Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Army											Date: February 2015	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603461A *I High Performance Computing Modernization Program*							
COST ($ in Millions)	**Prior Years**	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**Cost To Complete**	**Total Cost**
Total Program Element	-	213.238	221.518	177.159	-	177.159	177.190	182.338	183.339	186.373	-	-
DS7: *High Performance Computing Modernization Program*	-	174.567	181.518	177.159	-	177.159	177.190	182.338	183.339	186.373	-	-
DW5: *HIGH PERF COMP MODERN (HPCM) CONGR ADDS (CAS)*	-	38.671	40.000	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

The High Performance Computing Modernization Program (HPCMP) addresses the supercomputing requirements of DoD scientists and engineers by (1) demonstrating/maturing the most advanced, leading-edge computational architectures and exploiting these systems with complementary specialized expertise; (2) demonstrating/maturing the Defense Research and Engineering Network (DREN) which investigates/demonstrates/matures leading-edge digital networking and security technologies to securely deliver computational capabilities to the distributed DoD RDT&E community; and (3) leveraging specialized expertise from DoD, other federal departments/agencies, industry, and academia to demonstrate/mature leading-edge software application codes. DoD Supercomputing Resource Centers (DSRCs) provide extensive computational capabilities and demonstrate/mature emerging technologies that address the supercomputing requirements of the DoD RDT&E community in the areas of hardware, software, and programming environments. All HPCMP sites are interconnected to each other, the DoD HPC RDT&E community, and other major defense sites via DREN, a research network which investigates/demonstrates/matures (a) state-of-the-art digital networking technologies to ensure a robust distributed environment and (b) the most advanced digital security capabilities to effectively protect the intellectual property of the DoD and its contract entities, when employing HPCMP advanced capabilities. The HPCMP's software application effort (a) optimizes/enhances/demonstrates/matures critical DoD physics-based and parallel discrete event software in order to allow scientists and engineers to execute scientific calculations with precision and efficiency on advanced, leading-edge supercomputers, (b) demonstrates/matures robust immersive collaborative programming environments to improve science and engineering workflows, and (c) demonstrates/matures leading-edge computational technology from academia and industry. These synergistic activities collectively demonstrate/mature horizontal technologies that are exploited throughout the DoD RDT&E community, ensuring the DoD maintains the most advanced research ecosystem in the areas of computationally-intensive modeling and design.

Work in this project supports the Army S&T Innovation Enablers Portfolio.

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

Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Army					Date: February 2015
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 3: *Advanced Technology Development (ATD)*			R-1 Program Element (Number/Name) PE 0603461A *I High Performance Computing Modernization Program*		
B. Program Change Summary ($ in Millions)	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**
Previous President's Budget	220.565	181.609	178.460	-	178.460
Current President's Budget	213.238	221.518	177.159	-	177.159
Total Adjustments	-7.327	39.909	-1.301	-	-1.301
• Congressional General Reductions	-	-0.091			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	40.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-7.327	-			
• Adjustments to Budget Years	-	-	-1.301	-	-1.301

Congressional Add Details ($ in Millions, and Includes General Reductions)	**FY 2014**	**FY 2015**
Project: DW5: *HIGH PERF COMP MODERN (HPCM) CONGR ADDS (CAS)*		
Congressional Add: *Congressional Increase*	38.671	40.000
Congressional Add Subtotals for Project: DW5	38.671	40.000
Congressional Add Totals for all Projects	38.671	40.000

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army											Date: February 2015	
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603461A / *High Performance Computing Modernization Program*				Project (Number/Name) DS7 / *High Performance Computing Modernization Program*			
COST ($ in Millions)	**Prior Years**	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**Cost To Complete**	**Total Cost**
DS7: *High Performance Computing Modernization Program*	-	174.567	181.518	177.159	-	177.159	177.190	182.338	183.339	186.373	-	-

