Naval Aviation Enterprise
Science and Technology Strategic Plan

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NAVAL AVIATION SCIENCE AND TECHNOLOGY STRATEGIC PLAN

July 2006

The Naval Aviation Enterprise (NAE), under the leadership of Commander, Naval Air Forces (CNAF), Commander, Naval Air Systems Command (NAVAIR), and Director of Air Warfare (N88), present this Science & Technology (S&T) strategic plan. This document outlines capability gaps and the subsequent Science and Technology Objectives (STOs) and research areas to address the gaps. The intent is for these science and technology objectives to be considered for tasking at the BA 6.1 through 6.3 level within the Navy's budget process.

Each of the capability gaps and resulting STOs were developed from analysis performed by OPNAV N81 utilizing the Navy's Sea Power 21 document as overarching guiding vision for the future. Each capability need can be clearly traced to N81 gap analysis and Sea Power 21. The NAE will work to prioritize the STOs in support of the Chief of Naval Research's (CNR) planning process to ensure maximum return on investment for the Navy and Marine Corp Aviation team.

This plan is the product of the combined efforts from representatives from CNAF, OPNAV, NAVAIR, and Fleet Forces Command (FFC). When the Navy's Technology Executive Board decides which of these capability gaps and STOs to pursue, the NAE will collaborate with the Office of Naval Research (ONR) to develop detailed technology thrusts and projects. The Marine Corps has previously articulated their aviation requirements in the USMC S&T Strategic Plan dated September 2005; the NAE will coordinate with the Office Naval Research and Marine Corps Aviation to ensure the aggregate of Naval Aviation requirements are addressed.

The document presented here is the first time the Naval Aviation community has developed an enterprise-wide S&T strategic plan. While this is a significant step forward, it is only the first milestone required to ensure the ever changing technology needs of the NAE are met. Beginning in July 2006, a rigorous process will be developed which formally ties together representatives of all the stake holders in the NAE to regularly monitor task execution, perform updated gap analysis, develop capability needs and STOs based upon emerging requirements. The NAE will continually review priorities and update this S&T plan as required. In addition to these efforts, NAVAIR will begin to closely examine the various roles of the NAE's Warfare Centers and partners from industry and academia. Clear delineation of roles and responsibilities of all participants will better align resources with expected products and expedite the transition of new technology to the Fleet/Force.

Naval Aviation has enjoyed superiority over adversaries as a result of aviators' skills, training, equipment, and advanced technology. This S&T plan is expected to have a key role in the maintenance of the Navy's technology advantage over all current and expected foes.

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Naval Aviation Enterprise Science and Technology Strategic Plan

1. **Purpose:** Investments made to support Naval Aviation interests shall be aligned to the overarching goals of the National Defense Strategy, National Strategy for Maritime Security, and Sea Power 21. This Naval Aviation Science and Technology (S&T) Strategic Plan is intended to provide S&T guidance for the Naval Aviation Enterprise (NAE) by facilitating the alignment of the Navy's applicable Budget Activity (BA) 6.1-6.3 investments to the technology requirements of Naval Aviation to meet the objectives of Sea Power 21. This strategy shall be the vehicle for identifying, prioritizing, aligning and synchronizing NAE S&T investment efforts. This S&T strategic plan is aligned to the President's National Security Strategy, U.S. National Military Strategy, and the President's National Security Policy as well as the Chief of Naval Operations Sea Power 21 Capability Strategy. This strategy will provide the means to plan for Naval technological superiority and permits rapid reaction to advances from potential adversaries as well as exploitation of their weaknesses. The Naval capability gaps identified in this document form the basis for technology thrusts. The S&T roadmap developed from the gaps and thrusts described here will serve as the execution plan for the maturation of the technologies needed to remove the gaps as identified by OPNAV.

The NAE S&T strategic plan is expected to be updated on a recurring basis and approved by the NAE Board of Directors (BOD). The NAE BOD is the controlling authority for this plan.

2. **Background:** The Navy has historically relied upon advanced and emerging technology to provide operational advantages and superior warfighting capabilities. Development of required operational capabilities to execute the Sea Power 21 pillars will demand continued Science and Technology investment. This plan will define the linkage from required capabilities flowing from Sea Power 21 to corresponding S&T areas supporting the Naval Aviation community. The plan will define critical research areas for emphasis in S&T planning and budgeting.

The importance of aligning investments with the requirements of the NAE is increasingly critical due to the rapidly evolving threat environment in which the Navy and Marine Corps aviation team operates and decreasing fiscal resources. To ensure maximum return on investment while concurrently reducing opportunities for technological surprises from adversaries, the NAE's requirements must be aligned with the Navy's S&T program. This plan will serve as the basis for the roadmap for investments from basic research (6.1) through advanced development (6.3) in aviation related technology. The Marine Corps has previously submitted the USMC S&T Strategic Plan, September 2005, which addresses Marine Corps unique aviation requirements. The requirements described here will be coordinated with Marine Corps Aviation to ensure the aggregate Naval Aviation technology needs are met. When applicable, leveraging of Joint Service and commercial technology investments will be encouraged to further maximize return on investment for the Department of Defense.

The Navy's Future Naval Capabilities (FNC) program has made significant progress in focusing technology investments towards well defined requirements within

BA 6.3 and late 6.2 (applied research). This plan will continue defining investment strategies with the goal of addressing near-term, mid-term and far-term technology needs. The investment strategy derived from this plan will be defensible and stable over a prolonged period of time which is expected to provide a technology program delivering more products at higher efficiency to the Fleet/Force than current programs.

