Naval Aviation Enterprise
Science and Technology Objectives

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NAVAL AVIATION SCIENCE AND TECHNOLOGY OBJECTIVES

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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 these NAE Science & Technology (S&T) Objectives (STOs). Naval aviation has enjoyed superiority over adversaries as a result of aviators' skills, training, equipment, and advanced technology; the STOs presented here will have a key role in maintaining the Navy's technology advantage over all current and future foes.

This document represents the combined effort of representatives from CNAF, OPNAV, ONR, NAVAIR, the Program Executive Office (PEO) for Carriers, and the Naval Air Warfare Centers. Each of the capability gaps and resulting STOs were developed from a gap analysis utilizing national, defense and Navy strategic guidance documents as references for the overarching vision for the future. Each STO can be traced to this gap analysis and the guidance provided in the strategic documents. The STOs provide goals for the NAE and will facilitate the alignment of the Navy's applicable science and technology development investments to the capability requirements of Naval aviation.

The NAE Chief Technology Officer (CTO), in collaboration with the Office of Naval Research (ONR) and other technology developers from the Department of Defense, other federal government, academia and industry, will develop detailed technology thrusts and projects to support these objectives.

This document is an evolution of and replaces the NAE S&T Strategic Plan dated 1 July 2006. It represents the first step of a rigorous process for creating a Naval aviation strategic S&T plan that identifies needed capabilities and the technology developments that can, over time, provide those capabilities. The NAE will continually review priorities and will update this STO Document on a biennial basis.

Table of Contents

	Page
Introduction	4
Background	5
NAE S&T Objectives (STOs)	7
Sea Shield	7
Force Protection	7
Surface Warfare	8
Under Sea Warfare	9
Theater Air and Missile Defense	10
Sea Strike	11
Strike Operations	11
Sea Basing	13
Deploy and Employ Forces	13
Integrated Logistics Support	14
FORCEnet	15
C4ISR	15
Enterprise and Platform Enablers	18
Enterprise and Platform Enablers	18
System Safety, Availability and Affordability	18
Sea Warrior	19
Naval Warrior Performance	19
References	21
Acronyms	22
Appendix A: Strategy Framework	24
Appendix B: Alignment of NAE STOs to Sea Power 21 Pillars	27
Appendix C: Alignment of NAE STOs to Joint Capability Areas	29
Appendix D: Alignment of NAE STOs to ONR Focus Areas	32

INTRODUCTION

The Navy's science and technology vision is to sponsor scientific research and technology in pursuit of revolutionary capabilities for US Naval forces of the future, mature and transition S&T advances to improve US Naval capabilities, respond to current critical needs and maintain broad technology investments to anticipate, and counter potential technology surprises.[1] To support this mission, the Naval Aviation Enterprise science and technology portfolio must provide solutions that will enable the future force while simultaneously seizing opportunities to enhance current readiness.

The NAE Science and Technology Objectives (STOs) contained in this document provide guidance for the NAE and facilitate the alignment of the Navy's applicable science and technology development investments to the technology requirements of Naval aviation. Stated more simply, the STOs represent the *goals* of the NAE S&T program, and will be used as the baseline for identifying, prioritizing, aligning and synchronizing S&T investment efforts throughout the enterprise. They represent a broad strategy that provides strong direction for the future, but retains sufficient flexibility to allow the S&T community to meet emerging challenges.

The NAE STOs were developed by both warfighters and technologists, and are in alignment with national, defense and Naval strategies and visions. They form the basis for technology thrusts that will serve as the foundation for the maturation of the technologies to respond to current and future operational capability needs.

The STOs are part of a comprehensive strategy for managing the NAE S&T portfolio that includes investment planning and project execution. As stated by the National Research Council, "good technology planning and capability development can be achieved only within the context of a larger strategic plan"[2]. This strategy – managed by the NAE Chief Technology Officer - improves on the NAE's ability to align S&T priorities, strategically invest in S&T programs, measure S&T program success and deliver technology solutions to address capability gaps.

[1] Naval S&T Strategic Plan, dated 19 Jan 2007.
[2] Identification of Promising Naval Aviation Science and Technology Opportunities, National Academy of Sciences, 2006.

The NAE S&T Objectives document will be updated on a biennial basis to remain current with user needs and technology opportunities. The NAE BOD is the controlling and approval authority for this document.

BACKGROUND

To meet current and emerging warfighter needs and deliver future force capabilities, the Naval aviation S&T enterprise invests in near-, mid- and long-term research to provide the best technology solutions. S&T programs investigate new ideas to generate technology options and mitigate risk in acquisition, and also investigate a variety of technical solutions that can significantly impact the total ownership cost of military systems. The role of S&T is not to avoid risk, but to take scientifically feasible risk, and to ensure that anticipated capability needs are met while concurrently reducing opportunities for technological surprises from adversaries.

The NAE S&T portfolio must be balanced to ensure that near-term warfighting needs are addressed without sacrificing the pursuit of mid- and far-term revolutionary capabilities. To do this, technology must be developed through investments in the three components of S&T: (1) for the near term, demonstrating mature technology in relevant operational environments and facilitating transition of technology to acquisition; (2) in the mid term, translating research into militarily useful technology applications; and (3) in the far term, research to create new understanding for technologies that offer paradigm-shifting capabilities[3].

Within the NAE, it is the responsibility of the Chief Technology Officer to manage the S&T portfolio. Specifically, the NAE CTO must:

- Ensure alignment of applicable S&T programs with NAE missions and future capability needs.
- Balance and manage the applicable S&T portfolio in cooperation with the Office of Naval Research and other resource sponsors.
- Communicate the NAE S&T vision and approach to senior decision-makers, key stakeholders, S&T partners, customers and performers.