A. Mission Description and Budget Item Justification

The High Performance Computing Modernization Program (HPCMP) addresses the supercomputing requirements of DoD scientists and engineers by (1) demonstrating/maturing the most advanced, leading-edge computational architectures and exploiting these systems with complementary specialized expertise; (2) demonstrating/maturing the Defense Research and Engineering Network (DREN) which investigates/demonstrates/matures leading-edge digital networking and security technologies to securely deliver computational capabilities to the distributed DoD RDT&E community; and (3) leveraging specialized expertise from DoD, other federal departments/agencies, industry, and academia to demonstrate/mature leading-edge software application codes. DoD Supercomputing Resource Centers (DSRCs) provide extensive computational capabilities and demonstrate/mature emerging technologies that address the supercomputing requirements of the DoD RDT&E community in the areas of hardware, software, and programming environments. All HPCMP sites are interconnected to each other, the DoD HPC RDT&E community, and other major defense sites via DREN, a research network which investigates/demonstrates/matures (a) state-of-the-art digital networking technologies to ensure a robust distributed environment and (b) the most advanced digital security capabilities to effectively protect the intellectual property of the DoD and its contract entities, when employing HPCMP advanced capabilities. The HPCMP's software application effort (a) optimizes/enhances/demonstrates/matures critical DoD physics-based and parallel discrete event software in order to allow scientists and engineers to execute scientific calculations with precision and efficiency on advanced, leading-edge supercomputers, (b) demonstrates/matures robust immersive collaborative programming environments to improve science and engineering workflows, and (c) demonstrates/matures leading-edge computational technology from academia and industry. These synergistic activities collectively demonstrate/mature horizontal technologies that are exploited throughout the DoD RDT&E community, ensuring the DoD maintains the most advanced research ecosystem in the areas of computationally-intensive modeling and design.

Work in this project supports the Army S&T Innovation Enablers Portfolio.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Department of Defense (DoD) Supercomputing Resource Centers (DSRCs)	88.329	96.929	94.538
Description: The effort investigates, demonstrates, and matures general and special-purpose supercomputing environments that incorporate the most advanced, leading-edge computational architectures, distributed mass storage technologies, and data analysis methodologies; employs complementary specialized expertise to mature and exploit these environments; enables the			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
DoD RDT&E community to effectively and efficiently investigate, demonstrate, and mature a broad range of technologies through advanced computational methods. ***FY 2014 Accomplishments:*** Refined and exploited the advanced capabilities of 11 previously demonstrated supercomputers (culminating in the ability to complete 5,200 trillion floating point operations per second) in order to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the following 11 computational technology areas (CTAs): (1) space and astrophysical sciences, (2) structural mechanics, (3) fluid dynamics, (4) chemistry and materials science, (5) electromagnetics and acoustics, (6) climate/weather/ocean modeling and simulation, (7) signal/image processing, (8) forces modeling and simulation, (9) electronics, networking, and systems, (10) environmental quality, and (11) integrated modeling and test environments; demonstrated the viability of three large, tightly-integrated supercomputers containing leading-edge (i.e. 2014) processor, memory, disk input/output (I/O), interconnect, and operating system (OS) capabilities (culminating in the ability to complete 2,700 trillion floating point operations per second) to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the 11 CTAs cited above; demonstrated the ability to interactively apply portions of supercomputers to complex, geographically distributed near-real-time use cases (e.g. Army weather forecasts for geographically distributed test ranges); demonstrated the ability to interactively prepare/analyze extraordinarily large input and output data sets (e.g. 10 trillion bytes in size) from a remote location (e.g. thousands of miles away); demonstrated software and hardware-based methods for sharing memory across computational nodes to provide scientists and engineers large blocks contiguous memory (e.g. trillions of bytes) for use cases that require large matrices; investigated the energy required to address representative DoD use cases through experimentation and a sophisticated modeling of supercomputer hardware and application software in order to determine the benefits of simultaneous multi-threading (SMT) and 32-bit Acorn RISC Machine (ARM) processors for DoD supercomputing workloads. (NOTE: Europe's long-term supercomputing roadmap depends heavily on ARM processors.) ***FY 2015 Plans:*** Refine and exploit the advanced capabilities of 14 previously demonstrated supercomputers (culminating in the ability to complete 7,900 trillion floating point operations per second) in order to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the following 11 computational technology areas (CTAs): (1) space and astrophysical sciences, (2) structural mechanics, (3) fluid dynamics, (4) chemistry and materials science, (5) electromagnetics and acoustics, (6) climate/weather/ocean modeling and simulation, (7) signal/image processing, (8) forces modeling and simulation, (9) electronics, networking and systems, (10) environmental quality, and (11) integrated modeling and test environments; demonstrate the viability of six (or more) large, tightly-integrated supercomputers containing leading-edge (i.e. 2015) processor, memory, disk input/output (I/O), interconnect, and operating system (OS) capabilities (culminating in the ability to complete 9,000 trillion floating point operations per second) to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the 11 CTAs cited above; mature the ability to interactively apply portions of supercomputers to complex, geographically distributed			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
near-real-time use cases (e.g. Army weather forecasts for geographically distributed test ranges); mature the ability to interactively prepare/analyze extraordinarily large input and output data sets (e.g. 10 trillion bytes in size) from a remote location (e.g. thousands of miles away) ; mature software and hardware-based methods for sharing memory across computational nodes to provide scientists and engineers large blocks contiguous memory (e.g. trillions of bytes) for use cases that require large matrices; demonstrate graphical user interface (GUI) access to supercomputers without requiring software to be added to the client machine in order to allow scientists and engineers located at sites with prohibitive security practices to apply supercomputing to DoD use cases; demonstrate the ability to use both general-purpose and accelerated processors collectively in a single supercomputer (i.e. a hybrid supercomputer) into order to expand the breadth of DoD use cases that can be addressed by supercomputing; investigate the energy required to address representative DoD use cases through experimentation and a sophisticated modeling of supercomputer hardware and application software in order to determine the benefits of 64-bit Acorn RISC Machine (ARM) processors for DoD supercomputing workloads (NOTE: Europe's long-term supercomputing roadmap depends heavily on ARM processors.); investigate (in collaboration with Lawrence Livermore National Laboratory) the power consumption, performance, and reliability of supercomputers relative to environmental parameters within a supercomputing facility. ***FY 2016 Plans:*** Will refine and exploit the advanced capabilities of 20 (or more) previously demonstrated supercomputers (culminating in the ability to complete 16,900 trillion floating point operations per second) in order to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the following 11 computational technology areas (CTAs): (1) space and astrophysical sciences, (2) structural mechanics, (3) fluid dynamics, (4) chemistry and materials science, (5) electromagnetics and acoustics, (6) climate/weather/ocean modeling and simulation, (7) signal/image processing, (8) forces modeling and simulation, (9) electronics, networking and systems, (10) environmental quality, and (11) integrated modeling and test environments; will demonstrate the viability of two (or more) large, tightly-integrated supercomputers containing leading-edge (i.e. 2016) processor, memory, disk input/output (I/O), interconnect, and operating system (OS) capabilities (culminating in the ability to complete 10,000 trillion floating point operations per second) to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the 11 CTAs cited above; will further mature graphical user interface (GUI) access to supercomputers without requiring software to be added to the client machine in order to allow scientists and engineers located at sites with prohibitive security practices to apply supercomputing to DoD use cases; will mature the ability to use both general-purpose and accelerated processors collectively in a single supercomputer (i.e. a hybrid supercomputer) in order to expand the breadth of DoD use cases that can be addressed by supercomputing; will investigate data-intensive supercomputing architectures for DoD use cases in which it is more economical to move (in real-time) the executable code to the data (as opposed to the standard approach of moving the data to the executable code) in order to expand the breadth of DoD use cases that can be addressed by supercomputing.			
Title: Defense Research and Engineering Network (DREN)	28.896	31.443	30.397