The Director, Air Warfare Division (OPNAV N88) is engaged in the FNC process at the working level via N81T, the Sea Strike Department Head, who co-chairs the Sea Strike Integrated Product Team (IPT) Working Group (WG) with representatives from Marine Corps Combat Development Command/Headquarters Marine Corps (MCCDC/HQMC). Additionally, the N88 S&T advisor is actively engaged in each of the Sea Strike IPT WG meetings and decisions. Both N81T and the N88 S&T advisor brief IPT WG conclusions to the Director, Air Warfare Division. Further, the Director, Air Warfare, co-chairs the Sea Strike IPT with a representative from MCCDC/HQMC. While N88 is responsible for the Sea Strike pillar, the NAE is also actively engaged in the Sea Shield, Sea Basing, and FORCEnet pillars of Sea Power 21. It is critical that aviation requirements across all the pillars are defined and prioritized to support achievement of the Sea Power 21 vision.

3. **General:** The Naval Aviation Enterprise (Figure 1) represents the entire Naval Aviation community and is organized to provide cost-effective readiness to the Fleet.

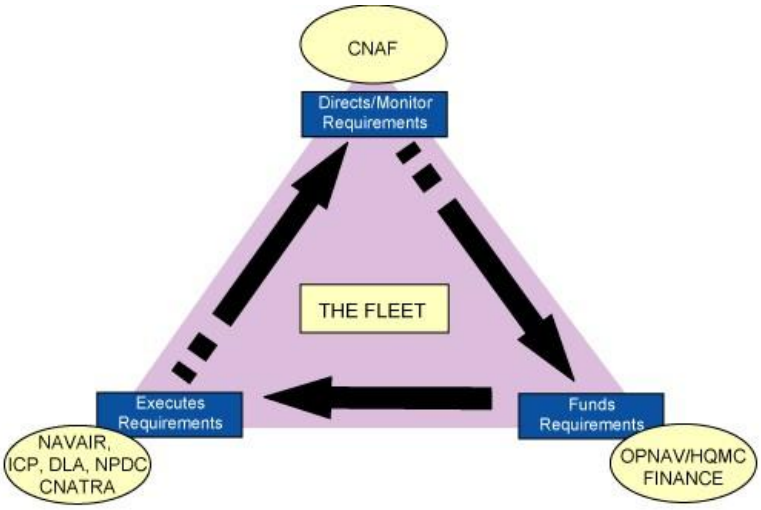

Figure 1 – The components of the Naval Aviation Enterprise (NAE)

Delivering the right readiness at the right cost, at the right time, now and in the future, is the core focus of the NAE. This philosophy is a critical element to the NAE S&T Enterprise shown in Figure 2.

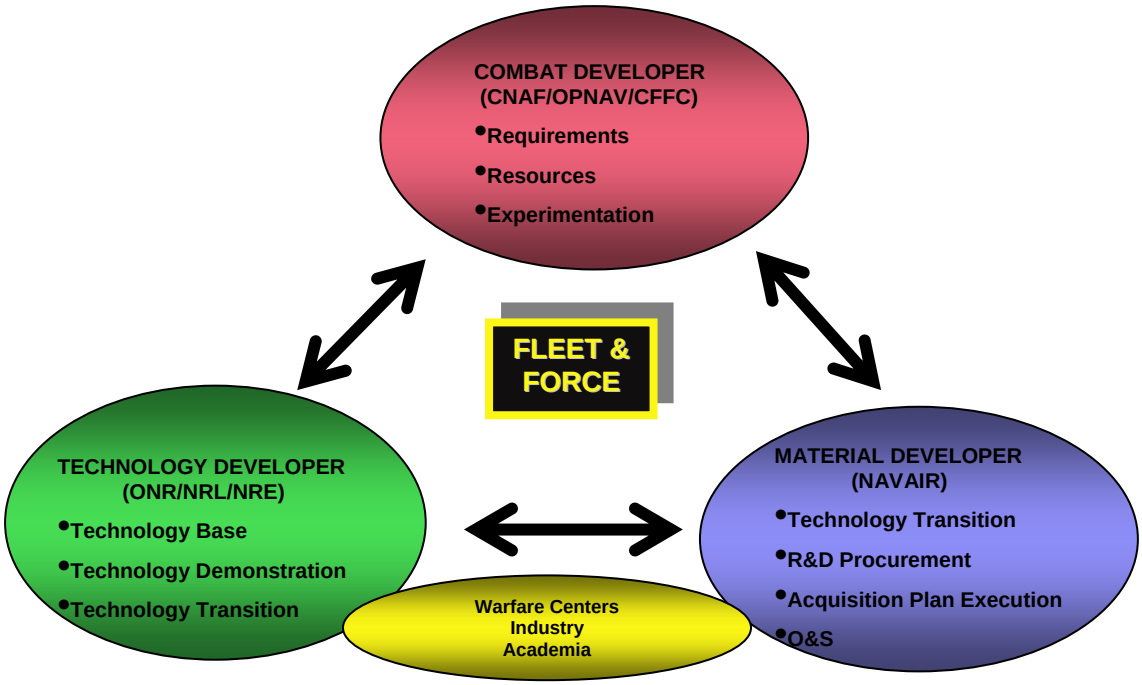

Figure 2 – The Naval Aviation S&T Enterprise

The principal roles of Combat Developer, Technology Developer, and Material Developer are all centered about the Fleet / Force.

Combat development is the responsibility of Commander Naval Air Forces (CNAF), OPNAV, and Commander US Fleet Forces Command (CFFC). These commands develop and validate requirements, provide resources, and conduct experimentation of promising new concepts.

Basing S&T investments on the results of the OPNAV Naval Capability Development Process (NCDP) ensures that the NAE investment decisions are justified by rigorous analysis and driven by Naval needs. OPNAV N81 annually produces a Warfighter Campaign Analysis based upon strategic guidance from the Joint Chiefs of Staff and the Chief of Naval Operations (CNO). The results of this analysis identify Naval capability shortfalls at a high level for a given war scenario. Each of the Sea Power 21 Pillars (Sea Strike, Sea Shield, Sea Basing and FORCEnet) produce Warfighting Capability Plans (WCPs) to identify these high level shortfalls and define Naval requirements. OPNAV N8F and N8 work collectively to produce a consolidated list of Naval S&T focus areas based on these analyses.

