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● THE 1997 SCIENCE AND TECHNOLOGY REQUIREMENTS GUIDANCE (STRG) ●

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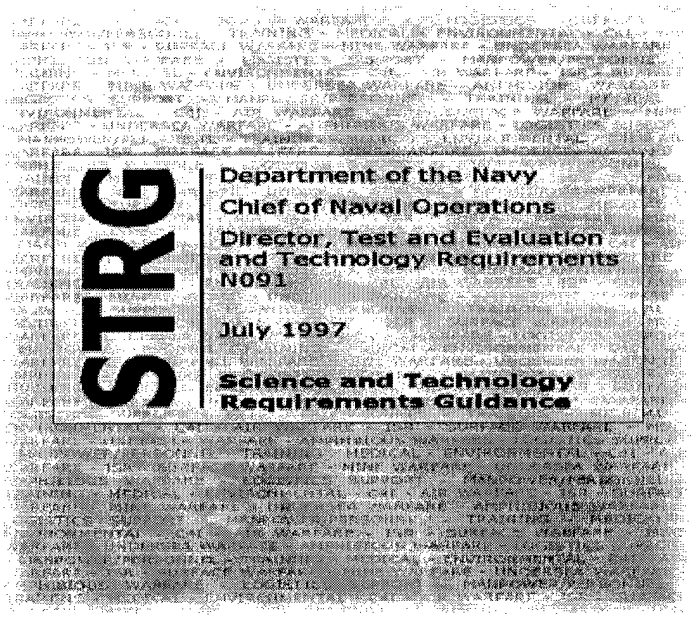

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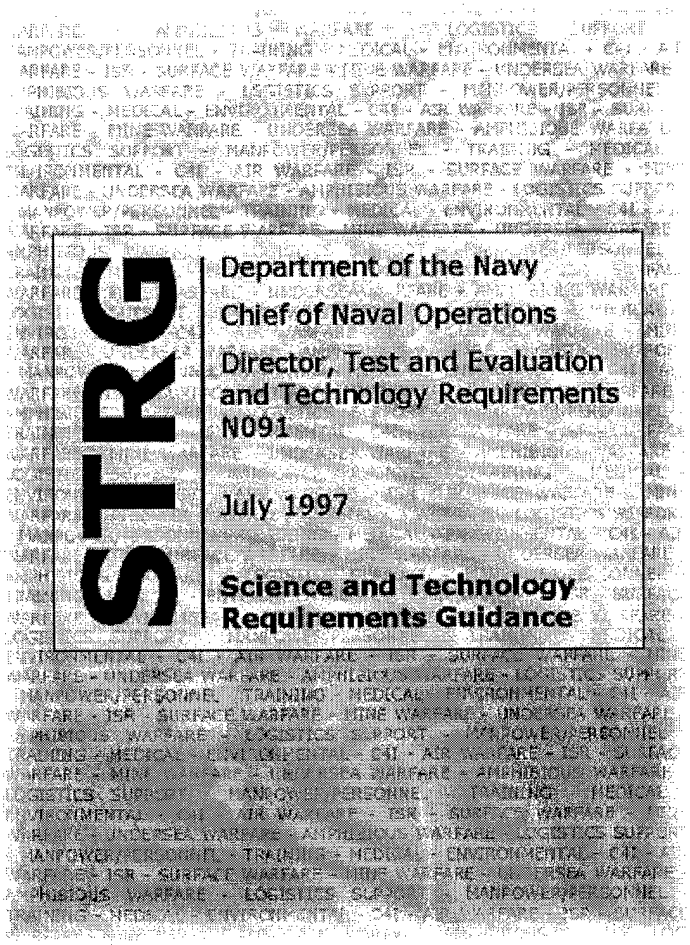
1997 Department of the Navy Science and Technology Requirements Guidance (STRG)



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EXECUTIVE SUMMARY

●The Department of the Navy *Science and Technology Requirements Guidance* - the *STRG* - is published each year by the Director, Test and Evaluation and Technology Requirements (CNO-N091) to provide guidance to the Office of Naval Research for the development of the Navy's science and technology investment plan. The Round Tables convened as part of this process are used by N091 as a forum to enhance and encourage communications between OPNAV, the Fleet and the technical community. Round Table I for 1997 was designed to build on the success of the *1996 STRG,* with the goal of refining and improving the focus of the document to provide a sound basis for long range science and technology investment planning.

●Requirements priorities for each of the functional area chapters were established using a groupware voting system. Priorities are grouped into three broad tiers in each chapter. These priorities are guides to the Office of Naval Research (ONR) for developing the science and technology investment strategy. Final decisions for future funding priorities will be made on the basis of the existing investment strategy, leveraged investments of other services and agencies, and the state-of-the-art in available science and technology capabilities.

●Overarching concerns of the 1997 Round Table I were the issues of 'enabling' technologies - Human performance; Affordability; Logistics; and Command, Control and Communications; - all aimed at extracting maximum advantage from new weapons and platform technologies, reducing the confusion created by the ever-increasing data assimilation pressures placed on operators and enabling reduced manning throughout the fleet. Platform and resource sponsors and the fleet have been developing new concepts of operation within all of the functional areas. The following Functional Area descriptions summarize the contents of the Functional Area Chapters which form the body of the *STRG.*

Command, Control, Communications and Computers:

●C4 is the primary enabler of modern warfare concepts. The chapter focuses on: connectivity for all forces and all data types; battlefield web systems; sensor and systems integration with attention to workload of the man in the loop; combat identification (ID) and battle damage assessment to support tactical picture; data fusion and processing for common tactical picture and situational awareness; man-machine interface enhancement; interoperability enhancements; information warfare.

Intelligence, Surveillance and Reconnaissance:

●The corollary enabler to C4 is ISR. It must provide: situational awareness and hostile intent indications; management of data stream/data bases and decision aids; target ID and battle damage assessment; theater-wide target, track and fire control; improved sensors at all wave lengths for all environments.

Air Warfare:

●The Air Warfare operational concepts require: improved weapons and sensors, especially detection and targeting capabilities, and lethality to enhance precision strike capability; airframe maintainability and survivability for long life cycle employment ensuring affordability through reduced life cycle costs; reduced platform vulnerability through stealth, agility and systems improvements; and, finally, reduced manpower requirements and improved training for mission rehearsal, as well as systems expertise.

Surface Warfare:

●Surface warfare has defined new operational concepts over the past two years. Major goals include: provision of precision fires for support of land forces and precision strike at extended ranges; sensors and non-lethal systems for maritime interdiction roles; reduced vulnerability and increased self-defense capabilities; reduced ship's signatures at all wave lengths; theater ballistic missile defense (TBMD); enhanced platforms with lower life cycle costs; innovative weapons; and ability to dominate the battlespace.

Mine Warfare:

●Mines continue to be a significant operational factor in emerging warfare concepts. Required to deal with the threat

are: mine and minefield surveillance and intelligence; rapidly deployable and covert survey systems; sensors for all environments; organic systems; in-stride neutralization and unmanned systems; minefield control; and knowledge of seafloor and mine-like objects.

Undersea Warfare:

●Undersea warfare has increased its focus on: stealth and survivability against air-independent diesel electric submarines in the littorals through reduced signatures and more flexible operating envelopes (quick reaction attack and evasion); on-board and off-board sensors and weapons for the littorals; enhanced undersea communications (e.g., Joint Task Group (JTG) connectivity); unmanned underwater vehicles (UUV) for minefield and covert reconnaissance; enhanced strike capability; affordability through reduced manning and enhanced training.

Amphibious Warfare:

●The re-write of this functional area this year places emphasis on: emerging operational concepts for operational maneuver from the sea, and ship to objective maneuver; linkages to Logistics, Training and C4; as well as Naval surface fire support (NSFS) to support forces ashore; and improvement of SOF capabilities.

Logistics Support:

●Logistics is a critical enabler in all new operational concepts. This chapter addresses: affordability through life cycle cost reduction - condition based maintenance and improved materials for systems and infrastructure; increased capabilities for over the shore and combat logistics force/underway replenishment (CLF/UNREP); reduced vulnerabilities during operations; and improved energy usage.

Manpower and Personnel:

●The objective of the Manpower and Personnel Mission Area, and it's closely linked partner, Training, is to deliver the right person, at the right time and the right place with the required training and skills to satisfy Navy warfighting requirements. A prerequisite to accomplishing this objective is effective Human System Integration (HSI) which is the incorporation of human performance capabilities and constraints into the task analysis and function allocation process conducted during system design.

Training:

●The Navy's training vision is to be capable of delivering quality training to the right people at the right time and at the right place as part of a career long training continuum supporting Navy operational readiness and personnel excellence. This demands innovative approaches to instructional methods and in situ/embedded capabilities that will enhance delivery and feedback in instruction. Also required are systems and methodologies to manage training resources efficiently.

Medical/Personnel Protection:

●The objectives of the medical technology area are to maximize health, safety and mission performance of military personnel. Traditional roles have centered around supporting the combat readiness of the Navy and Marine Corps by supporting global medical requirements to accomplish the mission. As the nature of deployment for combat troops changes, so must medical support. Consequently, preventive medicine practiced on collective and individual levels, aerospace medicine, human factors and human capabilities in relation to new weapons and platforms are emphasized.

Battlespace Environment and Support:

●Battlespace Environment and Support focuses on the development of technologies, models and systems to provide environmental information, Precise Timing and Astrometry (PTA), and Meteorological and Oceanographic forecasts and weapons effects data to Naval Forces afloat and ashore in support of their operations. Environmentally compliant platforms and control of materials and processes ashore and afloat are critical for future operational scope and for meeting legal restrictions.

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BACKGROUND

Purpose

●The Department of the Navy Science and Technology Requirements Guidance (*STRG*) is published each year by the Director, Test and Evaluation and Requirements (CNO-N091) to provide guidance to the Office of Naval Research (ONR) for the development of the Navy's science and technology investment plan. The Round Tables convened for this process are used by N091 as a forum to enhance and encourage communications between OPNAV, the Fleet and the technical community.

