FY 2009 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2008
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M
PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
MARINE CORPS LANDING FORCE TECHNOLOGY	40,822	31,813	36,480	39,858	44,568	45,848	47,155

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE is organized into seven expeditionary warfighting capability areas. These are: Command, Control, Communications, Computers (C4); Intelligence, Surveillance and Reconnaissance (ISR); Maneuver; Force Protection; Logistics; Human Performance, Training and Education; and, Firepower. The primary objective of this PE is to develop and demonstrate the technologies needed to meet the Marine Corps' unique responsibility of training and equipping the Marine Air/Ground Task Force (MAGTF) for Expeditionary Maneuver Warfare. This PE provides the knowledge base to support Advanced Technology Development (6.3) and is the technology base for future expeditionary warfare capabilities. This PE supports the Expeditionary Force Development System of the Marine Corps Combat Development Command and responds directly to the Marine Corps Science and Technology (S&T) process as well as supporting related Littoral and Expeditionary Maneuver Warfare capabilities developed by the Navy's Mission Capability Program. The Future Naval Capabilities (FNC) process is supported and funds are programmed accordingly. The FNC program explores and demonstrates technologies that enable Sea Strike, Sea Shield, Sea Basing and FORCEnet pillars. The core 6.2 program also supports Discovery and Invention (D&I) and Innovation and Transformation (I&T). Within the Naval Transformation Roadmap, this investment will achieve key transformational capabilities required by the Sea Power 21 Pillars, as well as enable Ship to Objective Maneuver (STOM), Persistent Intelligence, Surveillance and Reconnaissance and the Global War on Terrorism

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(GWOT).

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

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B. PROGRAM CHANGE SUMMARY:

	FY 2007	FY 2008	FY 2009
FY 2008/FY 2009 President's Budget Submission	42,031	26,785	26,902
Congressional Action	0	5,500	0
Congressional Undistributed Reductions/Rescissions	0	-205	0
Execution Adjustments	-190	0	0
Program Adjustments	-238	0	9,648
Rate Adjustments	0	0	-70
SBIR Assessment	-781	-267	0
FY 2009 President's Budget Submission	40,822	31,813	36,480

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: FY 2009 reflects funding for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. DoD directed this initiative in response to the determination that its S&T investment is likely too small to meet the imposing security threats that challenge our Nation, and it may not be adequately postured to take advantage of key scientific and technological opportunities that offer breakthrough advantages to our warfighters. This broad, multi-year (through the FYDP) initiative will expand existing technology integration and increase/spur the application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes, therefore, funding associated with this DoD initiative is reflected throughout the PE.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

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E. PERFORMANCE METRICS:

The primary objective of this PE is the development of technologies to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare and Combating Terrorism. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

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Project Number & Title	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
MARINE CORPS LANDING FORCE TECHNOLOGY	40,822	31,813	36,480	39,858	44,568	45,848	47,155

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project is organized into nine activities which are represented as seven Expeditionary Warfighting Capability Areas, as well as Future Concepts; Technology Assessment and Roadmapping; and the Littoral Combat/Power Projection (LC/PP) FNC. The seven Expeditionary Warfighting Areas support the Discovery and Invention (D&I) and the Innovation and Transformation (I&T) investment. The LC/PP FNC supports the Exploitation and Deployment (E&D) investment.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2007	FY 2008	FY 2009
LITTORAL COMBAT/POWER PROJECTION	21,064	9,589	9,657

This activity is aligned with the Sea Strike, Sea Shield, Sea Basing and FORCEnet pillars and provides the capability for the demonstration and transition of technologies developed through the related Marine Corps S&T programs directly to an acquisition program of record.

Through 2005, the focus of the FNC efforts was on satisfying technology gaps related to Power Projection and Littoral Combat as the products of those efforts are transitioned to acquisition programs of record. The funding profile for FY 2007 reflects the reorganization of the FNC program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been realigned to a Budget Activity as appropriate. The focus of the FNC within this PE is on technology related to Urban, Asymmetric, Littoral and Expeditionary Maneuver Warfare Operations. The related S&T development is of the highest importance to Marine Corps operations in Iraq, Afghanistan and the Global War on Terrorism (GWOT). These Warfighter Capability Gaps are among those highest ranked by the Office of the Chief of Naval Operations and the Marine Corps Combat Development Command based on urgency and need. The technologies associated with these gaps are being pursued as part of an overall effort that addresses Sea Strike, Sea Shield, Sea Basing

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and FORCEnet Capability Gaps. Warfighter Capability Gaps are made up of ECs and supporting products.

The decrease from FY 2007 to FY 2008 is due to the transition of a significant number of efforts to other PEs as described in the FY 2007 accomplishments, as well as zero-sum realignments within the Future Naval Capability program of record to fund Technology Oversight Group approved Enabling Capabilities.