Technology development is performed by the Office of Naval Research (ONR), the Naval Research Laboratory (NRL), and the numerous elements of the Naval Research Enterprise (NRE). These technology developers create the Navy's technology base, perform technology demonstrations, provide resources, and play a critical role in technology transition. Material development of emergent Fleet systems is led by Naval Air Systems Command (NAVAIR) whose responsibilities include technology transition,

Research and Development (R&D, BA6.4), acquisition related plan execution, and oversight of aviation's operations and sustainment (O&S) function. Naval Air Warfare Centers (NAWC), industry, and academia are involved in both technology and material development as well as transition of technology products to acquisition programs.

This S&T plan is consistent with the process steps defined by the Chief of Naval Research (CNR) and depicted in Figure 3.

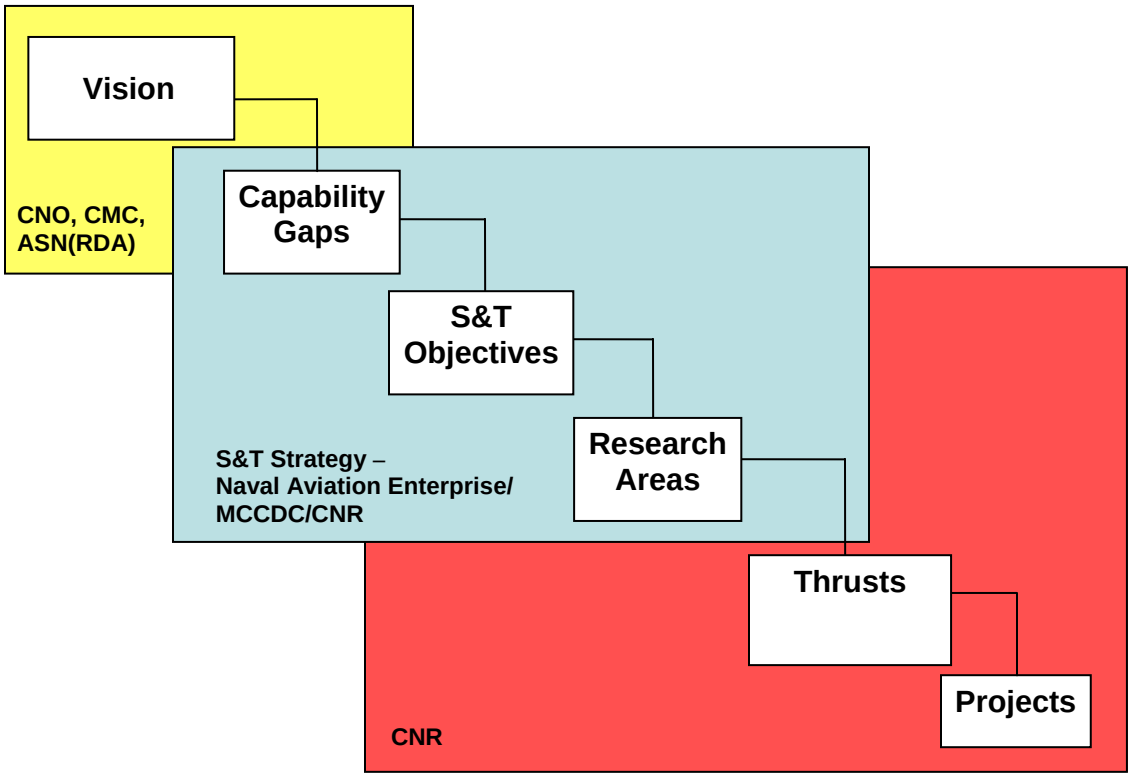

Figure 3 – CNR's S&T strategic plan development flow and portfolio management structure

NAE implementation of the CNR's guidance for S&T plan development begins with the Navy's top level **vision** document, Sea Power 21. The roles of the Naval Aviation Enterprise in achieving the goals of Sea Power 21 are outlined in Naval Aviation Vision 2020. From these vision documents **capability gaps** are developed based upon warfighting capability and technology gap analysis provided by OPNAV and CNAF. The gap analysis defines **S&T objectives** and **research areas**. These research areas are in turn used by ONR, teamed with the NAE's material developers, to identify **thrusts** and **projects**. The NAE will be responsible for the identification of **capability gaps**, **S&T objectives**, and **research areas**. ONR will assume the lead role in development of **thrusts** and **projects**, with participation and support from the NAE.

Once projects are identified, actual execution may be managed and executed within ONR with NAE technical assistance or managed by ONR with NAE providing technical execution responsibilities.

NAE leadership plans to regularly update the NAE S&T Strategic Plan to adapt to changes in the projected threat and operational environments. Updates will be coordinated with CNR and other critical stakeholders.

This NAE S&T Strategic Plan includes a set of Science and Technology Objectives with varying priorities for implementation. S&T prioritization is a critical element of the planning process. The NAE, with leadership from the operational community will regularly prioritize the objectives to ensure the most urgent and important issues are addressed. A prioritization process for S&T is in development.

A critical result of this strategic plan will be the Naval Aviation S&T roadmap which will summarize the S&T investment plans to close the highest priority capability gaps identified by the Combatant Commanders (COCOMs). Development of the investment strategy will be led by CNR with participation of the NAE. Many of the technologies discussed in this plan identify Navy unique interests that are unlikely to be addressed by outside organizations. This uniqueness will be a factor in the prioritization.