Science &Technology Requirements Definition

●The Department of the Navy (DoN) established a process in 1994 to improve the identification, prioritization and communication of mid-term to long-term S&T requirements in support of the naval mission and evolving concepts of operation. This process consists of a pair of annual Round Tables: Round Table I, which establishes the requirements, and Round Table II, which reviews the investment strategy developed in response to those requirements. The 1997 Round Table again brought together knowledgeable senior military officers and civilian technical advisors from the various fleet commands, platform sponsors, and Joint Mission Area/Support Area communities. Participants provided operational level information as well as higher level policy perspectives. In addition to developing a prescribed set of products, Round Table participants: exchanged views; identified operational goals and functions across the naval community; developed understanding of definitions, needs, functions, and S&T gaps; facilitated communication; built consensus; and focused on the community's long-term S&T needs. The results of this process are found within this document.

●The S&T Round Table process was inaugurated in FY-94 and its Science and Technology Requirements Guidance (*STRG*) document was first published as a formal document in 1995. The 1995 process was organized around the Joint Mission Area/Joint Support Area structure. In 1996, the requirements process was restructured to minimize repetition of mission needs and thereby provide a better correlation to the investment of S&T resources. To accomplish this, the requirements were reviewed within functional areas (e.g., Air Warfare, Surface Warfare). This approach has also made it easier to relate requirements and investment strategies to other needs statements and investment decisions.

●The *1997 STRG* continues this approach to the Round Table, building on the *1996 STRG* to ensure continuity and stability in the investment planning process.

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SCIENCE & TECHNOLOGY REQUIREMENTS OVERVIEW

●Developing requirements for scientific investment has a long and checkered history, and a large variety of methodologies have been developed to meet the goals of different organizations. Unfortunately, most major scientific advances - those serendipitous leaps of insight that lead to quantum steps in capabilities - are seldom the result of directly addressing requirements. And worse, these jumps are often seen as disruptive of the evolutionary *status quo.* However, once these leaps have been made - the laser arising from Navy sponsored microwave studies in the fifties for example - applications begin to proliferate, and for each application there is usually a predictable and traceable evolution of the technology in sophistication and capability. Developing an investment strategy must follow both of these paths. A successful strategy must provide stability and protect resources for the disruptive quantum leaps, while charting pathways for the capabilities needed to meet future operational concepts - requirements pathways which can guide the evolution of the consequent applications. The DoN *Science and Technology Requirements Guidance (STRG)* defines this evolutionary pathway, and also calls on the Navy investment strategy to foster the technological surprises for the future. As detailed below, each of the Department of Defense (DoD) and Department of the Navy (DoN) guidance documents adopts a science and technology taxonomy for its review that is in keeping with the mission of the organization. The *STRG* derives explicitly from the Navy vision and concepts of operation which address the Naval missions within the DoD objectives and strategies. Fundamental to all of these documents is the reliance on technological superiority for all U.S. forces.

Department of Defense Science and Technology Strategy

●*Joint Vision 2010* (JCS,1996) calls for the achievement of "Full Spectrum Dominance" to be reached through the leveraging of Information Superiority and Technological Advances to enable the operational concepts of:

- ●Dominant Maneuver
- ●Precision Engagement
- ●Full Dimensional Protection
- ●Focused Logistics

●Achieving *Joint Vision 2010* will depend on the accomplishment of twelve *Joint Warfighting Capability Objectives.* These twelve objectives, developed by the Joint Staff in collaboration with Office of the Secretary of Defense (OSD) and the Service science and technology executives represent the most critical capabilities for maintaining the warfighting advantage of U.S. forces. Table I shows the relationship of the *Joint Warfighting Capability Objectives (JWCOs)* to the Joint Vision 2010 concepts.

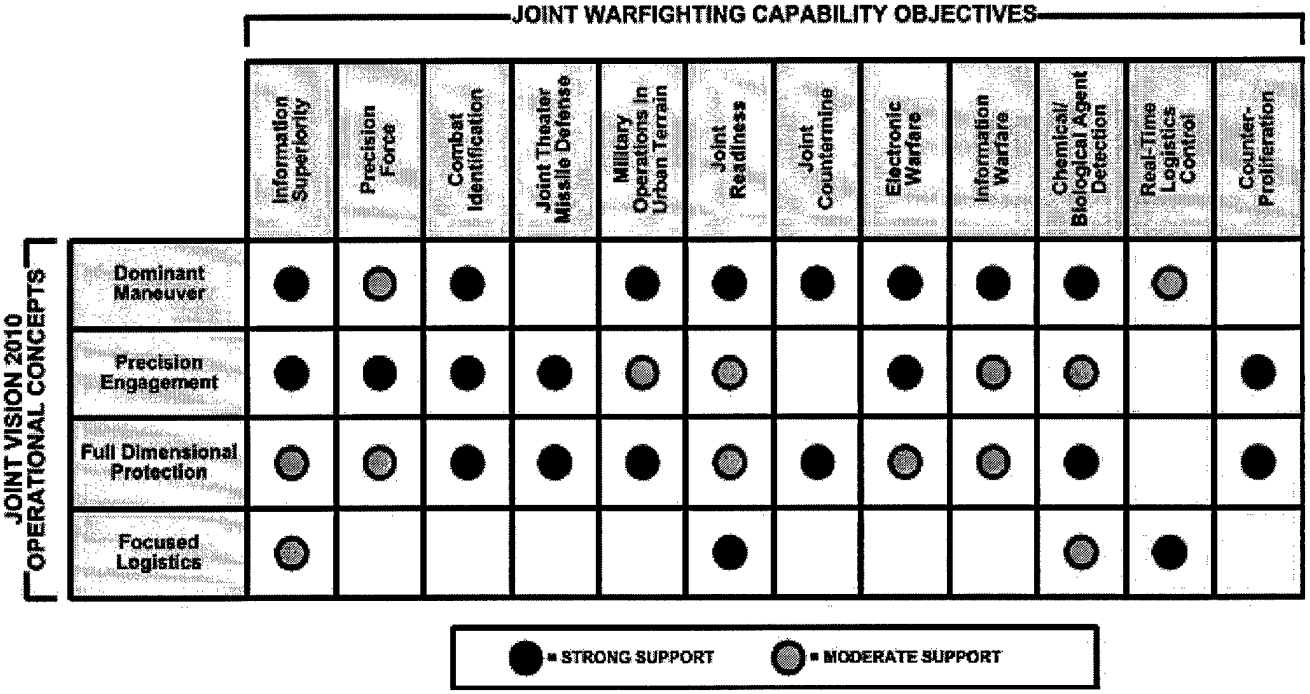

Table I. Relationship between Joint Vision 2010 and the Joint Warfighting Capability Objectives

●The Director, Defense Research & Engineering (DDR&E) addresses the responsibility for continued technological superiority through a review process which defines the components of the Defense Science and Technology Strategy in the *Defense Basic Research Plan,* the *Defense Technology Area Plan* and the *Defense Technology Objectives* (DDR&E, 1996). These plans provide a cross-cutting perspective on Service and Defense Agency technology development showing how they contribute to achieving the Chairman of the Joint Chiefs of Staff's *Joint Vision 2010.*

●The *Defense Basic Research Plan* provides a DOD investment strategy which is discipline based, and which incorporates the goals of a world class, multifaceted research program maintained through a flexible and balanced investment portfolio. Within this program the Services must sustain essential research infrastructure and conduct visionary planning and resource constrained prioritization. DDR&E outlines twelve broad research areas(Footnote 1) for investment and highlights six Strategic Research Objectives(Footnote 2) as part of the long-term diverse research and education agenda. This guidance is directed to the Services' basic research (6.1) investments.

●The *Defense Technology Area Plan (DTAP)* uses a systems based structure to document the focus, content and principal objectives of the Services science and technology efforts. The *Technical Area Review Assessments (TARA)* review the quality and progress of programs, and document cross-Service relations and leverage in the S&T investment. The DTAP and TARA review the programs in ten Technology Areas.(Footnote 3) This guidance is focused on the Services' applied research and advanced development investments (6.2 and 6.3) with a chapter on basic research to maintain connectivity between the technology based and the discipline based investments.

Department of the Navy Guidance

●The DoN *Science and Technology Requirements Guidance* (*STRG*) employs a warfare and support functional structure to address Navy investments in the 6.1, 6.2 and 6.3 budget categories. The *STRG* derives explicitly from the Navy vision and concepts which address the Naval missions within the DoD vision, objectives and strategies. Members of the DoN S&T Round Table bring to the Round Table their command's goals, master plans, mission requirements and views of the future. They use these to build the Navy's S&T requirements. Table II highlights the relationships between the DoN *STRG* and the JCS JWCOs. The Navy requirements are designed to meet Navy needs responding to the joint vision and objectives. These relationships are detailed in Appendix 3. *STRG* support of the Navy Warfare Tasks is detailed in Appendix 4.

●The Department of the Navy *STRG* is constructed from the immediate and anticipated long term needs of the Department of the Navy community. It's origins lie in the emerging concepts of operation with which the Naval forces will operate, and in the changing geopolitical situations in which these forces must carry out their missions. Operational concepts stem from the operational realization of the long range vision of the planners - in this case *"Forward...From the Sea...The Navy Operational Concept"* (SECNAV, 1997), *Joint Vision 2010* (Joint Chiefs of Staff, 1997) and the

National Security Science and Technology Strategy (National Science and Technology Council, 1995). Each of these is fundamentally based on the continued technological superiority of US Forces across the spectrum of future conflict and non-conflict situations. The DoN requirements are also fully aligned with the DoD science and technology investment strategy expressed in the *Defense Basic Research Plan,* the *Defense Technology Area Plan* and the *Defense Technology Objectives* (DDR&E, 1996).