FY 2007 Accomplishments:

- Continued Expeditionary Fighting Vehicle (EFV) obstacle avoidance subsystem design, integrated subsystems and prepared for demonstration.
- Continued efforts to provide urban direction finding of Radio Frequency (RF) emitters from moving platforms. (Concurrent funding in PE 0603640M. Realigns to PE 0603640M in FY 2007.)
- Continued effort in Distributed Common Ground/Surface System (DCGS) that involves the migration of tactical intelligence systems (sensor networks) to a net-ready architecture and the development of enterprise services that translate this data. (Realigns to PEs 0602235N and 0603235N in FY 2007.)
- Continued development of target acquisition architecture, information exchange, connectivity and interoperability of target hand-off, fire control, and coordination systems. (Previous and concurrent funding in PE 0603640M. Realigns to PEs 0602114N and 0603114N in FY 2007.)
- Continued design and test of hostile fire detection and counter-fire system (GUNSLINGER). (Realigns to PEs 0602114N and 0603114N in FY 2007.)
- Continued development of integrated vehicle self-defense system technologies to defeat incoming Rocket Propelled Grenades (RPGs). (Concurrent funding in PE 0602782N.)
- Continued development and integration of network monitoring and management tools technology and transition to acquisition. (Concurrent funding in PE 0603782N. Realigns to PE 0603235N in FY 2007.)
- Continued integration and demonstration of innovative relays Beyond Line Of Sight (BLOS) in the areas of wideband communications and advanced modular systems. (Concurrent funding in PE 0603782N. Realigns to PE 0603235N in FY 2007.)
- Continued development of algorithms and initiated modifications of hardware and software for use in discriminating between individual single channel RF emitters on the battlefield and determining their locations; provide algorithms to MARCORSYSCOM Program Manager (PM) INTEL. (Concurrent funding in PE 0603782N. Realigns to PE 0603640M in FY 2007.)
- Continued development and began transitioning EFV obstacle detection capability to EFV Direct Reporting Program Manager. (Realigns to PE 0603640M in FY 2007.)
- Continued development of land mine countermeasure insensitive munitions technology.

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- Continued development of integrated vehicle self-defense system to defeat incoming RPGs.
- Continued the development of tactical ISR data structures and pattern recognition algorithms. (Realigns to PE 0602114N in FY 2007.)
- Continued advanced concept development to alert approaching targets with an unambiguous warning that, if ignored, will clearly demonstrate hostile intent of the approaching target. (Realigned from PE 0602123N.)
- Completed development of a fires coordination architecture to network existing expeditionary fires systems to enable MAGTF/Joint Fires; transition multiple software injectors to MARCORSYSCOM PM GC2. (Transitions to PE 0602114N.)
- Completed investigation of ammunition packing techniques to lower weight and have the packaging provide additional use on the battlefield; provide prototype packaging to MARCORSYSCOM PM AMMO. (Transitions to PE 0602114N.)
- Completed development and transition of advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability to acquisition; provide prototype mortar tube, bipod and baseplate to MARCOSYSCOM PM Expeditionary Fire Support System (EFSS). (Transitions to PE 0602114N.)
- Completed integration and testing of secure mobile network/secure wireless LAN technologies, including advanced protocols, frequency conversions and power amplification; provide advanced networking protocols and antennas to MARCORSYSCOM PM COMM. (Previous effort funded in PEs 0602236N and 0603236N.)
- Completed development, integration and transition of airborne ISR (tactical littoral sensing) capability to MARCORSYSCOM PM INTEL.
- Completed transition of expeditionary maneuver planning and decision-making tools for Marine ground forces to Navy and Marine Corps acquisition; Expeditionary Decision Support System (EDSS) transitions to MARCORSYSCOM and PMS 490. (Transitions to PE 0602114N.)
- Completed development of the Asymmetric Threat Weapon. (Effort partially realigned from PE 0602123N, currently being funded by both PEs.)
- Initiated transparent urban structure ‘see thru the wall’,image and mapping technologies development.
- Initiated modular scalable effects weapons technologies development.
- Initiated development of an integrated company level Urban Sensor Suite. (Automated Control of Large Sensor Networks) (Transitions to PE 0602235N.)
- Initiated detect and ID facilities technology development. (Transparent Urban Structures)
- Initiated decision aids technology development. (Transparent Urban Structures)
- Initiated indirect prototype technology development. (Modular Scalable Effects Weapon)

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FY 2008 Plans:

- Continue all efforts of FY 2007, less those noted as completed above.
- Initiate development of Modular Scalable Effects weapons technologies. (Concurrent funding in PE 0603640M.)
- Initiate development of counter Improvised Explosive Device (IED) technologies. (Concurrent funding in PE 0603640M.)
- Initiate development of tactical urban breaching technologies. (Concurrent funding in PE 0603640M.)