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016

Description: This effort investigates, demonstrates, and matures state-of-the-art digital networking technologies to ensure a robust distributed environment among HPCMP sites, the DoD HPC RDT&E community, and other major defense sites; investigates, demonstrates, and matures the most advanced digital security capabilities to effectively protect the intellectual property of the DoD and its contract entities, when employing HPCMP advanced capabilities; employs complementary specialized expertise to mature and exploit this environment.

FY 2014 Accomplishments:
Demonstrated DREN III (a new advanced digital DoD research network) which provides robust, high-bandwidth, low-latency, low-jitter connectivity among the HPCMP and DoD RDT&E communities; refined and exploited the HPCMP's Defense Information Systems Agency (DISA) accredited Level 3 computer network defense capability to effectively protect the intellectual property of the DoD and its contract entities, when employing HPCMP advanced capabilities; investigated the advanced network technologies and complex information assurance mechanisms required to implement logically-separated (as opposed to physically-separated) networking communities-of-interest (COIs); demonstrated the ability to acquire a robust set of performance data for DREN III (i.e. bandwidth, latency, jitter, and configuration information) to ensure the network attributes are suitable for complex DoD RDT&E use cases; demonstrated the ability to observe the security profile of DREN III using a cloud of over 100 sensors in order to support the HPCMP's DISA-accredited Level 3 computer network defense capability; demonstrated the ability to provide secure access to DoD supercomputers through new web authentication technologies in order to facilitate the FY15 DSRC demonstration of GUI access to supercomputers.