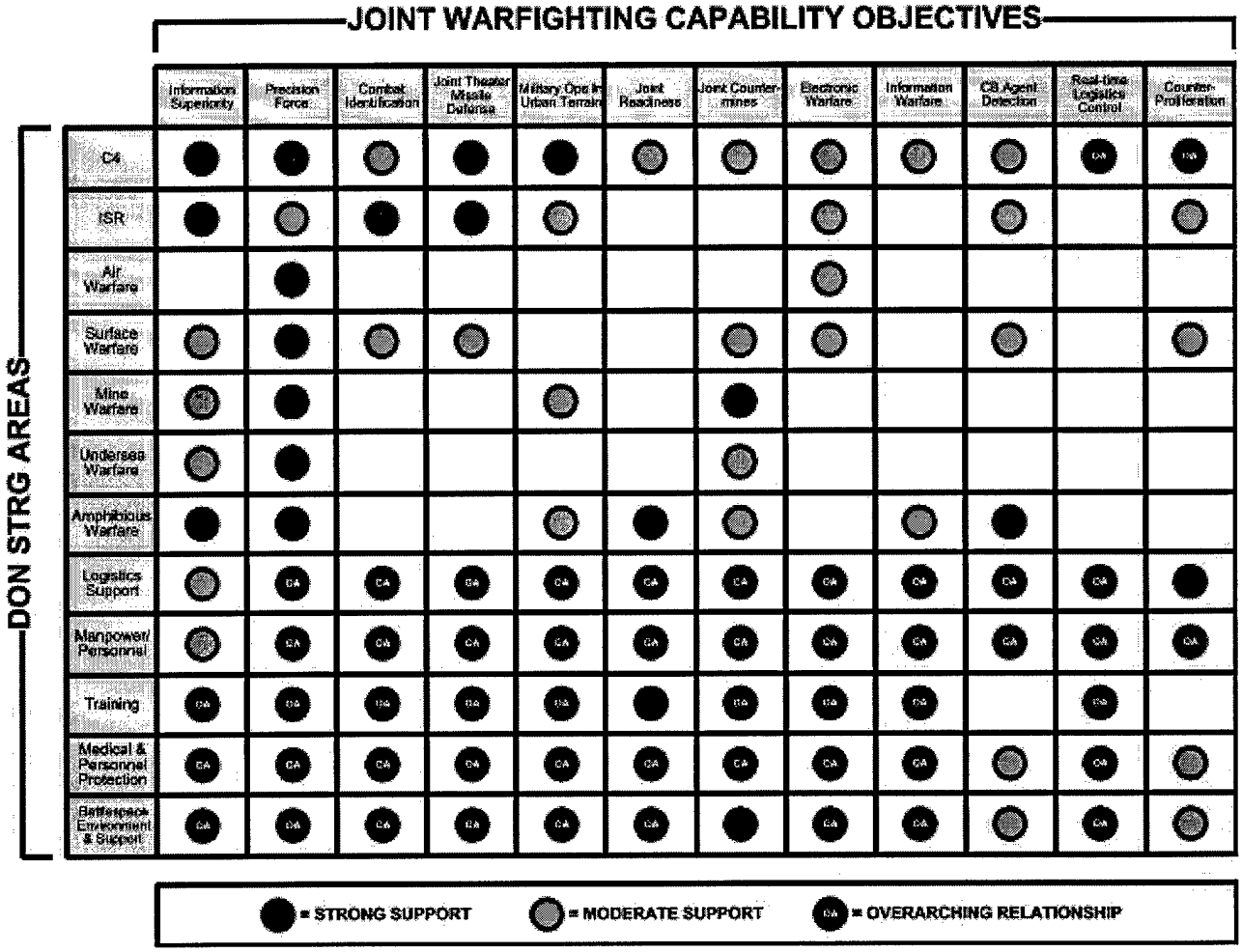

Table II - Relationship of DON S&T Requirements to the JCS Joint Warfighting Capability Objectives

Priorities

●Priorities provide a set of guidelines which allow the design of a sound S&T investment plan. Priorities can be set on the basis of perceived need for the overall Naval mission, perceived need for a specific command or platform sponsor, perceived adequacy of funding, perceived time line for accomplishment, perceived probability of success, or on any number of other metrics. To support a meaningful S&T investment plan, a priority scheme must capture as many of these issues as possible.

●The DoN S&T requirements process separates the two main parts of this problem: a) the setting of requirements, and b) the matching of requirements with resources and opportunities.

●Round Table I identifies priorities in terms of mission needs and capabilities desired and imagined (the more futuristic requirements). Priorities often derive from perceived urgency for mission accomplishment and 'far term' and 'near term' are common modifiers. No emphasis is placed on how achievable a particular goal may be either in terms of fiscal exigencies or the realities of the laws of physics. This is by design. The goal is to set the science and technology community requirements which span a range from five years to two or more decades.

●The *Science and Technology Investment Plan (STIP)* is published by ONR as a response to the *STRG.* The *STIP* is a prelude to Round Table II which provides the basis for the second half of the prioritization process. The *STIP* and Round Table II 1) decide what is feasible within anticipated time lines; 2) describe which priorities should be placed on Navy funding decisions given the investments of other services and agencies; and 3) screen which problems remain

more in the realm of science fiction than of science. Investment decisions for the funding categories 6.3/6.2/6.1 effectively define the 'near' through 'far' term nature of the issues.

•ONR's knowledge of DoD investments and responsibilities defined by DDR&E's *Technology Area Panels* and *Technology Area Review Assessments,* and of investments planned by other agencies (e.g., the National Science Foundation (NSF), the Department of Energy (DOE), commercial independent research and development (IRAD), and international programs) define priorities for the Navy S&T investment in terms of maximizing leverage and minimizing duplication of effort. ONR's technical expertise is the basis for the determination of what approaches are possible, affordable, guard against technological surprise, and provide the greatest probability of success.

•Round Table II is the final review and endorsement of the Navy Science and Technology investment. This Round Table is based on the *STRG* requirements set and on the ONR *STIP* . Endorsement and final guidance from Round Table II will complete the cycle of dialogue between the operators, platform sponsors and the science and technology community.

Overview of Round Table I Prioritization Process

•All requirements presented in the *1997 STRG* are important to one or more of the participating commands and are worthy of investment to ensure success in future Navy and Marine Corps missions. Priorities for planning the investment strategy are presented in the *1997 STRG* in three ways:

1. Requirement priorities in each Functional Area in tiers.
2. Relative weighting of Categories within each Functional Area reflecting the distribution of Requirements in each tier within each Category.
3. Overarching issues of common interest throughout the *1997 STRG.*

Requirements Priorities within Functional Areas

•Within each Functional Area, the Round Table established priorities by a vote of the members facilitated by a groupware system. All votes and voters are mapped and it is possible to examine not only the aggregate vote, but also individual votes and mission or interest group responses whether by the fleet, OPNAV, or JMA working group representatives. The votes were used to establish three tiers (High, Medium and Low) of roughly equivalently size. The Round Table sought approximate, one-third distributions and did not seek break points based on numbers of votes. Presence in the Low tier does not indicate that a requirement is unimportant, only that it is less urgent. All of the requirements in the *STRG* are valid and should be considered for the appropriate level of investment. In a very few cases, post-Round Table shifts were made to represent specific issues more accurately. This was done on a limited case basis and only after discussions with the principal OPNAV sponsor.

•In each of the following chapters in the *1997 STRG*, these priorities are presented in the tables of requirements opposite each requirement in the column headed **Tier** as: **H** (high), **M** (medium) or **L** (low). A parallel column traces the history of the requirement to the *1996 STRG.*

Functional Area Priorities

•The Functional Areas (chapters) in the 1996 *STRG* were ranked based on a weighted vote provided by the Round Table members as part of the pre-Round Table work-up. For 1997 the Round Table felt most emphatically that such a ranking was flawed for most voting schemes, and that the Round Table should not be ranking warfare areas such as *Air* versus *Surface* versus *Submarine.* What did emerge from the 1997 Round Table discussions was an extension of the pattern observed in the 1996 data - which is that the critical enabling functions are of importance to all commands. This pattern of emphasis is driven by the emerging operational concepts of *Forward...From the Sea...The Navy Operational Concept* for operational maneuver from the sea, ship to objective maneuver, distributed forces, and precision fire support (tactical to strategic ranges), coupled with the ongoing draw down in manpower, the need for affordable systems across their life times, and the need to maximize the capabilities of individual sailors. Any voting scheme which allows designation of several high interest areas and keeps all votes of equal weight will return these areas of overarching concern as the top half of the distribution.

•Round Table discussions made it clear that the issue of affordability is an underlying theme to all of future capability needs. Affordability in this context was defined to mean life cycle costs as opposed to simple acquisition costs, and included maintenance, manning, training and best use of resources and personnel. Reduced manning, both afloat and ashore is a major component of affordability and re-emphasizes the required technologies for maximization of human

capabilities, on-demand training and sophisticated manpower management tools. The capabilities of the sensors and the weapons are of great importance, and yet the sophistication of the technology demands more of the man in the loop in all scenarios. Overriding guidance for the Navy Science and Technology investment is that these critical enablers must be addressed and this must be done in consort with the weapons and platforms technologies which will provide the technological edge to our naval forces in future operations.

●The contradictory issues of high tech solutions and contracting budgets were apparent throughout the Round Table discussions. For the fleet it is clear that if research is to provide cost savings it has to address the "less flashy" issues of affordability, maintenance, manpower and training. Affordability also calls on ONR and the operational community to define where and when "enough is enough."

●Command, Control, Communications and Computers and Intelligence, Surveillance and Reconnaissance are dominating themes throughout all functional areas, and indeed through all current visions of future mission capabilities -- whether viewed through the Navy 2020, the Marine Corps Sea Dragon, the Army Force XXI, or Joint Requirements Oversight Committee (JROC) visions. These capabilities are critical enablers for precision strike, operational maneuver from the sea, distributed forces and maximum multiplier effect for advanced technologies in general. Training, especially embedded and distributed training, human factors for human-machine interface, and manpower selection and assignment and logistics for small foot print, just-in-time operations are also pervasive. The Navy's S&T investment plan must ensure that these overarching areas of concern are addressed and linked.

STRG Database

●This year the *STRG* is also available in electronic database format. This format allows the user to perform word searches, and also to view sets of requirements related to the Joint Mission Areas, Joint Warfighting Capability Objectives or Naval Warfare Tasks. With this tool it is possible to parse the *1997 STRG* on the basis of operational concepts and gain an added perspective on the requirements set and, ultimately, on the Navy's S&T investment. Copies of the database are available from:

CNO-N911C
2000 Navy Pentagon
Washington, DC 20350-2000

STRG and the Internet

●The *1997 STRG* is again accessible through the Defense Technical Information Center Home Page and through the DoN Information Network Program Office page (http://www.hq.navy.mil/97strg).