4. **Capability Gaps** Naval Aviation capability gaps are defined through a set of analytic and experiential processes. Many operational requirements are defined in initial Capabilities Documents, Capability Development Documents, and Capability Production Documents. The CNO's Assessment Division (N81) has conducted an extensive set of analyses in recent years to define long-term capability requirements for the Navy. In this plan, gaps are identified using the terminology of the Sea Power 21 Mission Capability Packages (MCP) used in the N81 analysis. Additionally, COCOMs and their staffs understand issues relating to current and future operations with no currently available solutions. Many of these requirements relate to Naval Aviation and are included in this plan. The Marine Corps has conducted a gap analysis leading to the Marine Corps Science and Technology Strategic Plan and has defined a unique list of S&T requirements supporting Marine Aviation. Because the Marines have a separate avenue for defining S&T requirements, Marine Corps science and technology requirements are not included in the NAE S&T strategic Plan. However, the NAE will coordinate development of thrusts and projects with Marine Corps Aviation and ONR.

In addition to addressing future technology needs, a balanced Naval Aviation S&T portfolio will provide technologies that enable capabilities to be executed more safely and requiring fewer people at lower cost. Technologies addressing safety and affordability are critical to achieving the objectives of Naval Aviation Vision 2020.

5. **S&T Requirements Flowdown** The vision and capabilities of Sea Power 21 provide the basis for accomplishing the current and future missions assigned to the Navy and Marine Corps. Naval Aviation forces, including the Navy and Marine Corp components, are focused on supporting the Sea Power 21 capabilities pillars. Within each pillar there are capability needs that currently are unmet and require technology

development. Under each capability need, unmet S&T objectives (STOs) are defined and described. Finally, critical research areas are defined for each S&T objective. An example of the flowdown of S&T demands from the Sea Power 21 pillars to research areas is presented in Figure 4.

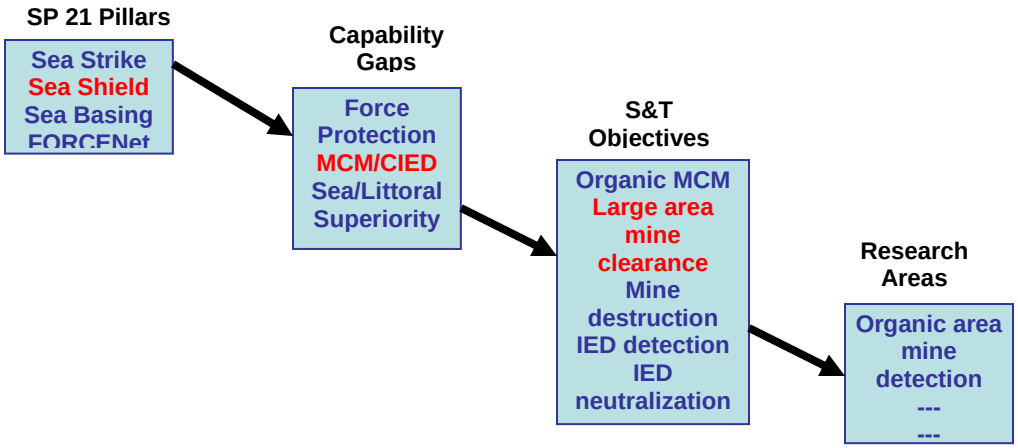

Figure 4
Example S&T Requirements Flowdown

The capabilities of the Sea Power 21 pillars are interdependent. For example, to conduct strike warfare, surveillance and targeting support must take place. The intent of the plan is to include all requirements to support all pillars, but only once, and not scattered through each pillar. Therefore, all ISR requirements are listed in the FORCEnet section, regardless of the pillar being supported.

In addition to the Sea Power 21 pillars there is a Capabilities and Affordability Enablers section for shared technologies. Included within the Enablers are shared technologies that support more than one future capability as well as technologies that support operational safety and affordable readiness goals. The S&T capability gaps for each pillar are provided in Table 1.

Sea Shield	Sea Strike	Sea Basing	FORCENet	Enablers
Force Protection	Strike Operations	Deploy and Employ Forces	Communications and Data Networks	Capability Enablers
Surface Warfare	Naval Fire Support	Provide Integrated Logistics Support	Intelligence, Surveillance and Reconnaissance	Affordability Enablers
Under Sea Warfare	Ship to Objective Maneuver		Common Operational and Tactical Pictures	
Theater and Air Missile Defense				

Table 1
Capability Gaps

6. S&T Objectives

6.1. Sea Shield

6.1.1 Force Protection (FP) Capability Gap

The Vision: ***To protect naval assets and to maintain fighting capabilities so that it can be applied at the appropriate time and place. This task includes those measures the force takes to remain viable and functional by protecting itself from the effects of enemy activities and natural occurrences.***

FP STO-1: Homeland Defense

Develop systems and procedures to supplement civilian agencies in ensuring homeland defense. Activities include but are not limited to area surveillance, command and control, and force application as required.

Homeland Defense Research Areas
- Human identification and tracking technologies, including facial recognition and tagging, for aviation employment
- Detection and engagement of terrorist and special operations threats to ships and shore facilities by land surface, air and subsurface threats, including determination of intent and non-lethal deterrence
- Standoff non-lethal alternatives for large vessel ship stopping

FP STO-2: Coordinated Small Boat Defense

Provide coordinated defense against simultaneous attack from large numbers of small boats.

Small Boat Defense Research Areas
- Small surface target detection, discrimination and tracking technologies
- Small, rapid fire weapons and payloads effective against a full range of small and intermediate boat threats

6.1.2 **Surface Warfare (SUW) Capability Gap**

<u>The Vision:</u> ***To attack sea targets with the intent to degrade the ability of enemy forces to conduct coordinated operations and/or perform critical tasks. This capability includes all efforts taken to control the battlespace by warfare commanders, strikes against High Payoff and High Value targets such as missile launching ships and other strike and power projection units throughout the theater, and efforts undertaken to undermine the enemy's will to fight***.