The CTO is assisted in managing the NAE S&T portfolio by an Integrated Program Team (IPT) of Product Line Managers (PLMs) and NAVAIR

[3] Army S&T Master Plan 2007, page I-1

technologists (also known as "T-codes"). Other organizations, including ONR, and PEO(Carriers), and fleet science advisors contribute to the development of the NAE S&T program..

The CTO and associated IPT members will use the STOs as part of a larger strategy for managing the NAE S&T portfolio that includes investment planning and project execution. The strategy improves the NAE's ability to align S&T priorities, strategically invest in S&T programs and measure program success through clearly identified NAE S&T goals, priorities, and metrics. Implementation of the strategy will result in an NAE S&T portfolio that is properly balanced, responsive to warfighter capability needs, and able to produce quality solutions within an optimum timeframe at reduced cost.

SCIENCE AND TECHNOLOGY OBJECTIVES (STOs)

The NAE S&T Objectives (STOs) are aligned with the Navy's top-level vision construct, Sea Power 21. The vision and capabilities of Sea Power 21 provide the basis for accomplishing the missions assigned to the Navy and Marine Corps. Within each Sea Power 21 pillar, capability gaps are identified that require technology development for a solution; under each capability gap, S&T objectives (STOs) are defined and described.

1.0 SEA SHIELD

1.1 Force Protection (FP) Capability Gap

***The Vision:* Protect Naval assets and provide increased survivability across the spectrum of conflict. This task includes those measures the force takes to remain viable and functional by protecting itself from the effects of enemy activities.**

FP STO-1: Platform Survivability

Advances in threat technology have resulted in improved weapon kinematics and other capabilities that place Joint and Coalition air and carrier forces well within the threat envelope.

Develop technologies to improve survivability of Naval platforms in current and emerging threat environments, and increase the defensive capabilities of Joint and Coalition platforms against advanced current and emerging threat environments.

FP STO-2: Mine and IED Detection and Neutralization

Joint and Coalition forces must be able to safely maneuver from deep water to land in order to perform their missions.

Develop technologies to improve capabilities to locate and neutralize mines and IEDs in areas through which Joint forces must operate. Capabilities include Intelligence, Surveillance and Reconnaissance / Intelligence Preparation of the Battlefield (ISR/IPB) in addition to engagement abilities. Research areas include: airborne area mine and IED detection and neutralization, deep and

shallow water mine identification and neutralization and beach mine and IED detection, identification and neutralization.

FP STO-3: Electronic Protection

Advances in threat airborne jamming systems, including the incorporation of Digital Radio Frequency Memory (DRFM) technology, require advanced counter-counter measures for Joint and Coalition forces.

Develop technologies to improve Joint and Coalition air-, land- and ship-wide systems' resistance to electronic attach, including electromagnetic pulse (EMP).

1.2 Surface Warfare (SUW) Capability Gap

The Vision: Project power within the littoral regions and preserve open access to key shipping lanes. 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 to undermine the enemy's will to fight.

SUW STO-1: Maritime Surveillance and Interdiction

To maintain the ability to project power within the littoral regions and preserve open access to key shipping lanes, the capability to detect, identify and track surface contacts is required. Tracking/ID capability is required for ship classes ranging from surface combatants to small vessels, in high and low density shipping traffic and during unintentional/intentional jamming scenarios.

Develop technologies to detect, identify and track surface combatants in all weather conditions, in both day and night operations, over long standoff ranges (beyond projected surface threat envelopes), with high probability of mission kill and low probability of collateral damage survivable weapons, to support the engagement of surface combatants, landing craft, and other high value surface assets in the most challenging scenarios.

1.3 Under Sea Warfare (USW) Capability Gap

<u>The Vision:</u> Establish battlespace dominance in the underwater environment to permit friendly forces to accomplish the full range of potential missions and deny opposing forces the effective use of underwater systems and weapons.

USW STO-1: Environmental sensing, assimilation and tactical decision aids

As sensors and weapons are developed to pace the advances in submarine threat technology in the increasingly complex and variable USW battlespace, more comprehensive real time environmental data is required. Onboard tactical decisions aids that rapidly assimilate the expanded data set are needed to decrease workload, optimize new sensor and weapon employment, and provide effective single as well as multi-platform tactical employment recommendations across all phases of the Anti-Submarine Warfare (ASW) kill chain.

Develop technologies that provide real time comprehensive sensing of the USW battlespace environment (air and ocean) along with integrated onboard and ground based decision aids that rapidly assimilate data, optimize multi-sensor and weapons employment and improve ASW effectiveness.

USW STO-2: Wide Area Search and Detection

Continued advances in threat submarine capability to avoid acoustic and non-acoustic detection increasingly challenge Air ASW platforms' ability to cover tactical significant search areas in both deepwater and the shallow water of the littorals. Stand-off or high altitude flight profiles are required in littoral or hostile threat environments, but high-altitude littoral ASW capability is limited by radio frequency (RF) interference and RF jammers.

Develop technologies to enable automatic detection and discrimination of small targets (i.e., periscope) from all altitudes and/or standoff ranges, and improve active/passive/multi-static identification algorithms to minimize false detects (mammal mitigation, distributed netted sensors).

Develop effective aerial search capability against threat submarines covering large areas at high search rates in shallow to deep water with high probability of detection with low probability of false alarm/detection, and develop methods

to mitigate RF interference at all altitudes in the littoral or hostile environments.

USW STO-3: Precision Localization/Identification/Attack

Continued advances in threat submarine capability to counter acoustic and non-acoustic sensors and weapons increasingly challenge Air ASW platforms' ability to rapidly localize, track, determine and deliver effective precision attacks. Stand-off or high altitude flight profiles are required in littoral or hostile threat environment, but high-altitude littoral ASW capability is limited by RF interference and RF jammers.