FY 2009 Plans:

- Continue all efforts of FY 2008, less those noted as completed above.
- Initiate development of individual Warfighter protection technologies. (Concurrent funding in PE 0603640M; funding will also be provided by PE 0603236N in FY 2009).
- Initiate development of advanced survivability and mobility technologies for Marine Corps tactical and combat vehicles. (Concurrent funding in PE 0603640M).

	FY 2007	FY 2008	FY 2009
MANEUVER	5,820	6,080	5,790

The Maneuver thrust area focuses on the development, demonstration, and transition of technologies that will increase the warfighting capabilities and effectiveness of the MAGTF. This thrust aims at capturing emerging and "leap ahead" technologies in the areas of mobility, materials, propulsion, survivability, durability, signature reduction, modularity, and unmanned systems. Special emphasis on survivability technologies for the defeat of small arms, IEDs, mine blast, and RPGs continue to be incorporated into this thrust area. A concentrated effort has also been made in the development of modeling and simulation tools that integrate many different physics based modeling systems with rigorous operational analysis simulations to accurately define a system's performance characteristics. These tools will aid in defining the trade space for emerging technologies and assist in providing the program manager insight and guidance into pursuing future technologies. Finally, this technology thrust area also seeks to develop technologies to enhance combat vehicle crewman effectiveness and situational awareness through the incorporation of advanced autonomous vehicle functions triggered directly by the cognitive state of the operator. Presently, Mine Countermeasures (MCM) supports and enhances the maneuver and force protection Marine landing forces with the development of technologies to enable detection, neutralization, breaching, and clearing of mines, IEDs, and Unexploded Ordnance (UXO) from the beach exit to inland objectives. MAGTF MCM is a functional component of Naval

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Expeditionary Maneuver Warfare and includes Ship to Objective Maneuver (STOM), Expeditionary Operations from a Sea Base, sustained Operations Ashore, Urban and Asymmetric Operations, and Operations other than War.

The decrease in funding from FY 2008 to FY 2009 reflects funds being realigned to the new activity "Force Protection" within this PE.

FY 2007 Accomplishments:

- Continued lightweight Expeditionary Systems Materials (ESM) efforts to determine feasibility of scaling and producing candidate structural armor.
- Continued Cognitive Assessment and Task Management technologies for combat vehicle crewmen (formerly Augmented Cognition effort).
- Continued development of Advanced Electromagnetic Armor (E-NERA).
- Continued the development of scalable explosive neutralization technologies for MCM.
- Continued S&T programs to address MAGTF Land MCM Master Plan capability gaps.
- Continued technologies for stand-off detection and neutralization of mines, IEDs, and Unexploded Ordnance (UXO). (Transitions to Force Protection activity in FY 2009)
- Continued technologies to defeat side/top attack and advanced fuse mines through signature reduction and advanced signature duplication. (Transitions to Force Protection activity in FY 2009)
- Continued development of modeling tools to accurately determine loading and fragmentation effects on targets from mine explosions. (Transitions to Force Protection activity in FY 2009)
- Continued development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared). (Transitions to Force Protection activity in FY 2009)
- Continued development of computational models to scale the effects of small-scale explosives tests to full-scale landmine explosions in order to study mine blast effects on advanced vehicle geometry. (Transitions to Force Protection activity in FY 2009)
- Completed development of Variable Load & Ride Height Suspension System.
- Completed Whole Vehicle Fuel Efficiency Improvement effort.
- Completed USMC participation in Explosion Resistant Coating Advanced Concept and Technology Demonstration (ERC ACTD).
- Initiated development of countermeasures for smart mine sensors.
- Initiated mobility enhancement development effort for current and future light and medium weight Marine Corps vehicle programs.
- Initiated and completed development of materials to promote Combat Science and Technology Vehicle (CSTV)

survivability.
- Initiated development of advanced electromagnetic armor for ground vehicle survivability.
- Initiated development of cognitive assessment and task management concept for CSTV.

FY 2008 Plans:

- Continue all efforts of FY 2007, less those noted as completed above.
- Complete development of scalable explosive neutralization methods.
- Initiate integration of CSTV capabilities.
- Initiate development of fuel efficiency and battlefield power technologies for the CSTV and ground vehicles.
- Initiate studies into mine signature classification. (Transitions to Force Protection activity in FY 2009)
- Initiate technology development programs to address force protection capability gaps. (Transitions to Force Protection activity in FY 2009)
- Initiate spectral signature classification efforts for MCM applications. (Transitions to Force Protection activity in FY 2009)

FY 2009 Plans:

- Continue all efforts of FY 2008, less those noted as completed above.
- Initiate efforts addressing survivability and technologies to mitigate acceleration and traumatic brain injuries to vehicle occupants to enhance tactical mobility in support of Distributed Operations.
- Initiate efforts addressing advanced suspension systems with ride height adjustment capabilities, adjustable ride quality capabilities, rollover prevention, and load equalizing systems to enhance tactical mobility and survivability in support of Distributed Operations.
- Initiate efforts addressing improvements in vehicle fuel efficiency by improvements in drive train efficiencies, engine efficiencies and alternative fuels capabilities to enhance tactical mobility in support of Distributed Operations.
- Initiate technology development programs to address maneuver capability gaps in Survivability such as an Advanced Seat Technology effort to improve/increase occupant protection within the platform by reducing injury due to the effects of dynamic blast events and accidental vehicle rollover.
- Initiate technology development programs to address maneuver capability gaps in Mobility such as a Vehicle Stability effort to improve/increase vehicle performance characteristics such as reducing vehicle rollover tendencies.