Conclusion

●All of these developments mean that the *process* of the Science and Technology Round Tables and the dialogue which it creates between the operational community and the science and technology community are increasingly critical to the maintenance of technological superiority. It results in the appropriate focusing of the resource investment through the development of understanding of both operational needs and emerging technological opportunities. This *1997 STRG* volume is part of this ongoing dialogue.

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Chapter 1

COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS

Introduction - Command, Control, Communications and Computers (C^4) is the conduit through which U.S. and allied forces act in order to achieve their operational objectives. C^4 elements include: 1) Measures to coordinate, correlate, fuse and employ aggregate capabilities in communications, surveillance, reconnaissance, data correlation, classification, targeting and electromagnetic attack. 2) Measures to direct and control employment of friendly forces. 3) Systems and methods required for the transmission, processing and storage of friendly-force, enemy and environmental data. In short, C^4 is directed toward the reduction of both time and uncertainty as a means of facilitating intelligent decision making.

Requirements Categories - Underlying C^4 are seven sub-categories which are grouped as follows:

1. Connectivity

2. Data Processing

3. Human-Machine Interface

4. Information Warfare

5. Interoperability

6. Command and Control

7. Navigation

1. Connectivity

•Connectivity is the ability to provide a full range of communications services and resources to all users. This includes connectivity for weapons systems effectiveness, high band width communications, and tailored covert communications between all components.

•To enable Dominant Battlespace Awareness/Dominant Battlespace Knowledge (DBA/DBK) in any given operation, connectivity that is secure and resistant to hostile actions must exist at all levels not only in order for warfare commanders to make sound, timely and informed decisions, but also facilitate large volumes of information (e.g., imagery, mission data, video teleconference).

2. Data Processing

•Data processing, by definition, is the processing of data received from both organic and non-organic sources, and is a function by which tactical decisions can be reduced. Data processing is a critical element of DBA/DBK in that data, once received, must be disseminated, sorted, fused and presented in a timely fashion, and must allow the warfighter to easily visualize the information. Current and future data processing requirements include: 1) the ability to provide a clear and comprehensive common tactical picture for all forces that eliminates blue-on-blue and aids accurate navigation; 2) the ability to perform all source data fusion with a high degree of confidence; and 3) the ability to be compatible with other tactical systems.

•This category also includes data management improvements which must be made to provide U.S. warfighters with ready access to information to support mission objectives. Information (tactical, intelligence, METOC, etc.) must be compatible with Joint Service operations, and must be non-exploitable. Provisions must be made to sanitize information in a timely fashion and must be made readily available to the warfighter.

3. Human-Machine Interface

•Human-machine interface refers not only to the ability of a particular system to provide functional aid to a user, but also the ability of the system to help reduce the fog of war by presenting information that is clearly and easily understood. Current and future requirements for human-machine interface must be met by systems that are easily

reconfigured to the warfighters' needs, that are able to "learn" from the user, and that can present the information in such a way as to allow the warfighter to visualize the information quickly during operations.

4. Information Warfare

●Electronic superiority of the battlespace is a critical aspect of battlespace dominance. Information warfare seeks to gain electronic superiority over the enemy by means such as: jamming, disrupting, denying and/or manipulating the enemy's command and control structure while protecting U.S. and allied forces' capabilities to do the same. Current and future needs for information warfare must be fulfilled in order to achieve superiority of the battlespace by creating confusion, overloading and deception of the enemy's C^2 and information infrastructure.

5. Interoperability

●As U.S. forces become more involved in Joint/coalition operations, an imminent need exists for systems to be interoperable. C^4I information must not only be compatible but also interpretable. This interoperability must also incorporate the capability to provide controlled access geared to security levels and needs in an automated manner to facilitate sound, timely and informed decisions by coalition players.

6. Command and Control

●Command and control provides battle management capabilities through improved system architectures, systems of systems, and management of the information flow and feedback through data push and data pull capabilities.

7. Navigation

●The advent of the Global Positioning System (GPS) has greatly increased U.S. forces' capability to navigate accurately. However, the requirement to navigate accurately remains even if GPS is rendered inoperable. Consequently, the need for a precise navigation system is critical in order to provide a backup to GPS, or a successor system once the GPS technology becomes obsolete.

Round Table Results - The Round Table placed greatest importance on connectivity at all levels, data processing for real time common tactical picture, and human-machine interface to deal with the large data volumes provided by the high band width communications.

TABLE I. C4 TECHNOLOGY AREAS

1. CONNECTIVITY	TIER	96 STRG
a. Develop data link technologies to enhance weapon systems effectiveness and battle force commander decision making--i.e., with the following attributes: 1. Over-the-horizon (OTH) capability. 2. Interoperability. 3. Low probability of intercept (LPI). 4. Anti-jam. 5. High Bandwidth. 6. Automatic routing. 7. Secure. 8. Enabling third-party weapons control (incl. Human-in-the-loop). 9. Improved human factors	**H**	**1.1.b**

b. Develop technologies for real-time covert communications between: 1. ships 2. submarines 3. ground platforms 4. air platforms 5. space platforms	**H**	**1.1.d**
c. Develop technologies to extend full range of communications services to all users. 1. Data-transfer: Provide high data-transfer rate to mobile users to support timely re-targeting (air tasking order (ATO) and Tomahawk mission data update (MDU)), imagery, video teleconferencing, etc. 2. Mobility/portability: Provide full communications capability to mobile users. 3. Exploitation of commercial services: Integrate commercial communications services into military networks. 4. Shared-aperture antennas: Reduce the number of antennas aboard ships through development of multi-band, multi-functional antenna. 5. Universal radio: Reduce the number of radio types used in the three services through development of a multi-band, multi-functional, programmable radio. 6. Multimedia communications services: Provide seamless transfer of information in any format (voice, data, imagery, video). 7. Provide real-time communication paths and techniques that work in all environments and have sufficient bandwidth for passing imagery. 8. Create overhead high gain antenna and micro-receivers on individuals 9. Protected: Ensure resistance to communications countermeasures (Anti- jam, anti-spoof, etc.). 10. Reconstitutable: Ensure recovery of communications capabilities following damage or loss (intended or otherwise). 11. Mission Reconfigurable: Provide capability to tailor system characteristics (e.g., wave form) for specific missions. 12. Secure: Provide multilevel information security over all networks. 13. Universal: Develop communication protocols to allow access to services by special users and other users under special circumstances, including language translators. 14. Generate techniques for rapid incorporation of technology.	**H**	**1.1.h**

d. Develop architectures and technologies for distribution: Ensure timely availability of the information the warfighter requires. 1. Improve distribution efficiency through technology (e.g. export agents, compression) and elimination of unwanted duplication. 2. Open Base system architectures on evolving commercial standards that allow affordable system growth in an open environment.	**H**	**1.1.i**
e. Develop technologies for inexpensive and unjammable wide-band communications links to a UAV.	**M**	**1.1.c**
f. Develop technologies to provide assured and survivable communications that support surface and subsurface forces. 1. Build channels that transfer retargeting plans directly from planning authorities to onboard weapons systems. 2. Provide continuous, survivable and interoperable commu-nications across the frequency spectrum for delivery platforms.	**M**	**1.1.g**
g. Develop technologies to allow submarines, aircraft, and ground vehicles to receive extremely high data rate long haul communications through a minimally sized antenna (for example T-3 communication rates through an 8 inch antenna).	**M**	**1.1.o**
h. Provide technologies for ship connectivity with undersea offboard sensors.	**L**	**1.1.f**
i. Develop technologies for world-wide satellite independent secure communications.	**L**	**1.1.m**
j. Develop technologies for real-time communication support for boarding teams.	**L**	**4.8.f**

2. DATA PROCESSING	**TIER**	**96 STRG**
a. Develop technologies to provide deployed units with an appropriate and robust imagery data base, with rapid capability to update the data base (e.g., via routine automated incorporation of the deltas.)	**H**	**1.4.c**
b. Develop technologies to provide real time, concurrent update, control, processing, fusion and dissemination of Battle/Crisis management information. 1. Provide BDI/BDA of quality sufficient to allow operators and strike managers to optimally allocate and re-allocate strike assets. 2. Prioritize information based on accuracy and urgency with operator assistance; prioritize information accuracy and urgency automatically. 3. Provide concurrent update, access control, and dissemination. 4. Provide accurate, real time assessment of the effects of actions in a battle/crisis management situation.	**H**	**1.4.d**

c. Establish the technologies needed to develop and maintain a real-time common tactical picture of all forces, derived from a fusion of multi-sensor and multi-platform data, with the completeness and accuracy to ensure zero BLUE-on-BLUE attacks and ensure that this contributes to navigational safety. 1. Automatic data fusion and force-wide dissemination of the common tactical picture. 2. Ensure compatibility with other tactical data systems through common tactical data bases, common graphical displays, common symbols and common formats. 3. Continue priority emphasis on in situ optimum track routing for all force capabilities to provide viable weather avoidance recommendations and improved precise navigation. 4. Be horizontally and vertically concurrent in real time. 5. Provide a consistent, relevant and scaleable overview to the user. 6. Provide a level of confidence attached to the data which conveys the degree of timeliness, latency and accuracy. 7. Develop techniques to maintain accuracy of data bases during data fill through automated discrepancy flagging, automated validation, and automated identification of potential discrepancies. 8. Be GCCS compatible 9. Provide a universal parser 10. Develop techniques to maintain accuracy of data bases during data fill through automated discrepancy flagging, automated validation, and automated identification of potential discrepancies.	**H**	**1.4.e**

d. Develop expert systems that integrate various intelligence data bases with different standard formats and protocols. Provide ready access to required information databases and sources to support any mission objective: 1. Improve methods to fuse, process, assess and disseminate data. 2. Develop improved decision aids. 3. Develop improved planning methods. 4. Develop database methods not exploitable by unauthorized users. 5. Develop means to maintain data bases. 6. Develop methods to sanitize information automatically. 7. Develop means to include coalition forces. 8. Establish a data highway for access to all sources of information. 9. National (Mapping, Charting, and Geodesy (MC&G); meteorological and oceanographic (METOC); non- traditional, non-combatant sources; joint intelligence; national sensors). 10. Tactical (organic sensors - unit/force/theater). 11. Readiness (plans, status, and capability). 12. Allied/coalition.	**H**	**1.4.h**
e. Develop technologies for a full active/passive Personnel Status Monitor (PSM) with appropriate secure filters.	**L**	**1.4.g**
f. Develop technologies for a sanitization system which allows dissemination of Special Compartmented Information (SCI) intelligence via non-compartmented paths.	**L**	**1.4.i**