Develop technologies for rapid and sustained precision localization and tracking and positive identification of threat submarines given initial air platform search sensor detection. Develop an advanced precision delivery ASW weapon for all-altitude attack of target at any depth.

1.4 Theater Air and Missile Defense (TAMD) Capability Gap

<u>The Vision:</u> Intercept, engage, neutralize, or destroy enemy aircraft and missiles in flight, including disruption of the enemy's theater missile operations through an appropriate mix of mutually supportive passive missile defense, active missile defense, and supporting C^3I measures.

TAMD STO-1: Anti-Air Warfare Performance

Air superiority requires the ability to engage the air threat prior to an enemy's ability to launch weapons at Joint and Coalition force surface combatants, ground stations/bases and logistical vessels. Advances in and proliferation of Air to Air threat technologies have resulted in improved threat air platforms (reduced RCS, enhanced sensors, improved C2/SA), threat weapon kinematics/sensitivity, and Electronic Attack (EA) capabilities that pose a threat to Joint and Coalition air forces. It is imperative Joint and Coalition systems (both sensors and weapons) provide sufficient situational awareness and standoff to ensure that they remain outside of the effective threat envelope of air-to-air weapons/systems.

Develop targeting and engagement systems and weapons technologies to detect, track, identify, and engage advanced air threats outside of their

projected sensor ranges and the kinematic range of emerging missiles in an EA environment.

TAMD STO-2: Airborne Missile Defense

Advances in and proliferation of advanced Cruise Missile (CM) (both Land Attack (LACM) and Anti-Ship (ASCM) variants) and Theater Ballistic Missile (TBM) threat technologies have resulted in an increased threat to the Joint Force. The defense of Joint and Coalition forces requires the ability to detect and engage the emerging missile threat at ranges sufficient to ensure the safety of our forces (and minimize the utilization of Close-In Weapon Systems (CIWS)) and to allow them to carry on their required missions.

Develop technologies to improve Joint and Coalition sensors, targeting and engagement systems and weapons technologies to detect, track, identify, engage and/or neutralize emerging missile threats at ranges commensurate to support a shoot-look-shoot strategy versus a shoot-shoot approach.

2.0 SEA STRIKE

2.1 Strike Operations (STK) Capability Gap

***The Vision:* Apply combined-arms Naval combat power, as part of a Joint and Coalition force, 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.**

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

Rapid changes in operational circumstances and enemy action result in very limited vulnerability windows for many critical targets. Immediate availability of systems to neutralize these targets and the capability to successfully prosecute multiple targets is essential to Joint and Coalition operations. Shorter engagement chains - including detection, identification, fix, track and finish – are required.

Develop technologies that enable all-weather endurance over a large area of responsibility and neutralization of a range of time critical targets in multiple locations, including ballistic missile launchers, SAM systems, small buildings,

light bunkers, critical nodes to lines of communication, and vehicles in the most challenging scenarios, with little collateral damage.

STK STO-2: Stand-off capability against mobile targets

The ability to engage moving targets from stand-off ranges increases the ability of Joint and Coalition forces to neutralize enemy threats and reduces the threat to Joint and Coalition forces. However, improvements in the ability to reduce the uncertainty that arises regarding a mobile or re-locatable target's location after its initial detection are required.

Develop technologies to improve stand-off, high lethality, selectable yield weapon capability against moving targets, including trucks, missile launchers, and small boats (and other swarm threats) in all weather conditions with positive target identification.

STK STO-3: Covert strike capability

Covert strike capability is required to ensure strategic targets can be neutralized without hostile forces identifying the source of the strike and to increase attacker survivability. An ideal covert strike gives defenses no warning and leaves behind no evidence but neutralized targets. The capability should be effective (lethal and/or non-lethal options) against a broad spectrum of targets including vehicles, small to medium sized buildings, bunkers, missile launchers and personnel.

Develop technologies to minimize detection of Joint/Coalition aircraft platforms, weapons and communications during strike operations.

STK STO-4: Unmanned strike capability

Elimination of the human from aviation strike force assets reduces the risk of casualties and reduces cost and weight of the platform. Endurance, payload and survivability can all be increased.

Develop technologies to enable unmanned, highly autonomous strike capabilities against the full spectrum of potential targets.

STK STO-5: Airborne Electronic Attack (EA)

Current Naval airborne EA capability is well suited to older generation radars but does not offer any countermeasure to netted passive sensors and requires improvement against newer radar and communication technologies.

Develop airborne EA technologies that can effectively deceive or degrade advanced search and tracking radars, can effectively disrupt modern communication and data links, both conventional military and asymmetric, and can disrupt asymmetric, non-traditional targets such as RF triggering devices.

STK STO-6: Suppression of Enemy Air Defense / Destruction of Enemy Air Defense (SEAD/DEAD)

Current and developmental SEAD/DEAD options are not useable in the most challenging scenarios.

Develop technologies to find, fix, track and destroy key modern Integrated Air Defense System (IADS) nodes without exposing Naval aircraft to hostile action.

STK STO-7: Enhanced Close Air Support (CAS)/Strike Coordination and Reconnaissance (SCAR)

Effective fire support of ground forces is essential to Joint and Coalition force operations. Fire support should be more mobile, more responsive, more precise, and capable in all weather conditions. Low collateral damage capability is required to support operations near friendly forces and in urban areas.

Develop technologies to improve all-weather, mobile and responsive fire support capability, including increased information sharing to enable enhanced target detection, location, identification, dissemination and neutralization.