FY 2015 Plans:
Refine and exploit DREN III (an advanced digital DoD research network) which provides robust, high-bandwidth, low-latency, low-jitter connectivity among the HPCMP and DoD RDT&E communities; further refine and exploit the HPCMP's DISA-accredited Level 3 computer network defense capability to effectively protect the intellectual property of the DoD and its contract entities, when employing HPCMP advanced capabilities; demonstrate the advanced network technologies and complex information assurance mechanisms required to implement logically-separated (as opposed to physically-separated) networking communities-of-interest (COIs); mature the ability to acquire a robust set of performance data for DREN III (i.e. bandwidth, latency, jitter, and configuration information) to ensure the network attributes are suitable for complex DoD RDT&E use cases; mature the ability to observe the security profile of DREN III using a cloud of over 100 sensors in order to support the HPCMP's DISA-accredited Level 3 computer network defense capability; investigate hardware architecture and software stack enhancements for network sensors to simultaneously allow (1) active support for the HPCMP's DISA-accredited Level 3 computer network defense capability and (2) active experimentation for novel, adaptive, cyber-security detection and intervention methods; investigate (in coordination with White House, Office of Science and Technology Policy [OSTP], the National Science Foundation [NSF], and the Army Research Laboratory [ARL]) the viability of software-defined networks (SDNs) to allow traditional Internet protocol (IP) and experimental protocol networks to coexist within a common DoD networking infrastructure; demonstrate (in collaboration with the DoD CIO's

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Office, U.S. Cyber Command, the National Security Agency [NSA], the Defense Information Systems Agency [DISA], and the Army Research Laboratory [ARL]) a DoD enterprise information system continuous monitoring (ISCM) capability to ingest robust, diverse host-based and network-based near-real-time information in order to provide a persistent situational awareness (SA); demonstrate (in collaboration with Lawrence Livermore National Laboratory) novel parallel discrete event simulation (PDES) methods to facilitate large-scale networking and cybersecurity research using supercomputers. ***FY 2016 Plans:*** Will further refine and exploit DREN III (an advanced digital DoD research network) which provides robust, high-bandwidth, low-latency, low-jitter connectivity among the HPCMP and DoD RDT&E communities; will further refine and exploit the HPCMP's DISA-accredited Level 3 computer network defense capability to effectively protect the intellectual property of the DoD and its contract entities, when employing HPCMP advanced capabilities; will mature the advanced network technologies and complex information assurance mechanisms required to implement logically-separated (as opposed to physically-separated) networking communities-of-interest (COIs); will demonstrate hardware architecture and software stack enhancements for network sensors to simultaneously allow (1) active support for the HPCMP's DISA-accredited Level 3 computer network defense capability and (2) active experimentation for novel, adaptive, cyber-security detection and intervention methods; will demonstrate (in coordination with White House, Office of Science and Technology Policy [OSTP], the National Science Foundation [NSF], and the Army Research Laboratory [ARL]) the ability to employ software-defined networks (SDNs) to allow traditional Internet protocol (IP) and experimental protocol networks to coexist within a common DoD networking infrastructure; will mature (in collaboration with the DoD CIO's Office, U.S. Cyber Command, the National Security Agency [NSA], the Defense Information Systems Agency [DISA], and the Army Research Laboratory [ARL]) a DoD enterprise information system continuous monitoring (ISCM) capability to ingest robust, diverse host-based and network-based near-real-time information in order to provide a persistent situational awareness (SA).			
Title: Software Applications ***Description:*** This effort investigates, demonstrates, and matures software applications to provide for the adaptation of broadband, widely used applications and algorithms to address research, development, test and evaluation (RDT&E) requirements. The Computational Research Engineering Acquisition Tools and Environments (CREATE) initiative demonstrates and matures advanced application codes to allow scientists and engineers to use supercomputers to design and analyze virtual prototypes of DoD ships, fixed-wing aircraft, rotorcraft, ground vehicles, and radio frequency (RF) antennas; HPCMP Institutes demonstrate and mature advanced supercomputing application codes to address critical high-impact DoD challenges (e.g. blast protection for platforms and personnel, high-power microwaves and lasers, munition sensitivities, and mobile network designs/prototypes); the Productivity, Enhancement, Technology Transfer, and Training (PETTT) initiative (1) optimizes/enhances critical DoD physics-based and parallel discrete event software in order to allow scientists and engineers to execute scientific calculations with precision and efficiency on advanced, leading-edge supercomputers, (2) demonstrates/matures robust immersive collaborative	57.342	53.146	52.224