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	FY 2007	FY 2008	FY 2009
FORCE PROTECTION	0	0	3,864

This activity supports the Force Protection Thrust's applied research program. Technologies are being developed that focus on the following: Landmine avoidance, detection, and breaching / neutralization; Counter Improvised Explosive Devices; Counter Rocket, Artillery, Mortars, and Snipers; Technologies for improved protection for individuals including Marine Personnel Protective Equipment against blast and ballistic threats and in chemical, radiological, and biological environments; and Physical installation and checkpoint security.

FY 2009 reflects additional funding for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:
- Pre-detonation of IEDs,
- Personal protection materials,
- Personal power generation,
- Micro power sources, and
- Augmented reality

The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. Technologies being developed by the Force Protection activity are central to the integrated demonstration program.

FY 2009 Plans:

The following efforts transitioned from the Maneuver activity:
- Continue development of technologies for stand-off detection and neutralization of mines, IEDs, and UXO.
- Continue development of technologies to defeat side/top attack and advanced mine fuzes (seismic, acoustic, and infrared) through advance signature reduction, duplication, and projection.
- Continue spectral signature classification efforts for MCM applications.
- Continue development of computational models to scale the effects of small-scale explosives tests to full-scale landmine explosions in order to study mine blast effects on advanced vehicle geometry.

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- Continue studies into mine signature classification.
- Continue technology development programs to address force protection capability gaps.
- Complete development of studies into mine signature classification.
- Complete development of modeling tools to accurately determine loading and fragmentation effects on targets from mine explosions.
- Complete evaluation of low passive inter-modulation narrowband antennas and wideband antennas for potential use in detection methodologies.
- Initiate studies of sensor fields to identify and classify mine threats.
- Initiate evaluation of active wideband double notch filters for a wide spur-free dynamic range in specific frequencies of interest to cover a variety of threats.
- Initiate an Explosive Hazard Defeat for IED Neutralization effort focused on applying passive infrared phenomenology understanding to a capability enabling defeat of PIR devices from significant stand-off distances.
- Initiate Counter Rocket, Artillery, Mortar, and Sniper efforts addressing indications and warnings for pre-shot sniper detection and enabling detection of sniper observation and targeting in advance of a ballistic event.

	FY 2007	FY 2008	FY 2009
HUMAN PERFORMANCE, TRAINING AND EDUCATION	1,927	2,202	3,495

This activity develops advanced training technology and technologies that enhance neural and cognitive aspects of human performance including cognitive task analysis, tactical decision-making, modeling, simulation, range instrumentation, and synthetic environment generation. This activity name has changed in FY 2008 to "Human Performance, Training and Survivability" to better describe its program/projects. Some projects will migrate from the Firepower activity during FY 2008.

The increase from FY 2008 to FY 2009 funding addresses USMC priorities in cognitive and physical enhancement, modeling and simulation, and virtual reality squad level training in support of Distributed Operations.
FY 2009 reflects additional funding for USMC priorities in cognitive and physical enhancement; modeling and simulation; virtual reality squad level training in support of Distributed Operations; and a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:
- Pre-detonation of IEDs,

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- Personal protection materials,
- Personal power generation,
- Micro power sources, and
- Augmented reality

The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. Technologies being developed by the Human Performance, Training and Education activity are central to the integrated demonstration program.

FY 2007 Accomplishments:

- Continued evaluation and development of tools to support real-time cognitive and behavioral assessment (augmented cognition) and improvement of individuals and teams during operations and training.
- Continued research in the area of team training task analyses and training effectiveness evaluation techniques to develop more effective training systems for Military Operations in Urban Terrain (MOUT).
- Continued and completed research to develop metrics for improving an individual's operational performance in stressful urban environments including use for selection and recruiting to that mission specialty.
- Continued research to evaluate the feasibility of integrating augmented reality technologies into current and emerging training systems.
- Completed development of a performance fidelity architecture, applying the model to develop guidelines and specifications for a to-be-built training system.
- Completed development of tools to rapidly generate synthetic environments (3D databases, database correlation techniques) within an urban landscape (MOUT), and apply to existing training programs (i.e., Virtual Technologies and Environments—(VIRTE) Demo III).
- Initiated research on combat situation awareness and its effect on combat performance.
- Initiated research on combat feeding and hydration.
- Initiated research on physiological correlates for strategic corporal assessment.
- Initiated development into a Marine performance optimization model.
- Initiated the development of training effectiveness measures and techniques as applied to disparate, multi-platform, multi-mission team training.