3.0 SEA BASING

3.1 Deploy and Employ Forces (DEF) Capability Gap

***The Vision:* Embark forces and move Naval units and/or organizations and their systems from one position to another to gain a position of advantage or avoid a position of disadvantage.**

DEF STO-1: Inter-theater deployment

Military success is often dependent on a commander's ability to effectively maneuver and mass forces, to support and reinforce deployed or embarked units, and to quickly react to changes in the tactical situation. Improved ability to conduct strategic transport and positioning of troops and equipment on short notice, against all threat levels, in prepared, urban and austere environments, to and from areas ranging from runways to small deck ships to unimproved landing zones is required.

Develop technologies to improve the inter-theater positioning of assets, including pre-positioned equipment and stores and operational Joint service units.

DEF STO-2: Improved Vertical Delivery – Air Vehicle

Naval forces rely heavily on efficient, effective vertical lift for re-supply and sustainment during inter-theater deployment and operations.

Develop technologies for air vehicle enhancements that improve durability/ speed/range/payload and take off/landing performance capabilities required to increase tactical effectiveness and survivability in all weather.

DEF STO-3: Improved Vertical Delivery – Systems enhancements

Naval forces rely heavily on efficient, effective vertical lift for re-supply and sustainment during inter-theater deployment and operations.

Develop technologies for vertical delivery system enhancements that improve ability to operate in the intended environment and increase tactical effectiveness, safety and survivability, including aerial delivery and internal/external cargo handling systems.

3.2 Integrated Logistics Support (ILS) Capability Gap

<u>The Vision:</u> Sustain forces, US agencies and friendly nations in the combat zone by arming, fueling, fixing equipment, moving, supplying, manning, and providing personnel and health services.

ILS STO-1: Enhanced Logistical Support of Joint Assets

The Navy's ability to generate and sustain combat readiness indefinitely, anywhere on the globe, requires that materiel flow seamlessly and as needed from the industrial base to where it is ultimately used. To position assets in critical areas of the world, including pre-positioned equipment and stores and operational joint service units, Naval logistics capability must develop better processes and business arrangements that reduce cost, increase logistic capabilities, and link customer demands with the supply chains.

Develop technologies that permit new missions to be rapidly planned and ongoing missions to receive flexible logistic support in response to unanticipated changes in the operational tempo, maximizes the effective throughput within and from the sea base to ashore combat operations with a tailored flexible response, and integrates operational, maintenance, and logistic planning and distribution systems to reduce or eliminate the operational pause to enable persistent combat operations.

4.0 FORCENET

4.1 Command, Control, Communications, Computers, Intelligence, Reconnaissance, and Surveillance (C4ISR) Capability Gap

The Vision: ***Enable the seamless and transparent flow of data to the warfighter across fault tolerant, adaptable, self-organizing, holistically engineered continuously available networks across a wide range of transmission paths in an interoperable manner with Naval, Joint, coalition and civil/law enforcement agencies. Platforms and vehicles should communicate freely and autonomously with other elements of the architecture in a manner where the existence and functions of the underlying network are transparent to the warfighter.***

C4ISR STO-1: Battlespace Awareness

Joint and Coalition forces must have the ability to accurately collect and securely disseminate information to the appropriate entity within the force with enough fidelity to be acted upon in a timely manner.

Develop technologies to improve autonomous situational awareness that provide warfighters intelligent access to digital information and enable near-

real-time distribution of tailored information using cognitive tools, intelligent agents, tailored services and other relevant technologies.

C4ISR STO-2: Information Security / Information Assurance

Naval aircraft operate with Joint, NATO, Allied, Coalition, and Homeland Security forces. Each of these enclaves have specific 'need-to-know' and security requirements. No automated guard exists to operate with a mix of these forces. Airborne systems and ground-based mission planning systems generate massive amounts of sensitive/classified data that is difficult to store and transport. The need exists for secure broadband communications and survivable Joint and Coalition command and control capabilities.

Develop technologies that facilitate rapid information sharing (down to the platform level), enables the integration of multi-level security (MLS) systems for Joint and Coalition operations and provides intra-, cross-, and inter-domain authentication, encryption, and information assurance/integrity services in all operating conditions, including areas of intermittent connectivity and limited throughput in restricted and hostile environments.

C4ISR STO-3: Communications and Networks

Network Centric Warfare (NCW) is a concept for collaborating at the machine-to-machine level for mutual support of widely dispersed combat assets. To fully realize the vision of automated collaboration at the machine-to-machine level in combat platforms requires advanced networking technologies beyond what is fielded today. A seamless, scalable, interoperable architecture that ensures timely distribution of information for managing the efficient use of sensors, platforms, weapons and relays is required.

Develop NCW technologies that enable early entry and sustained forces to communicate beyond line of sight and on the move (BLOS/OTM) with each other, and interoperate with other Naval, Joint and Coalition forces to enable distributed maneuver and leverage joint fires on the future battlefield.

Develop technologies to improve aircraft communications and network connectivity performance (speed, range, observability, communications) throughout the battlespace.

C4ISR STO-4: Persistent Target Detection, Discrimination, Identification and Targeting

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The ability to maintain constant, enduring contact with a potential target increases understanding about the target, which enables a faster decision cycle at all levels of command and supports the application of precision force to achieve desired effects. The ability to provide persistent, common, accurate and actionable tactical situational awareness to all participants is required to meet information requirements of Joint and Coalition forces.

Develop technologies to conduct persistent tactical surveillance, integrate sea, ground and air sensors in theater, automatically and confidently identify and track potential targets at standoff ranges and provide real time targeting data to Joint and Coalition forces with sufficient accuracy to prosecute targets when required.

C4ISR STO-5: Tactical Decision Support

The operator is burdened with an increasing volume of data as missions become more complex and multiple sensors provide more information. Tools are needed to sift through the data and help the operator make quicker, more informed decisions.

Develop technologies to enable rapid and accurate decision making. Technologies can include intelligent agents or decision aids for rapid and reliable threat/intent determination, distributed weapons/sensor coordination, real-time operations and improved mission planning.