SUW STO-1: Forced Entry Capabilities

Develop increased capability for forced entry into closed seas.

Forced Entry Research Areas

- Effective anti-ship weapons for use against major combatants and white shipping traffic deemed hostile with minimum collateral damage

6.1.3 **Under Sea Warfare (USW) Capability Gap**

<u>The Vision:</u> ***Operations conducted to establish battlespace dominance in the underwater environment, which permits friendly forces to accomplish the full range of potential missions and denies an opposing force the effective use of underwater systems and weapons.***

USW STO-1: Organic capacity to clear large areas of mines without cued ISR

Provide capability to counter large areas of sea mines without cued ISR, which should reduce current MCM timeline for detecting, classifying, identifying and clearing moored and ground mines in shallow to deep water.

Mine Clearance Research Areas

- Airborne area surface and buried mine detection
- Rapid, accurate minefield identification
- Automated airborne mine and minefield clearance, neutralization and/or destruction technologies

USW STO-2: Improve Anti-Submarine Warfare (ASW) capability

Develop enhanced ASW detection, localization, identification and engagement capabilities.

Anti-Submarine Warfare Research Areas

- Improved submarine multi-spectral detection, localization and identification, especially passive methods
- Remote interrogation and propagation of unattended ASW sensor fields
- Improved datalink capability for sharing ASW information and data with submarine and surface vessels

- Persistent ocean environmental data collection, storage and analysis for mission planning

6.1.4 Theater Air and Missile Defense (TAMD) Capability Gap

<u>The Vision:</u> ***To intercept, engage, neutralize, or destroy enemy aircraft and missiles in flight. Includes disruption of the enemy's theater missile (ballistic missiles, air-to-surface missiles, and air-, land- and sea-launched cruise missiles) operations through an appropriate mix of mutually supportive passive missile defense, active missile defense, and supporting C3I measures.***

TAMD STO-1: Improved Anti-Air Warfare Performance

Improve airborne anti-air warfare capability against emerging air threats.

Anti-Air Warfare Research Areas
- Autonomous, longer range and faster air to air missiles
- Increased multi-spectral detection range against hostile fighter aircraft
- Improved Counter Low Observable technology
- Improved aircraft passive detection and tracking systems
- Increased lethality and reliability ordnance sections, including fuzes, safe arm devices, and warheads
- Improved multi-spectral countermeasures against sensors and missiles
- Long range LPI air target ID

TAMD STO-2: Improved Missile Defense

Provide airborne defensive capability against ballistic and cruise missile threats.

Theater Missile Defense Research Areas
- Long range, high speed, low cost propulsion
- Reliable, high speed fuzing technologies
- Counter Low Observable detection and tracking technologies
- Extended range detection, identification and tracking
- Multi-band seeker capability

6.2. Sea Strike

6.2.1 Strike Operations (STR) Capability Gap

<u>The Vision:</u> ***To apply combined-arms naval combat power to disrupt, divert, delay, destroy, suppress, neutralize, or seize military objectives. Strike operations incorporate and integrate multi-dimensional capabilities for power projection with various combinations of forces and platforms.***

STR STO-1: Persistent capability to engage time critical targets

Develop and field a capability to destroy a range of time critical targets (TCT) including ballistic missile launchers, SAM systems, small buildings, light bunkers, critical nodes to lines of communication, and vehicles in all weather conditions.

Time Critical Targets Research Areas

- High temperature, low cost materials and apertures
- High speed propulsion and system level integration for longer range, lower cost, lower weight, increased reliability and greater fuel efficiency
- Techniques to engage TCTs in motion
- Integration of ground and other non-aviation capabilities to support targeting of air-launched weapons

STR STO-2: Weapons with standoff and fire and forget capability against moving targets in strike, Close Air Support (CAS), and anti-terror missions.

Develop low cost, high lethality, selectable yield weapon capability against moving targets, including trucks, missile launchers, and small boats in all weather conditions.

Moving Targets Research Areas

- Lightweight, low cost guidance systems capable of acquiring, tracking and guiding the weapon to impact against multiple moving targets, capable of launch from fixed wing and rotary wing aircraft in adverse weather, day and night
- Small lethal warheads, including selectable yield systems
- Flexible multi-mission fuzing systems with cockpit selectable fuze delays to increase lethality
- Through the weather sensing capabilities to provide bad weather strike capability, preventing the enemy from using weather for safe haven
- Automatic target recognition and identification, including target extraction in high clutter environment
- Bomb hit assessment technology
- Jam resistant GPS
- Low cost electric power sources
- Joint Combat ID (cooperative and non-cooperative)
- Directed energy weapons
- Guided lightweight weapons for UAV employment
- Surface target recognition and identification
- Selectable yield weapons and ordnance sections
- Low collateral damage technologies
- Eye-safe semi-active laser weapons
- Non-lethal weapons

STR STO-3: Covert strike capability

Develop capability to conduct covert strike.

Covert Strike Research Areas

- Multi-spectral signature control capability

- Advanced mission planning
- LO broadband multi-function antennas and arrays
- Air vehicle structure and geometry
- Detection and defeat of passive tracking systems
- Low Probability of Detection (LPD), Low Probability of Intercept (LPI) Joint and Coalition Communications
- Air-launched forward deployed passive sensors

STR STO-4: Aircraft survivability

Develop technologies to improve survivability of naval aircraft in high and low threat environments, including operating at low altitudes.

Aircraft Survivability Research Areas

- Multi-spectral signature control, including active and passive technologies
- Vulnerability reduction techniques, including damage tolerant structures
- Defensive avionics and counter SAM capabilities, including missile and laser warning systems, expendables, and passive and active countermeasures
- Defense against Man Portable Air Defense Systems (MANPADS)
- Multi-spectral threat warning and defeat

STR STO-5: Unmanned strike capability

Develop unmanned combat air system (UCAS) capable of autonomous strike against a wide range of potential targets including missile launchers, SAMs, buildings, bunkers, fast attack craft, and vehicles.