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FY 2008 Plans:

- Continue all efforts of FY 2007, less those noted as completed above.
- Complete research on combat situation awareness and its effect on combat performance.
- Initiate research into distributed operations peak neural and cognitive performance.
- Initiate research into next generation survivability enhancement technologies.

FY 2009 Plans:

- Continue all efforts of FY 2008, less those noted as completed above.
- Continue studies into next generation physical performance enhancement methodologies and technologies (continues in 0603640M).
- Complete evaluation of tools to support real-time cognitive and behavioral assessment (augmented cognition) and improvement of individuals and teams during training.
- Complete research in the area of team training task analyses and training effectiveness evaluation techniques to develop more effective training systems for MOUT.
- Initiate the development of foundational learning theories extended to complex tasks for a range of expertise levels, training mitigation strategies triggered by neurophysiological markers of learning, cognition and expertise, and principles of expertise development on a continuum of novice to expert.
- Initiate development of training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition and expertise.
- Initiate additional Human Performance and Training efforts (Cognitive and physical enhancement, modeling and simulation, and virtual reality squad level training in support of Distributed Operations).
- Initiate Distributed Operations training system investigations to perceptual skills enhancement that lead to enhanced cognition and decision making.
- Initiate additional efforts to incorporate effects of nutrition and functional fitness into models and simulations in the Distributed Operations Virtual Toolkit.
- Initiate Advanced Mobile Assessment and Field Readiness Technologies to improve the capability to assess situational awareness in the field and predict physical performance by developing mobile, rugged tools, algorithms, and models.
- Initiate a Mind-Body Integration Systems effort to improve team training by developing and validating Electroencephalogram (EEG) (and other physiological and performance measures) for use in assessing team performance, coordination, and cohesion in training environments.

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	FY 2007	FY 2008	FY 2009
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (C4ISR)	3,012	3,128	0

This activity provides technologies for secure, robust, self-forming, mobile communications networks (FORCEnet); distributed computing to support information dissemination to all echelons; and sensors, software and data processing to support formation of appropriate common picture. Emphasis for Marine Corps efforts includes power management, low detect ability, size and weight constraints, and interoperability within the joint environment.

The FY 2009 funding profile reflects both C4 and ISR efforts now being placed into new and separate activities within this PE.

FY 2007 Accomplishments:

- Continued development of conformal, broadband, Ultra High Frequency-Very High Frequency (UHF-VHF) antennas.
- Continued development of non-line-of-sight communications technologies.
- Continued development of technology to provide position location in Global-Positioning System (GPS) restricted environments.
- Continued development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data. (Transitions to ISR activity in FY 2009)
- Continued development of low power consumption urban sensing technologies.(Transitions to ISR activity in FY 2009)
- Completed development of low-probability of detection random noise communications waveforms.
- Completed development of communications technologies for high attenuation and multi-path environments. Efforts will continue to mature this technology within PE 0603640M.
- Completed development of network management capabilities for the low-bandwidth, heterogeneous communication environment.
- Completed development of urban navigation technologies.
- Initiated development of tagging, tracking and locating technologies to monitor adversary movement. (Transitions to ISR activity in FY 2009)
- Initiated development of information on demand technologies to provide warfighter with the right information at the right time. (Transitions to ISR activity in FY 2009)

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- Initiated development of urban sensing technologies to detect weapons at distance. (Transitions to ISR activity in FY 2009)
- Initiated development of adaptable enemy course of action engine to manipulate adversary decisions. (Transitions to ISR activity in FY 2009)

FY 2008 Plans:

- Continue all efforts of FY 2007, less those noted as completed above.
- Complete development of conformal, broadband, UHF-VHF antennas.
- Complete development of technology to provide position location in GPS restricted environments.
- Complete development of non-line-of-sight communications technologies.
- Initiate development of advanced tactical sensor technologies to improve unit awareness. (Transitions to ISR activity in FY 2009)

	FY 2007	FY 2008	FY 2009
COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS (C4)	0	0	2,994

This activity supports S&T investment in Command and Control and is focused in three main areas: (1) Implementing the FORCEnet concept. FORCEnet is the operational construct and architectural framework for naval warfare in the information age that integrates warriors, networks, command and control, and weapons into a networked, distributed, combat force that is scalable across all levels of conflict from the seabed to space and sea to land. The Marine Corps instantiation of FORCEnet is Marine Air Ground Task Force Command and Control (MAGTF C2), with technologies to exchange data and information with and among distributed tactical forces. (2) Developing decision support systems that enable warfighters to take advantage of the FORCEnet and MAGTF C2 and tactically extend Net-Enabled Command and Control (NECC) for shared situational awareness, and (3) providing effective combat identification of enemy combatants, friendly forces, and non-combatants. Activities in this R2 activity provide technologies for secure, robust, self-forming, mobile communications networks distributed computing to support information dissemination to all echelons; and sensors, software and data processing to support formation of appropriate common picture. Marine Corps specific efforts includes power management, low detect ability, size and weight constraints, and interoperability within the joint environment.