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
programming environments to improve science and engineering workflows, and (3) demonstrates/matures leading-edge computational technology from academia and industry			
FY 2014 Accomplishments: Demonstrated fixed-wing aircraft model which accounts for both the aerodynamic effects of the air-frame as well as the airflow of the jet engine in order to (a) specify a design modification which reduced the engine intake turbulence for the A-10 Warthog and (b) certify store-separation for military aircraft (i.e. to validate that a bomb or missile can be safely released from an aircraft); demonstrated rotorcraft model to determine if new blade proposed by Boeing for the CH-47F Chinook increased payload allowance while still allowing the same maximum forward velocity; demonstrated radio frequency (RF) electromagnetics (EM) model (a) to determine the EM scattering for jet engines and (b) to analyze the performance of antenna systems for military platforms; demonstrated structural model to determine (a) naval vessel vulnerability due to underwater explosions and (b) surface/ underwater maneuverability (e.g. for the Ohio Replacement Submarine); demonstrated coupled-physics model for conducting analyses of alternatives (AoAs) for concept ship designs (Navy used model to assess over 22,000 design options for the LX(R) Amphibious Assault Ship and to conduct initial Small Surface Combatant (SSC) studies under the direction of the Secretary of the Navy); investigated initial suite of computational models which couple (a) the high-fidelity dynamics of multi-bodies (i.e. interconnected rigid/flexible parts of an unpowered vehicle), (b) a model of a vehicle powertrain (i.e. components necessary to generate power and deliver that power to the road/surface), and (c) a physics-based model of the surrounding environment in order to virtually test vehicle mobility across a wide range of scenarios; investigated detonation shock dynamics for a GPS-guided munition (Excalibur) used in close-support situations (i.e. within 150m of friendly troops) and matured detonation shock dynamics portion of shock physics code ALE3D; demonstrated directed energy computational model used to improve the design (i.e. double the output power) of an air-launched directed-energy weapon intended to incapacitate/damage electronic systems; demonstrated parallel data analytics code used to reduce (by a factor of ~20) the processing time of large data generated by semiannual Army Network Integration Evaluation (NIE); matured model for examining personnel/platform blast protection (e.g. determining blast effects on (a) wheeled armored personnel carriers (APCs) and (b) vehicle occupants in support of Occupant Centric Platform (OCP) and Warrior Injury Assessment Manikin (WIAMAN) blast experiments); demonstrated initial capability to model grooved ductile (i.e. deformable) concrete slabs in order to refine designs for future military runways; investigated important explosive detonation code under an experimental execution framework to examine the viability of legacy codes on future (i.e. exascale) architectures			
FY 2015 Plans: Mature jet engine propulsion portion of fixed-wing aircraft model to account for engine dynamics under cruise flight conditions; mature rotorcraft model to address the complex multi-physics (i.e. fluid dynamics and structural mechanics) required to analyze the Joint Multi-Role (JMR) Helicopter (an anticipated replacement for over 4,000 medium-lift helicopters); investigate coupled-physics model for conducting analyses of alternatives (AoAs) for fixed-wing aircraft concept designs; mature radio frequency			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
(RF) electromagnetics (EM) model to increase dynamic range of features sizes (i.e. minute details on a large platform) in order to determine the optimal placement of antennas on a heavily armed ground-attack aircraft variant of the C-130 (i.e. the AC-130 Specter); mature structural ship model to assess naval vessels under various (a) sea-states (i.e. ocean conditions), (b) complex maneuvers, and (c) degrees of stability (e.g. intact and damaged); mature model for conducting analyses of alternatives (AoAs) for concept ship designs to support further Small Surface Combatant (SSC) studies under the direction of the Secretary of the Navy; demonstrate suite of computational models which couple (a) the high-fidelity dynamics of multi-bodies (i.e. interconnected rigid/flexible parts of an unpowered vehicle), (b) a model of a vehicle powertrain (i.e. components necessary to generate power and deliver that power to the road/surface), and (c) a physics-based model of the surrounding environment in order to virtually test vehicle mobility across a wide range of scenarios; further mature model for examining personnel/platform blast protection (e.g. determining blast effects on (a) wheeled armored personnel carriers (APCs) and (b) vehicle occupants in support of Occupant Centric Platform (OCP) and Warrior Injury Assessment Manikin (WIAMAN) blast experiments); investigate, demonstrate, and mature computational models via PETTT to address critical DoD HPC RDT&E needs ***FY 2016 Plans:*** Will further mature jet engine propulsion portion of fixed-wing aircraft model to account for engine dynamics under transient flight conditions (i.e. complex maneuvers); will further mature rotorcraft model to address the intricate maneuvers required to analyze the Joint Multi-Role (JMR) Helicopter (an anticipated replacement for over 4,000 medium-lift helicopters); will mature coupled-physics model for conducting analyses of alternatives (AoA) for fixed-wing aircraft concept designs to investigate (a) next generation cargo aircraft (i.e. potential future replacements for the C-130 and C-17) and (b) advanced precision-guided Army parachutes for deployment of equipment and supplies to ground troops; will further mature radio frequency (RF) electromagnetics (EM) model to assess the ability to shrink antennas for F-22s and F-35s using advanced materials (e.g. meta-materials – artificial substances engineered to have properties not found in nature); will further mature multi-physics ship model to allow refined ship/shock analysis for underwater/surface explosions, capturing the effects of moderate and severe structural damage; will further mature multi-physics ship model to allow detailed propeller analysis, capturing the effects of cavitation [i.e. the creation of voids/bubbles]; will further mature model for conducting analyses of alternatives (AoAs) for concept ship designs by incorporating cost as a design variable; will mature suite of computational models which couple (a) the high-fidelity dynamics of multi-bodies (i.e. interconnected rigid/flexible parts of an unpowered vehicle), (b) a model of a vehicle powertrain (i.e. components necessary to generate power and deliver that power to the road/surface), and (c) a physics-based model of the surrounding environment in order to virtually test vehicle mobility across a wide range of scenarios; will further mature model for examining personnel/platform blast protection (e.g. determining blast effects on (a) wheeled armored personnel carriers (APCs) and (b) vehicle occupants in support of Occupant Centric Platform (OCP) and Warrior Injury Assessment Manikin (WIAMAN) blast experiments); will investigate, demonstrate, and mature computational models via PETTT to address critical DoD HPC RDT&E needs			
Accomplishments/Planned Programs Subtotals	174.567	181.518	177.159