Unmanned Strike Research Areas

- Autonomous launch, route planning and recovery, including flight within controlled airspace
- Multi-spectral signature control
- Operator monitoring and reprogramming
- Reliable, autonomous flight control
- Timely battle damage assessment
- Low cost ordnance
- Intelligent agent target recognition
- Multiple UCAS single controller capability
- Multi-tier UCAS command and control
- Advanced sensors with automated decision making, and battle damage assessment capability
- UAV jet propulsion and power

STR STO-6: Electronic Attack

Increase capability to employ electronic attack capabilities against hostile forces.

Electronic Attack Research Areas

- Sensors to detect hostile electronic emissions
- Improved noise and deceptive jamming capabilities, including better techniques, more power, improved reaction, increased performance in dense threat environments, and broader spectrum coverage
- Reduced cockpit workload
- Automated signal correlation
- Automated interaction and coordination with off-board assets
- Improved power generation, routing and storage

STR STO-7: Information Operations

Use information operations to cause denial, deception and confusion among hostile forces while defending own information and information systems

Information Operations Research Areas
- Low cost computer network monitoring capability
- Airborne network attack capabilities
- Improved communication network exploitation, including jamming and hacking
- Improved effectiveness in multi-platform jamming collaboration

STR STO-8: Directed Energy Weapons

Develop and field directed energy weapons to provide lethal and non-lethal capability with dramatically reduced logistics support compared to that needed for ammunition and explosives.

Directed Energy Weapons Research Areas
- Small, efficient power generation
- Beam forming capabilities
- Thermal management systems
- Power storage capacity to reduce weapon cycle time
- High power directed energy countermeasures

6.2.2 Naval Fire Support (NFS) Capability Gap

<u>The Vision:</u> To employ fires, integrated with maneuver, in order to accomplish operational objectives. To employ responsive fires at any time and in any weather across the battlespace in order to destroy, neutralize, or suppress fixed and moving targets. Fire support can include the use of aviation, naval surface, and land-based fires.

NFS STO-1: Naval fires to support speed and depth of Marine Corps and joint maneuver

Marine Corps operational doctrine increasingly calls for high speed maneuver. Supporting fires must be able to accommodate rapidly changing target locations and quickly provide supporting fires on demand.

Naval Fires Research Areas
- Flexible aviation-based fire support, including lethal and non-lethal methods
- Joint fires coordination
- Improved real time battle damage assessment (BDA)

6.2.3 Ship to Objective Maneuver (STOM) Capability Gap

<u>The Vision:</u> ***To conduct ship to objective maneuver (STOM) to greatly increase operational tempo and flexibility by developing the ability to maneuver air and surface-delivered elements of the MAGTF directly against objectives deep inland, without first establishing an initial beachhead or support bases ashore.***

STOM STO-1: Destruction of mines and IEDs in areas through which Marine Corps and joint forces must maneuver, ranging from deep water through surf and beach zones

Provide the destruction of mines and or obstacles to allow Marine Corps and/or Joint Forces to safely maneuver from deep water through to land objective. Capabilities must include Intelligence, Surveillance and Reconnaissance/Intelligence Preparation of the Battlefield (ISR/IPB), in addition to engagement capabilities.

Mine and IED Research Areas
- Airborne area mine and IED detection
- Deep and shallow water mine identification and clearing
- Beach mine and IED detection, identification and clearing
- Obstacle detection and clearing

6.3. Sea Basing

6.3.1 Deploy and Employ Forces (DEF) Capability Gap

<u>The Vision:</u> ***To embark Navy / Marine Corps / Army / SOF forces and move naval units and/or organizations and their systems from one position to another in order to gain a position of advantage over or avoid a position of disadvantage with respect to an enemy.***

DEF STO-1: Accelerated deployment and employment timelines.

Develop capabilities to improve the positioning of assets in critical areas of the world, including prepositioned equipment and stores and operational joint service units.

Accelerated Deployment Research Areas
- High speed heavy lift connectors
- Increased capability tactical lift

DEF STO-2: Intra-theater high speed lift

Provide capability to rapidly transport critical assets between theaters.

High Speed Lift Research Areas
- High speed heavy lift connectors

DEF STO-3: Improved Vertical Delivery

Develop capability to conduct vertical delivery faster and with additional weight and volume.

Vertical Delivery Research Areas
- Increased efficiency and reliability vertical lift engine and drive performance
- Alternative vertical delivery methods to helicopters

6.3.2 Integrated Logistics Support (ILS) Capability Gap

The Vision: ***To sustain forces in the combat zone by arming, fueling, fixing equipment, moving, supplying, manning, and by providing personnel and health services. Includes logistic support, as necessary, to US agencies and friendly nations or groups.***

ILS STO-1: Enhanced Afloat Support of Joint Assets

Develop capabilities that improve the ability to position assets in critical areas of the world, including prepositioned equipment and stores and operational joint service units.

Afloat Support Research Areas
- Autonomic logistics
- Auto-tracking of sea based aircraft parts, consumables and components
- Auto-tracking of sea based ordnance and weapons systems
- Sand and dust penetrating sensors providing precision navigation in brownout and dustout visibility conditions

ILS STO-2: Sea Base Persistent Combat Operations

Maximize the effective throughput within and from the sea base to ashore combat operations with a tailored flexible response. Integrate operational, maintenance, and logistic planning and distribution systems, to reduce or eliminate the operational pause to enable persistent combat operations.