In FY 2007 and FY 2008, this effort was funded in the C4ISR activity within this PE. The increase in funding from FY 2008 to FY 2009 is due to this being the first year that C4 has been reported as a separate activity.

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FY 2009 Plans:

- Initiate development of C3 for the Distributed Operations Marine technologies. This includes development of technologies to allow small units to share Position and Location Information (PLI) in GPS-denied or restricted environments thereby enhancing current blue force situational awareness.
- Initiate development of urban/restricted environment communications technologies.
- Initiate new efforts in Over-the-Horizon Communications which include the development of an airborne software-defined communications, networking, Electronic Signals Intelligence (ELINT) and Electronic Warfare (EW) capability.

	FY 2007	FY 2008	FY 2009
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR)	0	0	1,995

This activity develops ISR technologies for applications in future intelligence, surveillance, and reconnaissance. Technologies being pursued enhance situational awareness, persistent surveillance, and tactical decision making through automated analysis of data and rapid integration of information and acquired knowledge. Specific technologies in this activity effectively present actionable information to decision-makers, especially those at the lower command levels. This includes complete future automation of options and persistent surveillance in support of distributed operations.

In FY 2007 and FY 2008, this effort was funded in the C4ISR activity within this PE. The increase in funding from FY 2008 to FY 2009 is due to this being the first year that ISR has been reported as a separate activity.

FY 2009 Plans:

The following efforts transitioned from the C4ISR activity:
- Continue development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data.
- Continue development of low power consumption urban sensing technologies.
- Continue development of tagging, tracking and locating technologies to monitor adversary movement.
- Continue development of information on demand technologies to provide warfighter with the right information at the right time.
- Continued development of urban sensing technologies to detect weapons at distance.

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- Continue development of adaptable enemy course of action engine to manipulate adversary decisions.
- Continue development of advanced tactical sensor technologies to improve unit awareness.
- Initiate and continue development of distributed information architecture technologies.
- Initiate and continue the decision prediction, manipulation, stimulation and learning detection capability to add tools that enable the warfighter to operate inside the OODA loop of an irregular actor. The Observe, Orient, Decide, Act (OODA) Loop provides a standard description of decision making cycles that is widely understood and accepted throughout the U.S. military.
- Initiate and continue development of a single integrated battlespace picture with tactical and strategic injects that begins to close the gap between ISR and C2.
- Initiate and continue Actionable Intelligence for Expeditionary and Irregular Warfare effort which includes real-time methods for Identifying Human Networks.
- Initiate tagging, tracking, and locating technologies development to address development of multi-INT track continuity.
- Initiate development of advanced tactical nets to include additional phenomenologies and the netting of C2, Sensors and Analysis nodes
- Initiate efforts addressing “battlespace awareness” of human networks, improving the accuracy of classification decisions and enabling a human network predictive capability. Once a human network tensor can be defined and dynamically observed in a common feature space, predictive capabilities are realized. If one network is observed to be moving towards at risk behavior, a generalized force warning may be enabled addressing the threat associated with all networks with similar human network tensors. When combined, research into human network awareness, network classification and network prediction, will be a powerful tool for warfare against the irregular actor.

	FY 2007	FY 2008	FY 2009
FIREPOWER	2,555	2,729	4,271

This activity develops technology for application on current and future expeditionary weapons and elements of the kill chain. It includes, but is not limited to, the following technologies: Fuze, fire control, launch/propulsion, lethality, and accuracy.

The increase in funding from FY 2008 to FY 2009 addresses expanded efforts in lightweight weapons and ammunition, as well as exploration of infantry applications in support of emerging USMC requirements in lightening the load of the individual Marine. FY 2009 reflects additional funding for expanded efforts in

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lightweight weapons and ammunition; exploration of infantry applications associated with emerging USMC requirements in lightening the load of the individual Marine; and a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:
- Pre-detonation of IEDs,
- Personal protection materials,
- Personal power generation,
- Micro power sources, and
- Augmented reality

The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. Technologies being developed by the Firepower activity are central to the integrated demonstration program.

FY 2007 Accomplishments:

- Continued development of a concept for an insensitive munition propulsion system to enable firing a shoulder launched rocket from an enclosed space.
- Initiated development of enhanced mortar munitions for more effective fire support.
- Initiated an investigation of the scalability of variable effects conventional munitions technology for improving firepower effectiveness while increasing affordability and decreasing logistical burden in support of expeditionary warfare.
- Initiated development of collaborative fires coordination technologies.
- Initiated development of precision fires engagement technologies.

FY 2008 Plans:

- Continue all efforts of FY 2007.

FY 2009 Plans:

- Continue all efforts of FY 2008.
- Initiate and continue development of Distributed Operations Precision Engagement collaborative fires coordination technologies.