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

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 2016 Army											Date: February 2015	
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603461A / *High Performance Computing Modernization Program*				Project (Number/Name) DW5 / *HIGH PERF COMP MODERN (HPCM) CONGR ADDS (CAS)*			
COST ($ in Millions)	**Prior Years**	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**Cost To Complete**	**Total Cost**
DW5: *HIGH PERF COMP MODERN (HPCM) CONGR ADDS (CAS)*	-	38.671	40.000	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This is a Congressional increase to the High Performance Computing Modernization Program.

This project enables the Defense research, development, test and evaluation (RDT&E) community to resolve critical scientific and engineering problems more quickly, and with more precision, using advanced, physics-based computer simulation supported by high performance computing (HPC) technology. The computational expertise and resources enable DoD personnel to analyze phenomena that are often impossible, not cost effective, too time-consuming, or too dangerous to study any other way. The High Performance Modernization Program (HPCMP) supports the requirements of the DoD's scientists and engineers in three major areas of effort: supercomputing resource centers, the Defense Research and Engineering Network (DREN), and support for software applications. DoD Supercomputing Resource Centers (DSRCs) provide extensive capabilities and demonstrate new technologies that address user requirements for hardware, software, and programming environments. Efforts of the DSRCs are augmented by dedicated HPC project investments (DHPIs) that address near real-time and real-time HPC requirements. The total aggregate computational capability is roughly 1.7 quadrillion floating point operations per second (1.7 petaFLOPS); this capability is expected to double by 2013. All sites in the HPC Modernization Program are interconnected to one another, the user community, and major defense sites via the DREN, a research network which matures and demonstrates state of the art computer network technologies. The DREN interconnects 45 user and center sites at network speeds of up to 3 gigabits per second. The Software Application Support (SAS) effort optimizes and improves the performance of critical common DoD applications programs to run efficiently on advanced HPC systems, matures and demonstrates leading-edge computational technology from academic and commercial partners, and provides collaborative programming environments.

Work in this project supports the Army S&T Innovation Enablers (formerly named Enduring Technologies) Portfolio.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015
Congressional Add: Congressional Increase	38.671	40.000

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DW5 / *HIGH PERF COMP MODERN (HPCM) CONGR ADDS (CAS)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015
FY 2014 Accomplishments: Congressional increase for the High Performance Computing Modernization Program. ***FY 2015 Plans:*** Congressional increase for the High Performance Computing Modernization Program.		
Congressional Adds Subtotals	38.671	40.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A