C4ISR STO-6: Combat Classification and Identification

Rapid and accurate combat classification and identification are paramount in any battlespace with both cooperative and non-cooperative targets. With joint engagements, coalition efforts, non-state combatants and asymmetric threats rapid and accurate combat classification and identification are becoming increasingly difficult, even amongst Joint and Coalition forces.

Develop technologies for improved combat classification and identification against all classes of targets to enable target engagement at longer ranges, reduce fratricide incidents and avoid engagement of non-hostile targets.

5.0 ENTERPRISE AND PLATFORM ENABLERS

5.1 Enterprise and Platform Enablers (EPE) Capability Gap

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

EPE STO-1: Enterprise, Platform and Weapon Enablers

Enterprise, platform and weapon enablers provide the technology base and options which can dramatically affect future capabilities, maintain critical U.S. S&T capacity, and develop the next generation of the S&T workforce. The portfolio, by design, has a broad focus and applicability across multiple platforms and systems. Pervasive research areas such as (but not limited to) advanced propulsion and power (including hypersonic capability), advanced material development, omniscient intelligence, and systems integration (to include carrier integration) should be considered as key elements of this objective.

Develop new technologies to enable legacy and future systems to provide long range, persistent, flexible and responsive capabilities assisting and strengthening our forces, allies and partners and deterring or striking hostile forces.

5.2 System Safety, Availability and Affordability Enablers (SSAA) Capability Gap

***The Vision:* Utilize advanced technology to improve safety, reduce cost and improve reliability of Naval operations and platforms.**

SSAA STO-1: System Safety and Availability

Improvements in system safety, inspection techniques and maintenance procedures can enhance long term mission performance and availability.

Develop, integrate and transition technologies to improve system safety, increase availability, extend useable service life, reduce maintenance actions and reduce environmental impacts on operations, basing and training.

SSAA STO-2: System Affordability

All of the Navy's forward presence and Sea Strike firepower depend on Navy systems. The platforms that perform this critical function span in age from 50 years of service to new systems that will remain in the Fleet for the next 30 years. To ensure the affordability of all of these systems, it is important to find innovative methods to reduce support and acquisition costs associated with maintaining systems throughout their life cycle.

Develop and implement methods and technologies that predict and identify performance problems and reduce the development, support, maintenance and acquisition costs of Naval systems, including air platforms, weapons, training systems and aircraft carriers.

6.0 SEA WARRIOR

6.1 Naval Warrior Performance (NWP) Capability Gap

***The Vision:* Sustain warfighter performance and enhance decision making through optimized protection, training technologies, integration, and health/casualty management.**

NWP STO-1: Training and Education

Increasing mission complexity, asymmetric warfare emphasis, high live/range exercise costs, and growing Fleet Response Plans (FRP) all require new metrics-driven processes, high-fidelity training environments, and fully linked training and readiness (T&R) competencies to achieve aircrew/maintainer qualifications and proficiency while reducing life-cycle cost drivers. The rapid creation of combat readiness and operational proficiency, while optimizing the use of live, virtual, and constructive assets, is required.

Develop education and training technologies to cost-effectively maximize transfer of knowledge from the classroom and trainer to the operational environment.

NWP STO-2: Improved Warrior Performance

Operator workload in a non-optimized data rich environment degrades effectiveness, resulting in slowed decision making with potential for increased human error.

Develop technologies to reduce operator workload, mitigate stress (physiological and psychological) and improve warfighter performance and effectiveness.

NWP STO-3: Warfighter Protection

Current technologies were designed as stand alone systems that do not adequately protect or enhance survivability of the individual warfighter.

Develop state-of-the-art life support technologies and protective devices to optimize warfighter performance, effectiveness, safety, and survival.

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Acronyms

ASW	Anti-Submarine Warfare
ASCM	Anti-Ship Cruise Missile
BLOS	Beyond Line-of-Sight
BOD	Board of Directors
C2	Command and Control
C3I	Command, Control, Communications, and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Reconnaissance and Surveillance
CAS	Close Air Support
CFFC	Commander, US Fleet Forces Command
CIWS	Close-In Weapon System
CM	Cruise Missile
CNAF	Commander Naval Air Forces
CTO	Chief Technology Officer
DEAD	Destruction of Enemy Air Defense
DEF	Deploy and Employ Forces
DoD	Department of Defense
DRFM	Digital Radio Frequency Memory
EA	Electronic Attack
EMP	Electromagnetic Pulse
EPE	Enterprise Platform Enablers
FP	Force Protection
FRP	Fleet Response Plan
IADS	Integrated Air Defense System
ID	Identification
IED	Improvised Explosive Device
ILS	Integrated Logistics Support
IPB	Intelligence Preparation of the Battlefield
IPT	Integrated Program Team
ISR	Intelligence, Surveillance and Reconnaissance
LACM	Land Attack Cruise Missile
MLS	Multi Level Security
N88	Director, Air Warfare
NAE	Naval Aviation Enterprise
NATO	North Atlantic Treaty Organization
NAVAIR	Naval Air Systems Command
NAWC	Naval Air Warfare Center
NCW	Network Centric Warfare
NRE	Naval Research Enterprise

NRL	Naval Research Laboratory
NWP	Naval Warrior Performance
ONR	Office of Naval Research
OPNAV	Office of the Chief of Naval Operations
O&S	Operations and Sustainment
OTM	On the Move
PLM	Product Line Manager
R&D	Research and Development
RCS	Radar Cross Section
RF	Radio Frequency
SA	Situational Awareness
SAM	Surface to Air Missile
SCAR	Strike Coordination and Reconnaissance
SEAD	Suppression of Enemy Air Defenses
SSAA	System Safety, Availability and Affordability
S&T	Science and Technology
STK	Strike Operations
STO	Science and Technology Objective
SUW	Surface Warfare
TAMD	Theater Air and Missile Defense
TBM	Theater Ballistic Missile
T&R	Training and Readiness
US	United States
USW	Under Sea Warfare

Appendix A

STRATEGY FRAMEWORK

The Naval Aviation Enterprise represents the entire Naval aviation community and is organized to provide cost-effective readiness to the Fleet. 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 1.