3. MAN-MACHINE INTERFACE	**TIER**	**96 STRG**
a. Develop technology for display functionality that is automatically configurable to the user's (warfighter's) needs with minimum human- machine interface. 1. System must be capable of providing automatic correlation /data fusion of organic and non-organic information. 2. System must manage, store, retrieve, and disseminate relevant contact data for timely, optimized and prioritized data display. 3. Human-machine interface must minimize human interaction in producing an optimized display for the tactical situation.	**H**	**1.5.a**

b. Develop tools to allow the analyst to access/manipulate/analyze data more efficiently. 1. Develop capability to retrieve data for fast browsing of data. 2. Develop capability for automated screening/filtering of data. 3. Provide automated capability to recognize target / signal of interest. 4. Provide automated capability to detect/flag changes in area of interest. 5. Adaptive output including multimedia to attract immediate attention of users when necessary but not distracting to the user.	**H**	**1.5.b** **b.2 correlates to 96 STRG 1.6.f**
c. Design "expert agents" as tactical aids that support the employment of weapons and provide an as-soon-as-possible reaction time while enabling correct, flexible decision making and control of weapons.	**H**	**1.5.e**
d. Develop mission planning methodologies and technologies which are simple and easy to use, traceable to commander's requirements, doctrinally correct, and provide for collaborative planning at all levels. 1. All levels share a common planning core in a common operating environment. 2. Sufficient independence of operation environment to permit easy migration to other environments as technology advances. 3. Automatic update (< 2 hrs) of plans to/from next level up/down. Real time, concurrent update to/from next level. 4. Define littoral battlespace in terms of meteorological / oceanographic / MC&G parameters. 5. Develop collaborative planning systems that allow joint/combined forces to operate as effectively as a single unit. 6. Develop systems that simplify the replacement of similar systems from other countries or services. 7. Develop functional modeling techniques to support virtual reality and incorporate them into planning, training, and assessment processes. 8. Develop tactical logistics information system focused on integration and enhancement of Combat Service Support Operations Center (CSSOC) and Mobile CSSOCs for Expeditionary force CSSE management and control.	**H**	**1.5.f**
e. Develop technologies to support integration and development of enhanced modular combat operations centers with standardized procedures and advanced technology displays of tailored information.	**M**	**1.5.g**
f. Develop better ways to visualize information in order to enhance pattern recognition.	**M**	**1.5.h**
g. Develop technologies for voice recognition systems which will be effective in the naval environment.	**M**	**1.5.i**
h. Model the cognitive process to deliver information in such a way to complement the way the brain works and prevent information overload.	**M**	**1.5.k**
i. Develop technologies and methodologies to translate text and speech among several foreign languages and alphabets.	**M**	**1.6.a**
j. Develop technologies to provide aircraft avionics with a virtual reality interface and the capability to learn from the operator.	**L**	**1.5.c**
k. Develop 3-D display Technology for the naval environment.	**L**	**1.5.j**

l. Develop technologies for the miniaturization of C4 equipment to maximize portability and match physical limitations of users.	**L**	**1.5.l**

4. INFORMATION WARFARE	TIER	96 STRG
a. Develop technologies and methodologies for the effective conduct of command and control warfare (C2W). 1. Develop methods for improved protection of C2 assets and techniques. 2. Develop improved methods to detect, locate, and counter enemy C2 assets and methods. 3. Develop C2W measures of effectiveness	**H**	**1.8.a**
b. Develop technologies to intrude upon or disrupt enemy's decision process (e.g. information overload, disinformation)	**H**	**1.8.b**
c. Develop battle damage assessment for C2W deception, disruption, denial and destruction.	**M**	**1.2.d**
d. Develop technologies for portable and deployable systems which will deceive the enemy.	**L**	**1.8.d**

5. INTEROPERABILITY	TIER	96 STRG
a. Develop technologies for the integration, interoperability, of equipment and transfer of C4I information to allied and coalition forces during peacetime presence, crisis, response and wartime operations.	**H**	**1.6.c**
b. Provide technologies to support controlled access to required information geared to user security level and needs. 1. System must provide for multi-level security. 2. Security levels must address access by joint multi-level.	**M**	**1.6.g**

6. COMMAND AND CONTROL	TIER	96 STRG
a. Develop technologies and methodologies to provide mine warfare (MIW) intelligence of the battlespace that is integrated into the overall Navy C4I system and architectures (i.e., connectivity, capacity, data correlation, data fusion and interoperability) which are installed within MCM force elements, the task force, supporting forces, and the chain of command. Must be compatible with Common Operational Picture.	**M**	**5.1.a**
b. Develop technologies for timely battle management capability for joint/combined operations. 1. Provide planning information that is automated 2. Develop systems that provide initial capability for interactive dissemination in an environment with low data rate/video/imagery capability 3. Provide initial rehearsal capability in an environment with a low data rate/video/imagery exchange 4. Provide real time dissemination of time-critical orders. 5. Horizontally and vertically concurrent in real time. 6. Prioritization of actions or decisions required.	**M**	**1.1.k**
c. Improve collection management process technologies and methodologies to increase accessibility and responsiveness. 1. Provide better connectivity and feedback from collection management system through brokering agency/organization. 2. Explore long-term storage and indexing as means to mitigate collector tasking by providing extant information. 3. Provide current status of active taskers to all customers.	**L**	**1.2.c**
d. Develop technologies to enhance battlespace architecture, which is a system to provide individuals and units in the battlespace access to a globally distributed and integrated C4I and surveillance network.	**L**	**1.1.j**

7. NAVIGATION	TIER	96 STRG
a. Develop technologies for alternatives to GPS. Provide accurate geopositioning to all theater and allied users (platforms and weapons). 1. Provide position, velocity, and time accuracy equivalent to or better than GPS 2. Provide a secure, jam resistant system for geopositioning. 3. Provide a system for the Commander that is portable/modular enough to allow common reporting from the unit level through platform level to the individual unit / man on the ground. 4. Improve accuracy to the point where targeting of individual weapons equivalent to or better than GPS	**M**	**1.7.a**
b. Develop technologies and methodologies which will allow the redirection or deployment of METOC and MC&G resources including numerical computing and environ-mental satellite reception capabilities in support of crisis operations.	**L**	**1.1.k.7**

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Chapter 2

INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE

Introduction - Intelligence is the collection, processing, integration, analysis, evaluation and interpretation of available information regarding the threat. Surveillance is the collection and categorization of target information. It provides systematic observations of the battlespace, with timely and accurate reporting of the information to the warfare commander. Reconnaissance considers the integration of intelligence with surveillance. It leads to systems that use intelligence to cue sensors for detection. Once detected, the tactical reconnaissance mission collects all available information for the identification task and then provides automated notification to operators of any changes.

Requirements Categories - Underlying Intelligence, Surveillance and Reconnaissance are four sub-categories which are grouped as follows:

1. Situational Awareness

2. ID, BDA and Target Recognition

3. Sensors and Processing

4. Target Track and Fire Control

1. Situational Awareness

●Issues in this category are an integral part of battlespace dominance. Situation Awareness not only provides U.S. and allied forces with potential hostile intentions but also enables the use of intelligence to cue sensors for detection. Real-time indication and warning (I&W) is critical to our warfighters in order to exploit and respond to threats in a timely manner, and if possible, create a perception for the enemy that its hostile action can only be a Pyrrhic victory.

2. ID, BDA and Target Recognition

●This category addresses critical elements needed to inflict maximum damage on the target while minimizing collateral damage. ID and Target Recognition is not only the capability to classify and identify targets, but also the ability to discriminate between real targets and decoys. BDA is a critical element in ensuring that high value targets are destroyed while obviating the expenditure of additional ordnance (1 shot, 1 kill). The necessity to have real-time ID, BDA and Target Recognition is imperative if U.S. forces are to achieve battlespace dominance. For 1997 all related requirements from the C4-IW chapter were consolidated in this chapter.

3. Sensors and Processing

●This category focuses on the need for sensors to possess the capability to operate under any condition and at any time, and be able to process the data in a timely manner. To achieve this capability, imagery must be high resolution and be available real-time/near real-time. Data fusion must be automated, with a high degree of confidence.**Target**

4. Track and Fire Control

●Target, track and fire control addresses not only the ability of ISR to detect and track targets, but also the ability to pass fire control quality data to relevant participants. In addition, real-time sensor-to-shooter requirements and theater-wide tracking requirements are addressed.

Round Table Results - The Round Table rankings placed somewhat greater emphasis on situational awareness and ID and battle damage assessment. However, the High ranked requirements are roughly equally distributed. Sensors had a much larger number of requirements with most of these being Medium and Low.