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- Initiate expanded efforts in lightweight weapons and ammunition (mortars, crew served weapons, ammunition and packaging).
- Initiate Targeting & Engagement and Precision Target Location efforts that include Integrated Day/Night Sight Technology.
- Initiate design and development of lightweight technologies that provide individual Marines enhanced capabilities to detect and identify man-size targets at least out to the maximum effective range of their personal weapons during all conditions (daylight, limited visibility, & darkness) by integrating multiple capabilities into a single system.

	FY 2007	FY 2008	FY 2009
LOGISTICS	1,691	1,985	3,410

This activity supports Marine Corps Expeditionary Logistics which is the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. Expeditionary Logistics replaces mass with assured knowledge and speed, is equally capable ashore or afloat in austere environments, and is fully scalable to meet uncertain requirements. Expeditionary Logistics logically divides into five pillars: deployment support, force closure, sustainment, reconstitution/redeployment, and command and control. These pillars are thoroughly integrated and perpetually related in execution.

The increase from FY 2008 to FY 2009 is due to the initiation of additional efforts in lightweight portable battlefield power sources supporting USMC priorities in lightening the load of the individual Marine and enhancing the Marine Corps rifle squad’s overall capabilities.
FY 2009 reflects additional funding for additional efforts in lightweight portable battlefield power sources supporting USMC priorities in lightening the load of the individual Marine and enhancing the Marine Corps rifle squad’s overall capabilities; and a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:
- Pre-detonation of IEDs,
- Personal protection materials,
- Personal power generation,
- Micro power sources, and
- Augmented reality

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The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. Technologies being developed by the Logistics activity are central to the integrated demonstration program.

FY 2007 Accomplishments:

- Continued developing and assessing concepts that permit precision delivery of logistics assets while also reducing the logistics footprint ashore.
- Continued development of an alternate power source to reduce logistics footprint and increase sustainability of Marine expeditionary forces.
- Completed research into using polymer gel electrolytes and novel air electrodes in next generation metal air batteries to demonstrate the feasibility of performance improvement.
- Initiated assessment of 20W Stirling Engine for increased efficiency during distributed operations.
- Initiated assessment of portable, alternative water purification systems.
- Initiated analysis of Personal Power Network / Centralized Distributed Operations Power Generation System.

FY 2008 Plans:

- Continue all efforts of FY 2007, less those noted as completed above.
- Initiate development of wireless vehicle health diagnosis and reporting.
- Initiate development of advanced logistics distribution system. The increase in funds supports Distributed Operations.

FY 2009 Plans:

- Continue all efforts from FY 2008.
- Complete analysis of Personal Power Network for transition to "Lighten the Load" FNC EC beginning in FY 2010.
- Initiate advancement of a solid oxide fuel cell capable of directly oxidizing liquid logistic fuels such as JP-8, thus eliminating the necessity for both reforming and sulfur removal pre-processing of the fuel.
- Initiate advancement of high specific energy electrochemical capacitors to function as peak electric load-leveling buffers in advanced lightweight portable power applications.
- Initiate applications of advanced material surface treatments and coatings for reducing required maintenance

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and enhancing operational readiness of expeditionary warfare vehicles, machinery, and electrical systems.

	FY 2007	FY 2008	FY 2009
FUTURE CONCEPTS, TECHNOLOGY ASSESSMENT, AND ROADMAPPING	430	635	1,004

This activity supports the planning and integration of technology development efforts across the entire PE. In conjunction with the Concepts Based Capabilities System and the Marine Corps Warfighting Laboratory, unique and novel concepts for advanced warfighting are developed and validated. Effectiveness analyses are conducted to identify the synergistic effects that can be achieved through the integration of emerging technology with innovative tactics, doctrine, and techniques. Technology assessments are conducted to determine the supporting technologies that have the highest impact across the warfare areas, and warrant further investment within this PE. Technology Roadmapping is conducted to help identify opportunities to leverage technology development within the Department of the Navy and the Department of Defense, as well as, with the commercial sector and university communities. The resultant technology investment strategy is developed and used to guide out-year technology development efforts.

FY 2009 reflects additional funding for new assessments in Asymmetric/Irregular Warfare and Distributed Operations; and a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. DoD directed this initiative in response to the determination that its S&T investment is likely too small to meet the imposing security threats that challenge our Nation, and it may not be adequately postured to take advantage of key scientific and technological opportunities that offer breakthrough advantages to our warfighters. This capability demonstration has been directed to be wide ranging and encompass technologies for:

- Pre-detonation of IEDs,
- Personal protection materials,
- Personal power generation,
- Micro power sources, and
- Augmented reality

The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. The Logistics activity funds the assessments which will determine the right USMC S&T investment to meet the imposing security threats.