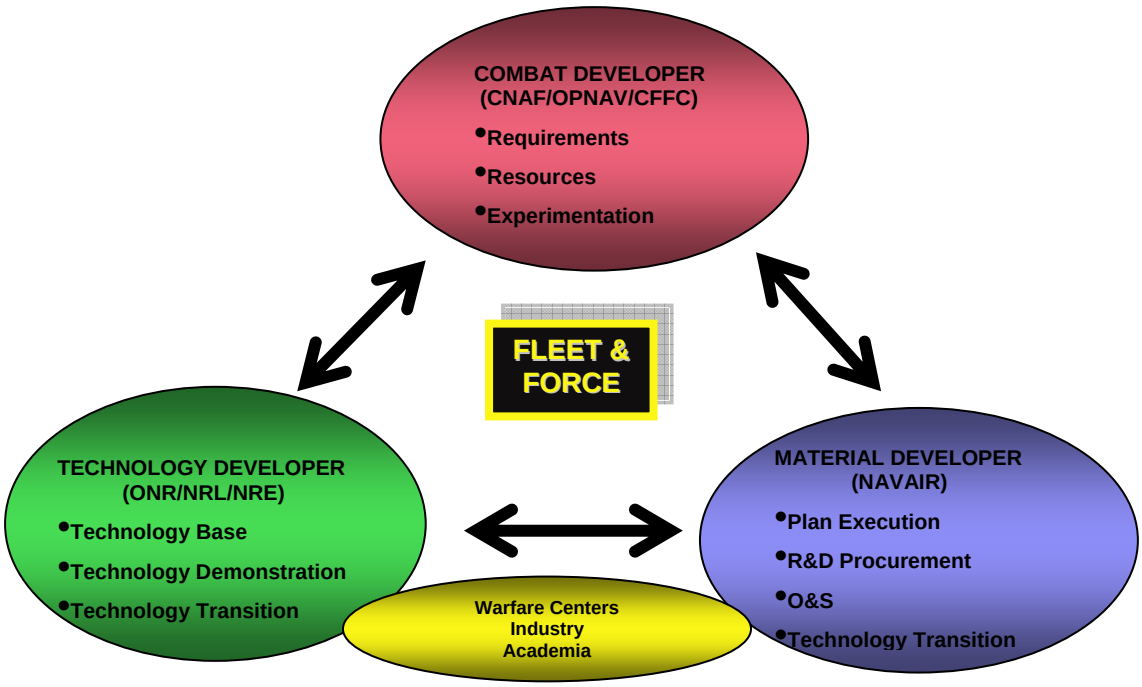

Figure 1 – The Naval Aviation S&T Enterprise

The principal elements - 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.

Technology development is principally performed by the numerous elements of the Naval Research Enterprise (NRE), including the Office of Naval Research (ONR) and the Naval Research Laboratory (NRL). Other technology developers – including the Defense Advanced Research Projects Agency (DARPA) and commercial industry – provide significant technology development solutions. All of these technology developers create the Navy's technology base, perform technology demonstrations, provide resources, and play a critical role in technology transition.

Material development is led by Naval Air Systems Command (NAVAIR) whose functions include plan execution, research and development (R&D), acquisition, 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.

STO Development. The STOs were developed in alignment with the Navy's top level vision document, Sea Power 21; the STOs also align with other key strategy documents, which provide guidance for Navy and Marine Corps missions, force capabilities, and technology needs in the context of DoD goals. These documents included the *Navy Strategic Plan, Naval Aviation Vision, NAE Capability Needs 2030 to 2050,* and the *Naval S&T Strategic Plan.* Other defense science and technology plans – including the US Marine Corps S&T Strategic Plan, the Army Science and Technology Master Plan and the DoD Research and Engineering Strategic Plan – were referenced to ensure that defense S&T priorities were understood and opportunities for collaboration were identified.

Throughout the DoD, there is a need for closer collaboration between concept developers and technology planners to allow early consideration of longer term technological opportunities and the co-evolution of the doctrine, organization and training needed to turn technology into materiel and materiel into usable capabilities[4]. The STOs were derived from capability gaps submitted by warfighters, the intelligence community and technologists. Multiple commands were canvassed for future Navy warfighting requirements, gaps, and needs; the responses were articulated from varying viewpoints, timeframes, and risk tolerance levels and encompassed elements of technology surprise and S&T opportunities (or "tech push"). The responses were assessed and assimilated to produce eleven capability gap areas. The STOs address the aggregated

[4] Defense Science Board 2006 Summer Study, "21st Century Strategic Technology Vectors", Vol III, Strategic Technology Planning, February 2007, pg 66

capability gaps, and form the basis for technology thrusts that will serve as the execution plan for the maturation of the technologies to respond to current and future operational capability gaps.

The STOs are in turn used by the Office of Naval Research (ONR) and other technology providers, teamed with the NAE's material developers, to identify thrusts and projects. The NAE CTO will be responsible for the identification of capability gaps and STOs.

Align-Invest-Measure. The NAE STOs will be a critical element used in developing the Naval Aviation S&T Strategic Investment Plan. Roadmaps within the plan will summarize the proposed S&T investment and current S&T projects that support each NAE S&T objective. Successful completion of STOs will close capability gaps identified by the Naval aviation requirement sponsors.

Figure 2 is a visual representation of how S&T projects evolve into warfighting capabilities.