TABLE II. ISR TECHNOLOGY AREAS

1. SITUATIONAL AWARENESS	TIER	96 STRG
a. Develop interactive systems that forecast potential aggressive actions and recommend deployment of intelligence and surveillance actions: 1. Develop improved means for determining hostile intent. 2. Develop means to make effective use of future information highways. 3. Automate lower-level information processing. 4. Enhance ability to consider alternate forecasts. 5. Ensure that timeliness of information supports weapons employment beyond enemy weapons capability.	**H**	**2.1.a**
b. Provide timely sensing, tailored and common situational awareness: 1. Provide for timely processing of information for all users. 2. Provide increased imagery throughput through image collection, interpretation, and analysis.	**H**	**2.1.b**
c. Develop ability to provide ISR for mining operations and activities to include: 1. production 2. movement 3. deployment 4. disposition	**H**	**5.1.e**
d. Implement real-time indication and warning (I&W) methods into combat operations. 1. Separate real targets from decoys. 2. In concert with the Defense Special Weapons Agency(DSWA)develop techniques to detect the movement, storage and presence of nuclear/chemical/ biological compounds.	**M**	**2.1.c**
e. Develop improved surveillance systems that support detection, classification and covert tracking of merchant ships.	**M**	**2.1.d**
f. Develop systems to automatically provide vulnerability alert by developing a Tactical Decision aid (TDA) for real-time optimization of sensor utilization.	**L**	**2.1.e**

2. ID, BDA AND TARGET RECOGNITION	TIER	96 STRG
a. Provide real-time (or near real-time) battle damage assessments: 1. Provide report of bomb hit with failure assessment, if unsuccessful, within 1 to 30 seconds. (MOE: response in seconds) 2. Provide sensor data that detects and records physical damage to a target which is highly resistant to environmental conditions and battle effects - 95%. (MOE: confidence factor)	**H**	**2.2.a**

b. Develop the technology to identify forces upon detection and with virtually 100 percent accuracy in all weather conditions to enable the following types of capabilities: 1. Discriminating between targets within 5 nm of each other (e.g., a group of friendly and hostile aircraft in proximity, as seen from a third party). 2. Performing a raid count of inbound targets (e.g., up to 8 in close proximity). 3. Determining the classification of air targets (aircraft, missiles, and helicopters) by type and mission (e.g. MiG 27 or MiG 29, SCUD or Exocet). 4. Performing target identification and classification simultaneously with target detection. 5. Developing credible, reliable IFF techniques that are covert, secure, and jam-resistant and are able to provide the identifications and positions of multiple OTH surface contacts in various environmental and countermeasures environments. 6. Develop systems to provide Marine Corps tactical IFF and combat ID to a rifle squad engaged in combat. 7. Provide capability for timely and correct ID and precise location of friendly and hostile: 8. Aircraft. 9. Missiles (cruise, ballistic, etc.) 10. Ships. 11. Boats. 12. Submarines 13. Mines 14. Troops on shore 15. Land vehicles and fixed sites	**H**	**2.2.b**
c. Develop autonomous target recognition systems that can, in real-time, distinguish a specific shore target from background targets, false targets and other clutter: 1. Cataloging signature characterizations in all spectra by target classification. 2. Improving the capability to discriminate targets from decoys. 3. Permitting high-resolution imaging.	**H**	**2.2.c**
d. Develop "tagging mechanisms" for friendly forces in war zones.	**M**	**1.3.c**
e. Develop sensor suite to support BDI/BDA capability and weapon control at standoff range from enemy defenses.	**M**	**1.3.e**
f. Provide accurate ID of all elements in area of regard beyond employment range of threat and commensurate with ability to redirect current/near-term weapons.	**L**	**1.3.a**

3. SENSORS AND PROCESSING	**TIER**	**96 STRG**

a. Improve sensor efficiency and reduce sensor environmental sensitivity in concert with DARO and National Programs: 1. Improve module efficiency. 2. Reduce sensor size and weight 3. Improve performance in clutter. 4. Provide continuous detection and location of major units and prime targets of interest over the entire theater of operation (150,000 km2 area). Major units include troop concentrations, artillery and logistic support. Prime threats include TBM armored vehicles, aviation and mobile defenses, power plants, oil refineries, weapons production facilities, etc. 5. Provide continuous location and tracking of tactical combat units, supporting units and defenses in/around the battle area (100,000 km2 area). (Tactical combat units are at platoon level; supporting units include direct support aviation.) 6. Provide continuous location and tracking of naval units in and around the OPAREA, including air, surface, and subsurface units. This coverage needs to extend from blue water through the land/sea interface.	**H**	**2.4.a**
b. Develop wide-area, anti-sensor technologies for weapons of deception, disruption, denial and destruction. For air, land, and subsurface.	**H**	**2.4.c**
c. Improve undersea acoustic LF and MF processing capabilities for bi-static (separate source and receiver) and multi-static (multiple sources and receivers) active prosecutions.	**M**	**2.4.f**
d. Develop sensor payloads for untethered, unmanned off-board surveillance platforms.	**M**	**2.4.i**
e. Develop capability to provide unobtrusive ISR of naval vessels for nuclear weapons and materials.	**M**	**2.4.n**
f. Improve capabilities for mapping the battlefield using covert systems (e.g., low probability of intercept/detection (LPI/LPD)), that have high endurance, and work in various environmental and countermeasures environments. (This is the same capability needed for naval surface fire support (NSFS))	**M**	**2.4.o**
g. Integrate all sensor/weapons input, giving ability to detect/engage threats in all quadrants. 1. Ensure correlation of off-board sensors for I&W cueing to allow human-in- loop and autonomous operation at full capability against all classes of targets in all environments. 2. Ensure real-time assimilation of data and communications with employed weapons. 3. Improve missile seeker and target detection device (TDD) sensitivity versus all classes of targets in all environments.	**M**	**1.2.b**
h. Develop above water and land based acoustic sensors and processing.	**M**	**New**
i. Develop sensor integration/function compatible with Low Observable (LO)/Very Low Observable (VLO) characteristics. i.e., Surveillance, reconnaissance and combat identification/positive identification (CID/PID) functionality in LPI modes - 90%. (MOE: integration into platforms)	**L**	**2.4.d**

j. Develop the following improvements in imaging capability: 1. Provide a high-resolution capability for multi-band IR imaging. 2. Provide a passive imaging capability for direct fire weapons that is unaffected by weather conditions.	**L**	**2.4.e**
k. Improve/enhance sensor preprocessing.	**L**	**2.4.g**
l. Develop an improved precision ESM capability with: 1. At least 0.1-degree resolution in azimuth and elevation 2. Pulse feature analysis and recognition 3. Low probability of intercept (LPI) detection capability 4. Simultaneous processing of multiple signals in a high pulse environment.	**L**	**2.4.k**
m. Develop capability to deploy small, lightweight sensor systems on indigenous craft of coalition forces.	**L**	**2.4.m**
n. Develop submarine towed/tethered body receive antennas.	**L**	**1.1.e**
o. Develop improved targeting and communications systems, specifically tailored to support Precision Guided Munitions (PGM) and cruise missiles currently in the inventory (and also those weapons planned for the mid-term future; see below), per the following specifications: 1. Targeting and terminal guidance based on localization by GPS or at least equally accurate follow-on systems. 2. Targeting and terminal guidance to include input of such data as target image, target aspect angle, target's relative position to other objects (e.g., third building in a row of five), and target depth (e.g., detonate after penetration). 3. Develop targeting in real time.	**L**	**1.2.a**
p. Improve bi-static RF sensing and processing.	**L**	**New**

4. TARGET TRACK AND FIRE CONTROL	TIER	96 STRG
a. Develop ISR technologies that provide targeting and fire control quality data. 1. Provide a seamless platform/weapon interface. 2. Develop advanced capability for automated platform-based target classification/identification. 3. Provide capability for producing fire- control-quality targeting information outside the threat envelope that fully exploits the weapon's capability. 4. Improve and automate sensor-to-shooter capability. 5. Provide platform targeting capability that does not increase the platform signature. Include passive targeting sensors and multi-sensor/platform cooperative techniques. 6. Provide real-time sensor-to-shooter targeting capability. 7. Reduce false-alarm and fratricide rates to zero.	**H**	**2.3.a**
b. Develop improved systems that provide a significant increase in the detection ranges of all (high and low altitude) cruise missiles, theater ballistic missiles (TBMs) and other hostile air targets; and provide the operator with discrimination, contact identification, and kill assessment.	**H**	**2.3.d**
c. Develop theater-wide target tracking techniques: 1. Implement tracking algorithms that provide "weapons-quality" data. 2. Develop methods to tag targets with earned information. 3. Develop methods to prioritize and maintain tracks. 4. Provide over-the-horizon (OTH) detection, tracking and signature cataloging of suspect merchant ships. 5. Provide wide-area detection, tracking and signature cataloging of all merchant ships (e.g. satellite surveillance.)	**M**	**2.3.b**

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Chapter 3

AIR WARFARE

Introduction - Air Warfare encompasses the range of weapons, platforms and tactics designed to project power, on short notice, against a wide range of targets and sophisticated air defense systems, during day and night, in all weather conditions, providing a robust and credible forward presence through flexible response and dominant power projection. Just as in the over 265 times since World War II that it has been called upon, Naval Aviation will again be tasked to respond to crises; often the first U.S. force on the scene, and often in locations far distant from home, without benefit of allied support. The principal objective of Air Warfare is to provide the National Command Authority with a range of capable, credible, and scaleable options ranging from non-lethal deterrence to rapid, precise, and decisive engagement. Air Warfare is unencumbered by the dictates of host nations and the politics of gaining access ashore, and provides independent strike, precision, depth of influence and maneuver capabilities. This timely and sustainable sea-based presence provides ready, visible and scaleable response to uncertain humanitarian, political and military challenges.

Requirements Categories - Underlying Air Warfare are four sub-categories which are grouped as follows:

1. Precision Strike

2. Platforms (airframes & propulsion)

3. Air Superiority

4. Mission Rehearsal and Assessment

1. Precision Strike

•Precision Strike addresses those requirements needed to enable the warfighter to inflict the required or desired amount of damage to the target while minimizing collateral damage in the target area.

2. Platforms (Airframe & Propulsion)

•This category addresses the requirements necessary for sustainability and survivability of future aircraft. Sustainability includes the concepts of increased endurance, range, operational tempo, while reducing maintenance and life cycle costs. Survivability encompasses signature control, countermeasures, hardening, damage control and maneuverability.

3. Air Superiority

•This category addresses those requirements needed for airspace dominance.

4. Mission Rehearsal and Assessment

•Mission Rehearsal and Assessment addresses those requirements necessary to take a mission from the planning stage through the evaluation of its success. It includes preflight planning, simulated mission rehearsal, and post-flight evaluation to provide feedback to the aviator.

Round Table Results - Precision strike was the dominant consideration for the Round Table rankings for the development of technologies to provide increase lethality, improved sensors suites, and non-conventional weapons. Improved aircraft survivability was also ranked at the top.