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FY 2007 Accomplishments:

- Continued Technology Assessments associated with the Urban Asymmetric and Expeditionary Warfare Capability Gap.
- Continued the integrated planning of concepts and technology development.
- Continued development of the Expeditionary Maneuver Warfare Investment Strategy.
- Continued Technology Assessments and Roadmapping within Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR); and Firepower Thrust Areas of the PE.
- Completed Technology Assessment and Roadmapping of the Maneuver, Human Performance, and Training and Survivability Thrust Areas.
- Completed development of the Expeditionary Maneuver Warfare Investment Plan.
- Initiated implementation of an S&T Management Information System.
- Initiated Technology Assessment of the Combating Terrorism portfolio.

FY 2008 Plans:

- Continue all efforts from FY 2007, less those noted as completed above.
- Complete implementation of S&T Management Information System.
- Initiate assessment of the technical requirements of the Marine Corps Special Operations Command (MARSOC).

FY 2009 Plans:

- Continue all efforts from FY 2008, less those noted as completed above.
- Continue assessment of the technical requirements of the MARSOC.
- Initiate and continue assessments in Lightening the Marine’s Load and Enhancing the Capabilities of the Marine Corps Rifle Squad.
- Initiate assessments in Asymmetric / Irregular Warfare and Distributed Operations.
- Initiate assessments of all new and emerging Counter Sniper Technologies.
- Initiate new planning and integration of technology development efforts to meet imposing security threats that challenge our Nation.

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CONGRESSIONAL PLUS-UPS:

	FY 2007	FY 2008
HIGH POWER LIGHTWEIGHT ZINC-AIR BATTERY	1,603	994

FY 2007: This effort addressed the potential application of highpower lightweight zinc-air batteries in addressing the battlefield needs of the Marine Corps.

FY 2008: The Marine Corps has multiple Science and Technology Objectives (STOs) stating a need for the Warfighters to carry fewer batteries that are lighter, more powerful and longer lasting and has a power source capable of supporting all ground communications systems with increased mission run time per battery. The FY 2008 Congressional Add is directly relevant to those STOs and will continue the efforts initiated in FY 2007 that address those needs, such as developing an air electrode that provides 60% higher power capability over commercially available air electrodes.

	FY 2007	FY 2008
INTEGRATED ASYMMETRIC URBAN WARFARE	971	0

This effort addressed the asymmetric warfighting challenges of the urban battlefield: specifically, the need for greater speed of information, enhanced urban visualization/speed of tactical level decisions, enhanced close quarter combat capabilities and infantry equipment, and greater speed of action and sustainment as well as related priority work in weapon accuracy and lethality and enhanced individual survivability. The product will be a quantitative modeling and simulation approach offering an opportunity to develop specific performance criteria for asymmetric warfare technologies under development and thus is of great value for integrating these technologies.

	FY 2007	FY 2008
SURVIVABILITY PROGRAM	0	1,491

This effort will produce a system of systems that are expeditionary and lightweight, which provide increased protection from a myriad of enemy attacks throughout the spectrum of warfare.

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	FY 2007	FY 2008
WARFIGHTER RAPID AWARENESS PROCESSING TECHNOLOGY FOR DISTRIBUTED OPERATIONS	1,749	2,980

FY 2007: This effort supported Distributed Operations. This was a new USMC concept which described an operating approach that created an advantage over an adversary through the deliberate use of separation and coordinated, interdependent, tactical actions enabled by increased access to functional support, as well as by enhanced combat capabilities at the small-unit level.

FY 2008: The current focus of this investment is on small-unit leader decision making and control of fires. The FY 2008 increase will focus on the exploration of all aspects of individual cognition and decision-making, physiology and ergonomics, and the technologies needed to integrate these aspects in order to support the development of a Marine who is optimized to perform within an asynchronous/distributed operational setting.

C. OTHER PROGRAM FUNDING SUMMARY - NAVY RELATED RDT&E:
PE 0204163N Fleet Telecommunications (Tactical)
PE 0206313M Marine Corps Communications Systems
PE 0206623M Marine Corps Ground Combat/Supporting Arms Systems
PE 0601152N In-House Laboratory Independent Research
PE 0601153N Defense Research Sciences
PE 0602235N Common Picture Applied Research
PE 0602782N Mine and Expeditionary Warfare Applied Research
PE 0603235N Common Picture Advanced Technology
PE 0603236N Warfighter Sustainment Advanced Technology
PE 0603612M USMC Mine Countermeasures Systems - Adv Dev
PE 0603635M Marine Corps Ground Combat/Support System
PE 0603640M USMC Advanced Technology Demonstration (ATD)
PE 0603782N Mine and Expeditionary Warfare Advanced Technology

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OTHER PROGRAM FUNDING SUMMARY - NON-NAVY RELATED RDT&E:
PE 0603004A Weapons and Munitions Advanced Technology
PE 0603005A Combat Vehicle and Automotive Advanced Technology
PE 0603606A Landmine Warfare and Barrier Advanced Technology

D. ACQUISITION STRATEGY:
Not applicable.