Persistent Combat Operations Research Areas
- Labor reducing methods for aircraft maintenance, repair, fueling, arming, launch and recovery
- Utilizing unmanned aircraft capability on missions to offset higher cost manned aircraft
- Low maintenance, high reliability support equipment and launch and recovery gear
- On demand logistic support

- Auto-tracking of parts and supplies

6.4. FORCEnet

6.4.1 Communications and Data Networks (CDN) Capability Gap

<u>The Vision:</u> ***To provide data and information flow seamlessly and transparently to the warfighter across a fault tolerant, adaptable, self-organizing, holistically engineered continuously available network. The data and information flows across a wide range of transmission paths in an interoperable manner with naval, joint, coalition and civil / law enforcement agencies. Platforms and vehicles are able to communicate freely and autonomously with other elements of the architecture thus the existence and functions of the underlying network are transparent to the warfighter.***

CDN STO-1: Networks

Provide ubiquitous, secure communications and network infrastructure that includes the major architecture components for transmitting and receiving high data rate voice and video from a single aperture.

Networks Research Areas

- Dynamic, secure and survivable networks, including BLOS OTH capability, with capability for international sharing
- Computer network defense and information assurance
- Joint and Coalition Combat ID (cooperative and non-cooperative)
- Integrated common surface and subsurface picture and common air picture
- Adaptive automated decision aids and knowledge enhancement systems
- Improved geo-positional and pointing translation
- Improved auto cueing technologies
- Improved activity alert processing for perimeter surveillance and defense
- Improved networked missile defense systems exploiting both airborne and ground networks of missile detection systems for threat isolation, quick kill/counter of perpetrators, and threat defeat
- Improved detection and defeat of Rocket Propelled Grenades
- Autonomous sense and avoid flight control technologies
- High bandwidth and ultra wide bandwidth communications technologies

6.4.2 Intelligence, Surveillance and Reconnaissance (ISR) Capability Gap

<u>The Vision:</u> ***To provide battlespace situational awareness sufficient for the conduct of assigned tactical operations. Includes determining locations of all units of interest, analysis of friendly effects and hostile potential using technical and human assets.***

ISR STO-1: Battlespace Awareness

Develop capabilities to ensure persistent domain awareness in the battlespace.

Battlespace Awareness Research Areas

- Autonomous, organic long dwell sensors
- Integrated national, theater and force sensors
- Automated decision support

ISR STO-2: Persistent target detection, discrimination, identification and targeting.

Provide real time targeting data to naval forces with sufficient accuracy to engage with available weapons.

Persistent ISR&T Research Areas
- Integrated, joint, multi-tiered sensor and weapon grid
- Automated, assisted, surface target discrimination
- Behavior directed intent determination

ISR STO-3: Unmanned Air Vehicles (UAV)

Develop Unmanned Air Vehicles to conduct persistent tactical surveillance and other naval missions at reduced cost and reduced risk of casualties. Unmanned systems should have a goal of high and increasing autonomy to reduce human workload and dramatically reduced sustainment and operational costs.

Unmanned Air Vehicles Research Areas
- Vehicle autonomy capability
- UAV integration into friendly joint and coalition force structure
- Automated targeting and fire control functionality
- UAV integration into manned airspace

6.4.3 Common Operational and Tactical Picture (COTP) Capability Gap

The Vision: ***To manage land, sea and air operational forces in time, space, and purpose to produce maximum relative combat power and minimize risk to own forces. This activity ensures all elements of the tactical force, including supported agencies and nations' forces, are efficiently and safely employed to maximize their combined efforts beyond the sum of their individual capabilities. This includes the tactical need to arrange surface, subsurface, air, and ground forces and coordinate detection assets and tactical fires with the maneuver of forces in time, space, and purpose to support the commander's concept of operations and produce maximum relative combat power of combined arms at the decisive point.***

COTP STO-1: Distributed Weapons Coordination

Develop capability to increase effectiveness of counter-air and counter-sea defenses by coordinating weapon and weapon direction systems across the naval force.

Weapons Coordination Research Areas
- Weapons control transfer capability between platforms

6.5 Capability and Affordability Enablers

6.5.1 Capability Enablers (CE) Capability Gap

<u>The Vision:</u> ***Leverage existing and emerging technologies to achieve operational capabilities across multiple warfare areas, providing cost savings and increased operational effectiveness.***

Capabilities Enablers Research Areas

- Advanced pulsed electric power, including compact high density power generation and storage
- Advanced rocket technology to provide longer range and faster speed
- Variable speed aerial refueling capability to allow one vehicle to refuel fixed and rotary wing aircraft
- Cost effective mass memory to support memory requirements for digital maps and other autonomous operational requirements
- Low drag multifunction VHF, UHF and UHF SATCOM antenna
- Improved Human System Interface to provide increased situational awareness through exploitation and integration of advanced sensor, display, and processing technologies including data visualization; aural, visual tactile and immersive interfaces; and decision-centered staff process control
- Increase mission effectiveness by maximizing protection, sustainment and physical performance including multi-spectral, fused displays, improved hearing protection, enhanced extreme temperature and altitude protection, advanced crashworthy systems, advanced ceramic based oxygen systems and smart visor systems
- Optimize training and selection of the warfighter through intelligent adaptive simulation based training, adaptive training and performance measurement methodologies, development of leaders and teams in a coalition and network enabled environment, communications decision support mechanisms, and advanced language processing for training devices

6.5.2 Safety and Affordability Enablers (SAE) Capability Gap

<u>The Vision:</u> ***Utilize advanced technology to improve safety and reduce cost of naval operations.***

SAE STO-1: Reduced cost turbine engines

Develop and field high power, reduced TOC turbine engines with increased fuel efficiency, including small engines for weapon and UAV integration.

Reduced Cost Engines Research Areas

- Turbine engine reliability and life extension
- Advanced design and manufacturing capabilities
- Fuel efficiency improving technologies

SAE STO-2: Reduced Support Costs

Develop and implement methods and systems that reduce the support costs of naval systems.