TABLE III. AIR WARFARE TECHNOLOGY AREAS

1. PRECISION STRIKE	TIER	96 STRG
a. Provide improved weapons seeker capabilities for strike platforms which: 1. Provide Autonomous target recognition 2. Provide all-weather day/night capability	**H**	**3.1.a**
b. Improve weapons lethality for current and programed strike platforms. 1. Increased penetration 2. Develop a "dial-a-yield" weapon for urban environments. 3. Improve destructive energy densities (bang/pound) 4. Develop multi-mission warheads	**H**	**3.1.b**
c. Improve weapon effectiveness to include: 1. Hypersonics 2. LO	**H**	**New**
d. Improve targeting sensor performance 1. Target discrimination in high clutter 2. Deception resistance	**H**	**3.1.a**
e. Develop non-traditional weapons, to include directed energy, that: 1. Have soft kill potential against people, vehicles and electronic systems 2. Adversely affect computer and fiber optic systems	**M**	**3.1.e**

2. PLATFORMS (AIRFRAMES & PROPULSION)	TIER	96 STRG
a. Develop technologies to improve aircraft survivability 1. LPI Sensors 2. RF/EO/IR/Laser/Acoustic Countermeasures 3. All aspect missile warning 4. Reduce vulnerability to catastrophic system failures (electric/hydraulic/fuel) 5. Develop enhancements to situational awareness	**H**	**New**
b. Improve EW capabilities 1. Improved jamming/spoofing technologies 2. Increased jamming/spoofing output	**M**	**New**
c. Develop technologies to enable next generation vertical flight 1. Reduce weight and complexity 2. Increase range, payload and speed 3. Enable transition from vertical (rotary) to conventional (fixed wing) flight	**M**	**New**
d. Develop unmanned aircraft and flight vehicle technologies.	**M**	**3.3.j**
e. Reduce air vehicle signature to reduce probability of detection and targeting from threat sensors	**L**	**3.3.b**
f. Develop new materials which increase strength and reduce weight	**L**	**3.3.c**
g. Improve engine thrust/weight and thrust/fuel performance.	**L**	**New**

3. AIR SUPERIORITY	TIER	96 STRG
a. Develop non-traditional weapons, to include laser and other directed energy, to degrade and/or defeat enemy weapon systems.	**M**	**3.2.d**
b. Improve anti-air weapons to: 1. Enable off-axis air intercept launch. 2. Include a kill mechanism that is improved over kinematic energy transfer mechanisms	**M**	**3.2.a.9 &** **3.2.a.6**
c. Improve targeting sensor performance 1. Target discrimination in high clutter 2. Deception resistance	**L**	**3.2.a.10**

4. MISSION REHEARSAL AND ASSESSMENT	TIER	96 STRG
a. Develop realistic scene generation 1. Improve image quality 2. Enable high speed, all altitude "Fly through" 3. Develop small, field deployable systems	**L**	**New**
b. Develop an imbedded training capability in aircraft platforms 1. Direct digital mission recording and analysis 2. Performance measurement	**L**	**New**

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Chapter 4

SURFACE WARFARE

Introduction - Surface warfare is the conduct of battle from the sea and land, from the open ocean to the littorals, with the principle objective of achieving battlespace dominance; that is, to fully neutralize enemy offensive and defensive weapons/systems and allow friendly forces to meet their operational objectives with minimal losses. Threats to surface forces include next generation fighter/attack aircraft with a variety of cruise missiles as well as shore based cruise missiles, tactical ballistic missiles, low slow flyers, sea and land-based gunfire, surface/ subsurface torpedoes and mines. Our ability to dominate the battlespace depends not only upon our capability to counter these threats but also our ability to operate freely, and, with that freedom of action, to make the beaches and surrounding areas safe for landing by amphibious forces.

Requirements Categories - Underlying Surface Warfare are eight sub-categories, grouped as follows:

1. Precision Strike

2. Naval Surface Fire Support (NSFS) and Interdiction

3. Theater Air Dominance

4. Maritime Dominance

5. Weapons

6. Ship Design for Enhanced Warfighting

7. Signature Reduction

8. Military Operations Other Than War (MOOTW)

1. Precision Strike

•Precision Strike addresses those requirements needed to enable the warfighter to inflict the maximum amount of damage on high-value targets while minimizing collateral damage in the target area.

2. Naval Surface Fire Support (NSFS)

•Naval surface fire support addresses the requirements for weapons, support equipment, personnel and tactics needed to make safe landing areas and protecting personnel and equipment located ashore. This category includes extended range, fast reaction land attack systems beyond close support.

3. Theater Air Dominance

•This category includes requirements for over-the-horizon target identification and target localization. Advanced defensive systems for CW/BW, unmanned aerial vehicles, and theater ballistic missile defense are also addressed.

4. Maritime Dominance

•Maritime Dominance addresses requirements to fully neutralize enemy offensive and defensive weapons/systems and allow friendly forces to meet their operational objectives with minimal losses. This not only requires that friendly units have absolute battlespace awareness (air, surface and undersea), but also the capability to counter any threat entering the battlespace.

5. Weapons

•This category includes requirements for advanced offensive systems including Land Attack weapons and defensive systems to counter threats with increased performance (e.g. cruise missiles: LO-VLO, supersonic, waypoint capable, simultaneous arrival capable, deceptive maneuvers, multi-mode, jinking). With increased performance in threat weapons defensive forces reaction times are reduced to a minimum and require that engagements result in a high Pk. Surface force weapons will need to be smarter, more autonomous, and more lethal.

6. Ship Design for Enhanced Warfighting

•Ship Design for Enhanced Warfighting addresses sustainability, vulnerability, survivability, and affordability issues which can be improved through ship design, signature suppression, hardening, magazine protection, electrical power survivability, pre-hit configuration management technologies, countermeasures, and damage control equipment and procedures that collectively prevent or limit combat damage from enemy fire. Ships designed for enhanced warfighting is a critical need as U.S. forces are continued to be called to contingency operations. Ship designs will need to be more modular to accommodate tailored mission packages. This catagory also addresses the ship system innovations for improved performance, reduced manning and life cycle cost reduction.

7. Signature Reduction

•Signature reduction addresses those requirements needed to reduce ship signatures from all sources. For survivability of our surface ships, it is critical that signatures be reduced to a minimum. Advanced technologies are required to address:

1. Reduction/control of EO signatures

2. Reduction/control of IR signatures

3. Reduction/control of RCS

4. Reduction/control of acoustic signatures

5. Reduction/control of magnetic signatures

6. Reduction/control of wake signatures

8. Military Operations Other Than War (MOOTW)

•Military Operations Other Than War includes efforts to stop illegal trafficking in drugs, weapons, people (e.g., illegal immigration) or other contraband and has become a key aspect of enforcing United Nations Sanctions.

Round Table Results - Precision Strike and Naval Surface Fire Support are the dominant requirements categories. Followed by Theater Air Dominance and Maritime Dominance and Weapons. This is a restructuring from 1996 reflecting the surface role in the littoral battle space. Votes give 19 High, 19 Medium and 13 Low.

TABLE IV. SURFACE WARFARE

1. PRECISION STRIKE	TIER	96 STRG
a. Develop technologies to improve existing targeting and C4ISR systems to maximize accuracy and speed of ordnance on target.	**H**	**4.2.a**
b. Develop technologies for systems to destroy Weapons of Mass Destruction (WMD) vice just dispersing CW/BW agents.	**H**	**4.2.b**
c. Provide technologies to improve weapon seeker capabilities: 1. Provide autonomous target recognition. 2. Provide all weather - day/night capability. 3. Ensure engagement capability in high natural and man-made clutter.	**H**	**4.2.c**
d. Develop technologies to improve weapons lethality for current and programmed strike platforms by improving single-shot probability of kill (Pk) of all weapons.	**H**	**4.2.d**
e. Develop technologies to improve capability to attack mobile Theater Ballistic Missile (TBM) launchers and time-critical fixed sites.	**H**	**4.2.e**
f. Develop technologies for weapons systems that will detect and attack high value targets. 1. Develop improved hard kill, penetrating weapons. 2. Develop soft kill systems against vent and power systems. 3. Develop weapons systems to sever bunkers from C3 nodes, sensors & weapons.	**H**	**4.2.f**
g. Develop technologies to improve the capability of current and future naval weapon systems for the Suppression of Enemy Air Defenses (SEAD). 1. Develop weapon system for preemptive strike against integrated air defense systems (IADS). 2. Define capabilities and parameters to isolate IADS emitters.	**H**	**4.2.g**
h. Develop technologies which will integrate sensor suites with strike weapons and platforms to allow man-in-the-loop and autonomous operation, at full capacity of weapon and platform.	**M**	**4.2.h**
i. Develop technological improvements to weapons systems and launching systems: 1. Improve propulsion systems to result in higher speeds and longer ranges. 2. Provide inflight retargeting capability	**M**	**4.2.i**
j. Develop technologies for improved weapon capability to engage multiple, mobile/moving targets such as tanks, armored personnel carriers and light armored vehicles.	**M**	**4.2.k**
k. Develop technologies to support design and production of more variants of submunitions, including warheads with greater penetrating capability.	**L**	**4.2.j**

2. NAVAL SURFACE FIRE SUPPORT & INTERDICTION	TIER	96 STRG
a. Develop technologies for targeting, weapon kinematics, and weapon control to stand outside 10-20 year threat envelope.	**H**	**4.1.a**
b. Develop technologies for precision guided munitions (PGM) for Naval gun systems that are affordable and effective against low-cost surface and land targets, and which possess the following characteristics: 1. Payload of 24-40 pounds 2. Range of 40 nm (conventional round in a 5-inch gun) 3. Range of 75 nm (adv. propulsion gun with twice the muzzle energy) 4. CEP of less than 20 m (non-GPS guided) 5. CEP of less than 2 m (GPS guided) 6. Built-in terminal seeker (e.g., mm wave, IR, EO, SAL).	**H**	**4.1.b**
c. Develop technologies for long-range, precision, onboard, renewable weapons capable of high rates of fire with scaleable lethality and timely engagement.	**H**	**4.1.c**
d. Develop technologies to improve propulsion systems, including the combination of launcher and projectile, to increase gun and missile ranges while maintaining shore targeting precision.	**M**	**4.1.d**
e. Develop technologies for sub-munitions variants that are appropriate for given target sets (e.g., based on target size, location, etc.) to permit a distribution of firepower against shore targets including between several targets or between areas within a single target.	**M**	**4.1.e**
f. Develop technologies to improve the design of conventional munitions to permit longer ranges (possibly via wave rider or drag reduction technology), increased payload capacity, greater structural strength and a capability against hard targets ashore.	**L**	**4.1.f**

