiles		5.000	-	
FY 2020 Accomplishments: FY 2020 Congressional Add for Technical Textiles \$5000K				
Congressional Add: FY 2020 Congressional Add - Nanoscale Materials Manufacturing		12.500	-	
FY 2020 Accomplishments: FY 2020 Congressional Add for Nanoscale Materials Manufacturing \$12500K				
Congressional Add: FY 2020 Congressional Add - Glass Separators for Lithium Batteries		5.000	-	
FY 2020 Accomplishments: FY 2020 Congressional Add for Glass Separators for Lithium Batteries \$5000K				
Congressional Add: FY 2020 Congressional Add - Additive Manufacturing Technology Insertion		5.000	-	
FY 2020 Accomplishments: FY 2020 Congressional Add for Additive Manufacturing Technology Insertion \$5000K				
Congressional Add: FY 2020 Congressional Add - Power Take-off Hybridization		7.000	-	

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	FY 2020	FY 2021
FY 2020 Accomplishments: FY 2020 Congressional Add for Power Take-Off Hybridization \$7000K		
Congressional Add: FY 2020 Congressional Add - Tungsten Manufacturing Affordability Initiative for Armaments	5.000	-
FY 2020 Accomplishments: FY 2020 Congressional Add for Tungsten Manufacturing Affordability Initiative for Armaments \$5000K		
Congressional Add: FY 2020 Congressional Add - Manufacturing Technology Program	5.000	-
FY 2020 Accomplishments: FY 2020 Congressional Add for Manufacturing Technology Program \$5000K		
Congressional Add: FY 2020 Congressional Add - Transparent Armor	4.000	-
FY 2020 Accomplishments: FY 2020 Congressional Add for Transparent Armor \$4000K		
Congressional Adds Subtotals	48.500	-

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

N/A

Remarks

Not applicable for this item.

D. Acquisition Strategy

Not applicable for this item.

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Exhibit R-4, RDT&E Schedule Profile: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 7	R-1 Program Element (Number/Name) PE 0708045A / End Item Industrial Preparedness Activities	Project (Number/Name) E25 / Mfg Science & Tech

	FY 2013				FY 2014				FY 2015				FY 2016				FY 2017				FY 2018				FY 2019			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
N/A																												

	FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025				FY 2026			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
N/A																												

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Exhibit R-4A, RDT&E Schedule Details: PB 2022 Army		Date: May 2021
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Schedule Details

Events	Start		End	
	Quarter	Year	Quarter	Year
N/A	1	2016	4	2019

Note

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 7					R-1 Program Element (Number/Name) PE 0708045A / End Item Industrial Preparedness Activities				Project (Number/Name) EA2 / MANTECH INITIATIVES (CA)			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
EA2: MANTECH INITIATIVES (CA)	-	-	72.000	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This effort accelerates manufacturing technology for more affordable electronic warfare, communications and sensors systems components and subsystems to include radio frequency amplifiers, antennas, and focal plane arrays. This effort accelerates and supplements manufacturing technology for more affordable components and subsystems for tactical and combat vehicles and weapon systems. Work focuses benefit from working to develop and scale up the manufacturing process for nano-tungsten carbide powders and high-volume single-crystal tungsten rod manufacturing processes. This effort accelerates and supplements manufacturing technology for more advanced manufacturing and enterprise solutions. Work focuses on accelerating model based manufacturing to specific organic Army facilities and novel ways of applying additive manufacturing and monitoring material powder beds and process controls during additive manufacturing part build for weapon system components.

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

	FY 2020	FY 2021
Congressional Add: Functional Fabrics and Smart Textiles- Continued FY 2021 Plans: Scale-up advanced fabric-based sensor manufacturing processes.	-	10.000
Congressional Add: Smart Manufacturing of Engineered Fabrics - Continued FY 2021 Plans: Integration of engineered fabrics into wearable soldier applications.	-	7.000
Congressional Add: Scalability of Functional Fabric Manufacturing - Continued FY 2021 Plans: Integrate fiber and fabric capabilities for fabric-based electronic devices and systems.	-	5.000
Congressional Add: Nanoscale Materials Manufacturing- Continued FY 2021 Plans: Mature processes for silver Ink provider to support flexible electronic printing.	-	10.000
Congressional Add: Compact Efficient Rotary Engine FY 2021 Plans: Advanced manufacturing for heavy-fuel rotary engine technology for next generation unmanned aircraft systems.	-	10.000
Congressional Add: Lightweight High Efficiency Generators FY 2021 Plans: Mature manufacturing of High Efficiency Hybrid thermodynamic Cycle (HEHC) engine to power a 1-3 kW electric generator.	-	10.000
Congressional Add: Glass Separators for Lithium Bateries- Continued	-	5.000

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
FY 2021 Plans: Advance the manufacturing technology and processes for battery materials to be integrated into these SL and Future Vertical Lift CFT systems.		
Congressional Add: Advanced Manufacturing Cell for Missile Fins FY 2021 Plans: Mature manufacturing cell for missile fins to improve performance, quality and throughput.	-	5.000
Congressional Add: Advanced Manufacturing Technology FY 2021 Plans: Mature advanced manufacturing processes for aluminum rolling mills, to include real time measurements of mill products and automated operations for improved cold mill processes, producibility and throughput for armor products.	-	5.000
Congressional Add: Tungsten Manufacturing Affordability Initiative for Armaments - Continued FY 2021 Plans: Provides new manufacturing source for to produce rocket nozzles and long rod penetrators.	-	5.000
Congressional Adds Subtotals	-	72.000

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-4, RDT&E Schedule Profile: PB 2022 Army							Date: May 2021				
Appropriation/Budget Activity 2040 / 7				R-1 Program Element (Number/Name) PE 0708045A / End Item Industrial Preparedness Activities				Project (Number/Name) EA2 / MANTECH INITIATIVES (CA)			

FY 2013				FY 2014				FY 2015				FY 2016				FY 2017				FY 2018				FY 2019			
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
N/A																											

FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025				FY 2026			
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
N/A																											

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Exhibit R-4A, RDT&E Schedule Details: PB 2022 Army		Date: May 2021
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Schedule Details

Events	Start		End	
	Quarter	Year	Quarter	Year
N/A	1	2016	4	2016