Reduced Support Cost Research Areas

- Automated parts tracking and inventory
- Demand pull inventory systems
- High reliability systems and subsystems
- Improved structural repair technologies
- Structural life surveillance and analysis system to be applied to legacy and emerging aircraft
- Reduced logistics footprint for aviation systems
- Integration of civilian technologies and capabilities with military communications networks

SAE STO-3: Platforms and Systems Safety and Availability

Develop, integrate and transition technologies to improve system safety, extend useable service life, reduce safety-, age- and environment- related maintenance actions, and reduce environmental impacts on operations, basing and training, thereby increasing long-term savings, enhancing long term mission performance, and enabling long-term platform availability.

Platforms and Systems Safety and Availability Research Areas

- Durable, affordable high performance aerostructures
- Improved materials including life prediction, detailed characterization, manufacturing and repair processes
- Improved design and manufacturing processes, including verified design tools, analysis models and simulations
- Diagnostic and prognostic health management technologies and integration to enable state awareness and condition-based fleet management
- Advanced instrumentation and sensors to enable real time usage monitoring and life tracking
- Advanced Military Flight Operations Quality Assurance (MFOQA) data collection, analysis, and reporting/visualization technologies and processes to improve safety and operational efficiencies

Bibliography

a. ADM Vern Clark, Sea Power 21, Projecting Decisive Joint Capabilities; Proceedings, October 2002.
b. Naval Aviation Enterprise, Naval Aviation Vision 2020, 2005.
c. Marine Corps Science and Technology Strategic Plan, Marine Corps Combat Development Command, September 2005.
d. POM 06/PR07 Naval Gaps, CNO N7, June 2005.
e. POM 08 MCP EPE Gaps, CNO N81, undated.
f. POM 08 Naval Warfighting Gaps, CNO N81, Undated.
g. Identification of Promising Naval Aviation Science and Technology Opportunities, National Academy of Sciences, 2006.
h. AIRTECH Strike Platform ARB 11 and Weapons ATRB 16, NAVAIRSYSCOM, April 2006
i. Air Platforms Technology Area Review and Assessment, ODUSD(S&T), 3 April 2006.
j. Carrier Technology Future Studies Group, Phase II Final report, SPA Inc., June 2005.
k. Fuze Technology Needs, PEO(W), undated
l. Aviation TYCOM Priority List (TPL) for POM-08, COMNAVAIRFOR, September 2005.
m. CNO Strategic Studies Group XXI, Accelerating FORCEnet—Winning in the Information Age, December 2002.
n. CNO Strategic Studies Group XXII, Coherent Adaptive Force: Ensuring Sea Supremacy for Sea Power 21, January 2004.
o. CNO Strategic Studies Group XXIV, Beyond Maritime Supremacy, Balancing Maritime Capabilities for the Age of Unrestricted Warfare, January 2006.

Acronym List

ASN(RDA)	Assistant Secretary of the Navy (Research, Development and Acquisition)
ASW	Anti-Submarine Warfare
BA	Budget Activity
BDA	Battle Damage Assessment
BLOS	Beyond Line-of-Sight
BOD	Board of Directors
CAS	Close Air Support
CDN	Communications and Data Networks
CFFC	Commander, US Fleet Forces Command
CIED	Counter Improvised Explosive Device
CNAF	Commander Naval Air Forces
CNATRA	Chief of Naval Air Training
CNO	Chief of Naval Operations
CNR	Chief of Naval Research
COCOM	Combatant Commander
COTP	Common Operational and Tactical Picture
DEF	Deploy and Employ Forces
DLA	Defense Logistics Agency
EA	Electronic Attack
FNC	Future Naval Capability
FP	Force Protection
GPS	Global Positioning System
HQMC	Headquarters, Marine Corps
ICP	Inventory Control Point
ID	Identification
IED	Improvised Explosive Device
ILS	Integrated Logistics Support
IPB	Intelligence Preparation of the Battlefield
IPT	Integrated Product Team
ISR	Intelligence, Surveillance and Reconnaissance
LO	Low Observable
LPD	Low Probability of Detection
LPI	Low Probability of Intercept
MANPADS	Man Portable Air Defense Systems
MCCDC	Marine Corps Combat Development Command
MCM	Mine Countermeasures
MCP	Mission Capability Packages
N8	Deputy Chief of Naval Operations (Resources, Requirements and Assessments)
N81T	Sea Strike Department Head, Warfare Assessment Division, OPNAV
N88	Director, Air Warfare
N8F	Director, Warfare Integration and Assessment
NAE	Naval Aviation Enterprise
NAVAIR	Naval Air Systems Command

NAWC	Naval Air Warfare Center
NCDP	Naval Capability Development Process
NFS	Naval Fire Support
NPDC	National Parts Distribution Center
NRE	Naval Research Enterprise
NRL	Naval Research Laboratory
ONR	Office of Naval Research
OPNAV	Office of the Chief of Naval Operations
O&S	Operations and Sustainment
OTH	Over the Horizon
RF	Radio Frequency
SAE	Safety and Affordability Enabler
SAM	Surface to Air Missile
SATCOM	Satellite Communications
SIAP	Single Integrated Air Picture
SP21	Sea Power 21
S&T	Science and Technology
STR	Strike Operations
STO	Science and Technology Objective
STOM	Ship to Objective Maneuver
SUW	Surface Warfare
TAMD	Theater Air and Missile Defense
TCT	Time Critical Targets
TOC	Total Ownership Cost
WCP	Warfighting Capability Plan
WG	Working Group
UAE	Urban, Asymmetric and Expeditionary Operations
UAV	Unmanned Aerial Vehicle
UCAS	Unmanned Combat Air System
UHF	Ultrahigh Frequency
USMC	United States Marine Corps
USW	Under Sea Warfare
VHF	Very High Frequency