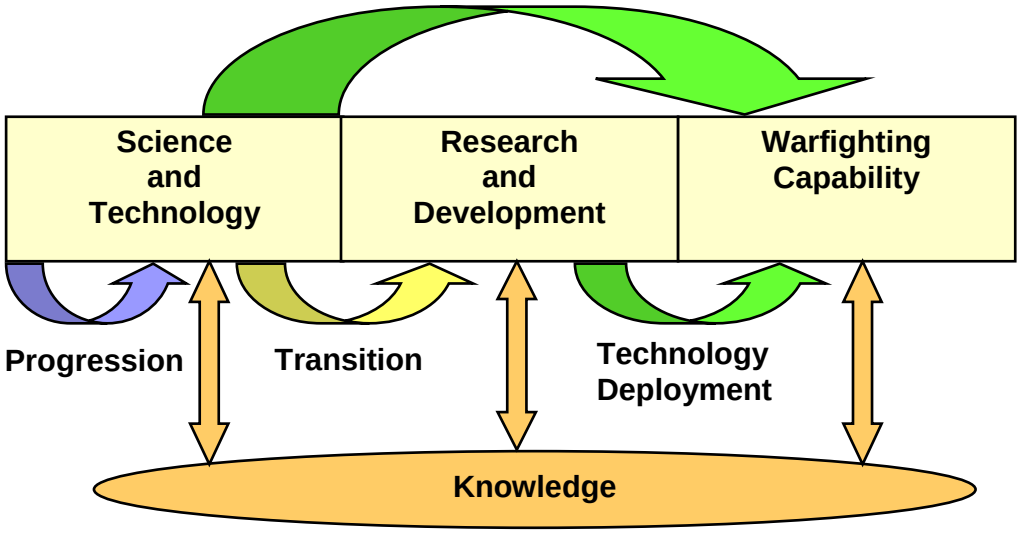

Figure 2
Progression of S&T to the Warfighter

Appendix B

Alignment of NAE STOs to Sea Power 21 Pillars

Pillar	STO Number	STO Title
Sea Shield		
	FP STO-1	Platform Survivability
	FP STO-2	Mine and IED Detection and Neutralization
	FP STO-3	Electronic Protection
	SUW STO-1	Maritime Surveillance and Interdiction
	USW STO-1	Environmental sensing, assimilation
	USW STO-2	Wide Area Search and Detection
	USW STO-3	Precision Localization/Identification/Attack
	TAMD STO-1	Anti-Air Warfare Performance
	TAMD STO-2	Airborne Missile Defense
Sea Strike		
	STK STO-1	Persistent capability to engage time critical targets
	STK STO-2	Stand-off capability against mobile targets
	STK STO-3	Covert strike capability
	STK STO-4	Unmanned strike capability
	STK STO-5	Airborne Electronic Attack (EA)
	STK STO-6	Suppression of Enemy Air Defense (SEAD) / Defeat of Enemy Air Defense (DEAD)
	STK STO-7	Enhanced Close Air Support (CAS) / Strike Coordination and Reconnaissance (SCAR)
Sea Basing		
	DEF STO-1	Inter-theater deployment
	DEF STO-2	Improved Vertical Delivery – Air Vehicle
	DEF STO-3	Improved Vertical Delivery – Systems enhancements
	ILS STO-1	Enhanced Logistical Support of Joint Assets
FORCEnet		
	C4ISR STO-1	Battlespace Awareness
	C4ISR STO-2	Information Security / Information Awareness
	C4ISR STO-3	Communications and Networks
	C4ISR STO-4	Persistent Target Detection, Discrimination, Identification and Targeting
	C4ISR STO-5	Tactical Decision Support
	C4ISR STO-6	Combat Classification and Identification

Pillar	STO Number	STO Title
Enterprise and Platform Enablers		
	EPE STO-1	Enterprise, Platform and Weapon Enablers
	SSAA STO-1	System Safety and Availability
	SSAA STO-2	System Affordability
Sea Warrior		
	NWP STO-1	Training and Education
	NWP STO-2	Improved Warrior Performance
	NWP STO-3	Warfighter Protection

Appendix C: Alignment of NAE STOs to Joint Capability Areas

	Force Application	Command & Control	Battlespace Awareness	Net-Centric	Protection	Logistics	Force Support	Corporate Management & Support	Building Partnerships
FP STO-1 **Platform Survivability**					X			N/A	N/A
FP STO-2 **Mine and IED Detection and Neutralization**					X			N/A	N/A
FP STO-3 **Electronic Protection**					X			N/A	N/A
SUW STO-1 **Maritime Surveillance and Interdiction**	X						X	N/A	N/A
USW STO-1 **Environmental Sensing, Assimilation and Tactical Decision Aids**	X	X	X					N/A	N/A
USW STO-2 **Wide Area Search/Detection**	X	X	X					N/A	N/A
USW STO-3 **Precision Localization / Identification / Attack**	X		X					N/A	N/A
TAMD STO-1 **Anti-Air Warfare Performance**	X				X			N/A	N/A
TAMD STO-2 **Airborne Missile Defense**	X				X			N/A	N/A

Appendix C: Alignment of NAE STOs to Joint Capability Areas

	Force Application	Command & Control	Battlespace Awareness	Net-Centric	Protection	Logistics	Force Support	Corporate Management & Support	Building Partnerships
STK STO-1 **Persistent Capability to Engage Time Critical Targets**	X							N/A	N/A
STK STO-2 **Standoff Capability Against Mobile Targets**	X							N/A	N/A
STK STO-3 **Covert Strike Capability**	X							N/A	N/A
STK STO-4 **Unmanned Strike Capability**	X							N/A	N/A
STK STO-5 **Airborne Electronic Attack**	X							N/A	N/A
STK STO-6 **Suppression of Enemy Air Defense / Destruction of Enemy Air Defense (SEAD/DEAD)**	X				X			N/A	N/A
STK STO-7 **Enhanced Close Air Support (CAS) / Strike Coordination and Reconnaissance (SCAR)**	X							N/A	N/A
DEF STO-1 **Inter-theater Deployment**						X	X	N/A	N/A
DEF STO-2 **Improved Vertical Delivery - Air Vehicle**						X	X	N/A	N/A
DEF STO-3 **Improved Vertical Delivery - Systems Enhancements**						X	X	N/A	N/A
ILS STO-1 **Enhanced Logistical Support of Joint Assets**						X	X	N/A	N/A

Appendix C: Alignment of NAE STOs to Joint Capability Areas

	Force Application	Command & Control	Battlespace Awareness	Net-Centric	Protection	Logistics	Force Support	Corporate Management & Support	Building Partnerships
C4ISR STO-1 **Battlespace Awareness**	X	X	X	X				N/A	N/A
C4ISR STO-2 **Information Security / Information Assurance**		X		X				N/A	N/A
C4ISR STO-3 **Communications and Networks**		X		X				N/A	N/A
C4ISR STO-4 **Persistent Target Detection, Discrimination, Identification, and Targeting**	X	X		X				N/A	N/A
C4ISR STO-5 **Tactical Decision Support**		X		X				N/A	N/A
C4ISR STO-6 **Combat Classification and Identification**		X		X				N/A	N/A
EPE STO-1 **Enterprise, Platform and Weapon Enablers**	X	X	X	X	X	X	X	N/A	N/A
SSAA STO-1 **System Safety and Availability**						X	X	N/A	N/A
SSAA STO-2 **System Affordability**						X	X	N/A	N/A
NWP STO-1 **Training and Education**							X	N/A	N/A
NWP STO-2 **Improved Human Performance**							X	N/A	N/A
NWP STO-3 **Warfighter Protection**					X		X	N/A	N/A

Appendix D: Alignment of NAE STOs to ONR Focus Areas

	Power & Energy	Operational Environments	Maritime Domain Awareness	Asymmetric & Irregular Warfare	Information Analysis and Communication	Power Projection	Assure, Access & Hold At Risk	Distributed Operations	Naval Warrior Performance & Protection	Survivability & Self Defense	Platform Mobility	Fleet/Force Sustainment	Affordability, Maintainability & Reliability
FP STO-1 Platform Survivability										X			
FP STO-2 Mine and IED Detection and Neutralization				X						X			
FP STO-3 Electronic Protection										X			
SUW STO-1 Maritime Surveillance and Interdiction			X	X			X						
USW STO-1 Environmental Sensing, Assimilation and Tactical Decision Aids		X					X						
USW STO-2 Wide Area Search/Detection			X				X			X			
USW STO-3 Precision Localization / Identification / Attack				X		X	X			X			
TAMD STO-1 Anti-Air Warfare Performance						X				X			
TAMD STO-2 Airborne Missile Defense						X				X			

Appendix D: Alignment of NAE STOs to ONR Focus Areas

	Power & Energy	Operational Environments	Maritime Domain Awareness	Asymmetric & Irregular Warfare	Information Analysis and Communication	Power Projection	Assure, Access & Hold At Risk	Distributed Operations	Naval Warrior Performance & Protection	Survivability & Self Defense	Platform Mobility	Fleet/Force Sustainment	Affordability, Maintainability & Reliability
STK STO-1 Persistent Capability to Engage Time Critical Targets			X	X	X	X	X						
STK STO-2 Standoff Capability Against Mobile Targets			X	X	X	X	X						
STK STO-3 Covert Strike Capability			X	X	X	X	X						
STK STO-4 Unmanned Strike Capability			X	X	X	X	X						
STK STO-5 Airborne Electronic Attack					X	X	X						
STK STO-6 Suppression of Enemy Air Defense / Destruction of Enemy Air Defense (SEAD/DEAD)					X	X	X						
STK STO-7 Enhanced Close Air Support (CAS) / Strike Coordination and Reconnaissance (SCAR)			X	X		X							
DEF STO-1 Inter-theater Deployment				X				X				X	
DEF STO-2 Improved Vertical Delivery - Air Vehicle				X				X				X	
DEF STO-3 Improved Vertical Delivery - Systems Enhancements				X				X				X	
ILS STO-1 Enhanced Logistical Support of Joint Assets								X				X	X

Appendix D: Alignment of NAE STOs to ONR Focus Areas

	Power & Energy	Operational Environments	Maritime Domain Awareness	Asymmetric & Irregular Warfare	Information Analysis and Communication	Power Projection	Assure, Access & Hold At Risk	Distributed Operations	Naval Warrior Performance & Protection	Survivability & Self Defense	Platform Mobility	Fleet/Force Sustainment	Affordability, Maintainability & Reliability
C4ISR STO-1 Battlespace Awareness			X		X								
C4ISR STO-2 Information Security / Information Assurance			X		X								
C4ISR STO-3 Communications and Networks			X		X			X					
C4ISR STO-4 Persistent Target Detection, Discrimination, Identification, and Targeting			X		X		X						
C4ISR STO-5 Tactical Decision Support			X		X		X	X					
C4ISR STO-6 Combat Classification and Identification			X		X		X	X					
EPE STO-1 Enterprise, Platform and Weapon Enablers	X	X	X	X	X	X	X	X	X	X	X	X	X
SSAA STO-1 System Safety and Availability	X											X	X
SSAA STO-2 System Affordability	X											X	X
NWP STO-1 Training and Education									X			X	
NWP STO-2 Improved Human Performance									X			X	
NWP STO-3 Warfighter Protection									X			X	