3. THEATER AIR DOMINANCE	TIER	96 STRG
a. Develop technologies which mprove shipboard capabilities to perform over-the-horizon (OTH) target identification, target localization, and knowledge of the environment (in the target's area) for various environmental and countermeasures environments.	**H**	**4.4.a**
b. Develop technologies for advanced active defensive systems: 1. Develop a TBMD capability that detects and attacks missiles and provides automated multi- sensor data fusion. 2. Provide capabilities to counter high altitude, long duration unmanned air vehicle (UAV).	**H**	**4.4.b**
c. Develop technologies to include Active Phased Array Radar (APAR) that can detect, control and engage theater missile and air threats, including TBMs, in sea, land, and coastal environments.	**H**	**4.4.c**

4. MARITIME DOMINANCE	TIER	96 STRG
a. Develop technologies for an integrated ASW system that can detect, control and engage/neutralize submarines, torpedoes and naval mines.	H	4.7.a
b. Develop technologies and methodologies to improve the capability to conduct ASW in littorals.	H	4.7.g
c. Develop technologies for a lightweight ASW sensor system suitable for transfer and use by allied/coalition partners on small ships and indigenous craft during MRC/LRC situations.	M	4.7.b
d. Develop the capability to detect, identify and engage small, low-speed multiple surface threats while operating in severe environmental and countermeasures environments.	M	4.7.c
e. Develop the capability for autonomous target recognition systems that can, in real-time and in all types of weather, distinguish a hostile air or small surface-contact from background tracks, false targets, and other clutter.	M	4.7.d
f. Develop the technologies to counter supersonic stealth cruise missiles.	M	4.7.e
g. Develop technologies for multi-sensors/satellite-linked/all- weather air dropped mines.	L	4.7.f

5. WEAPONS	TIER	96 STRG
a. Develop technologies for renewable weapons, such as directed energy weapons (e.g., lasers), that are agile, easy to target, need little logistics support, are compatible with a shipboard ElectroMagnetic (EM) environment and can deliver both lethal and non-lethal charges in all types of weather against both surface and low-altitude air targets.	H	4.6.d
b. Develop technologies for a multi-target capable weapon for shipboard use (close-in) against small boats, sea skimmers, aircraft, submarines, mines, etc. Implement a swarm vehicle defensive system.	H	4.6.f
c. Develop technologies and methodologies for the use of unmanned combatant craft for surface missions.	M	4.6.a
d. Improve the design of surface-launched, smart-weapons fusing so that the fuse is not triggered by ground or water when engaging surface, low-altitude air or sea skimming targets.	M	4.6.g
e. Develop technologies for an exhaust-riding missile that can follow the threat exhaust back to the launcher.	L	4.6.c
f. Develop technologies for improved gun/missile propellants that have a higher energy content and are more insensitive (possibly including low- cost turbines in the design or take advantage of electro-chemical or electro- thermal effects).	L	4.6.e
g. Develop technologies for a large volume coverage capability for submunitions.	L	4.6.h
h. Develop technologies for cheap, dumb, powerful bullets and a gun system that permits improved accuracy and smaller dispersion.	L	4.6.i

6. SHIP DESIGN FOR ENHANCED WARFIGHTING	TIER	96 STRG

a. Develop technologies to reduce a ship's vulnerability to weapon impact through the use of various technologies, possibly including: 1. Redundancy and separation of critical functions. 2. Improved personnel protection. 3. Improved internal communication and information management. 4. Improved emergency escape breathing devices. 5. Longer lasting oxygen breathing apparatus. 6. Integrated survivability management system. 7. Graphic display of damage areas. 8. Damage containment decision aids. 9. Blast resistant decks and bulkheads 10. Damage resistant construction materials and coatings. 11. Lightweight armor. 12. Active armor (absorbs energy of the blast). 13. Improve CBR defenses. 14. Provide Automated Damage Control (ADC) 15. Integrated power systems	**H**	**4.5.j**
b. Develop modular designs which can accept tailored mission packages.	**M**	**4.5.a**
c. Develop technologies for shipboard systems that can operate in high sea states, at rates appropriate for future mission taskings. 1. Expand ships' parameters for weapons launch (i.e., firing rate, shoot at faster speeds, shoot in any sea state). 2. Enhance ships' sea-keeping for aircraft launch and recovery. 3. Develop rapid, reliable and safe weapons load, reload and test systems which provide a rapid fire rate while minimizing manpower. 4. Develop sufficient shipboard protection systems to ensure survivability of onboard weapons and systems.	**M**	**4.5.i**
d. Develop technologies for systems to neutralize and self- cleanse CW/BW agents in a surface ship environment.	**M**	**4.5.k**
e. Develop CW/BW sensors for surface warfare.	**M**	**4.5.l**
f. Develop technologies which will provide the capability to defend a ship, in-port, against threats of terrorist attacks, mob action, protesters, etc., using multi- layered defense, including non-lethals.	**M**	**4.5.m**
g. Develop technologies to improve platform ability to survive mine damage.	**M**	**New**
h. Develop technologies which will significantly increase speed without sacrificing combat capability.	**L**	**4.5.d**

i. Develop technologies which will improve damage-control/ ship-survivability through: 1. Mine/torpedo resistant hulls. 2. Fire suppression systems. 3. Non-combustible hydraulic fluids. 4. Self-extinguishing hydraulic fluids.	**L**	**4.5.e**
j. Develop integration technologies - human /system interfaces.	**L**	**4.5.g**

7. SIGNATURE REDUCTION	**TIER**	**96 STRG**
a. Provide technologies for highly survivable surface combatants with features that minimize signature and enable forces to transit clandestinely through dynamic platform signature controls. 1. Develop technologies to reduce and/or control the electro-optical (EO) signature of ships via coatings, cloaking or reconfigurable camouflage. 2. Develop the technology to permit multi-spectral signature reduction via coatings or hull shaping to reduce the radar cross section of ships and to reduce the radiation of antennas and other sensors. 3. Improve the technology to reduce ships' acoustic signatures by developing quieter propulsors, improved acoustic coatings, machinery silencing techniques, hydroacoustic silencing techniques and/or active noise control methods. 4. Improve the technology to reduce ships' magnetic signatures by developing the capability for closed loop degaussing and active field suppression, and by a greater use of non-magnetic materials and/or variable moment magnets. 5. Improve the technology to reduce and/or control ships' infrared (IR) signatures, possibly by the use of material treatments, active cooling systems or improvements in the design of propulsion systems. 6. Employ LO technology in the design of surface ship superstructures. 7. Develop technologies to reduce and/or mask the electromagnetic, underwater electric potential (UEP) and pressure signatures of ships to levels commensurate with current and projected threat. 8. Improve the technology to reduce and/or control a ships' wake signature, possibly via modified hull designs, modified propulsion designs or by surfactants.	**H**	**4.3.a**

8. MILITARY OPERATIONS OTHER THAN WAR	TIER	96 STRG
a. Develop sensors that can be used onboard a merchant ship to detect drugs, munitions or weapons (including biological and chemical) anywhere on the ship (including in the cargo holds or attached to the ship's external or internal hull).	**M**	**4.8.a**
b. Develop technologies for new non-lethal anti-ship weapons for use against merchant ships with the following characteristics: 1. Capable of stopping a merchant ship with minimal damage to its structure at a range of up to 500 yards and with an accuracy of better than 5 m. 2. Capable of stopping a merchant ship without casualties and with no damage to its structure at a range of up to 1000 yards and with an accuracy of better than 1 m.	**M**	**4.8.d**
c. Develop sensors that can be used remotely, prior to boarding, to detect drugs, munitions, weapons (including biological and chemical) or people anywhere on the ship (including in the cargo holds or attached to the ship's external or internal hull).	**L**	**4.8.b**
d. Provide technologies which will support the capability to conduct maritime intercept operations, such as blockades, embargoes or quarantines: 1. Provide capability to tag and track all shipping--neutral, friend, foe. 2. Provide capability to inspect shipping by noninvasive methods. 3. Control movement/intent of shipping by non-lethal methods.	**L**	**4.8.c**
e. Develop equipment and/or procedures to permit the boarding of merchant ships in any sea state in the daytime or at night.	**L**	**4.8.e**

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Chapter 5

MINE WARFARE

Introduction -- Mines are a relatively cheap way to deny access to an ocean area and otherwise disrupt maritime traffic. Through their use, commercial and military ports can be closed, the sea lanes can be shaped and controlled, and beaches protected against amphibious landing. Some mines sink to the bottom, others are buoyant and are tethered some distance below the surface, and still others float and drift on the surface. But all mines lie still and are silent, making their detection and avoidance particularly difficult.

The overriding issue for mine warfare is the development or improvement of the capability to detect, identify, classify and destroy all types of mines at all times and in any environment. The implementation of these as organic capabilities for battlegroups and amphibious ready groups is critical. A second issue is the use of selective mining as a tool to inhibit an enemy's freedom to operate by closing ports or sea routes to his shipping traffic.

The technology of mine warfare involves not only the mines themselves and their sensors but also mine laying and mine removal, all aspects of Mine CounterMeasures (MCM) and mine warfare effectiveness and readiness through training systems and better support for mission planning.

Requirements Categories - Mine warfare S & T issues come under one or more of the eight following categories:

1. Command and Control, Communications, and Computers and Intelligence (C^4I)

2. Mine Warfare in Stride

3. Mines and Mine Field Control

4. Sensors

5. MCM -- Neutralize Mines

6. Mine Warfare Surveys

7. Platform Survivability

8. Mine Warfare Environmental Support

1. Command and Control, Communications, and Computers and Intelligence

- This category includes all aspects of command, control, and communications, largely but not exclusively through the use of or with the help of computers. It also includes all aspects of intelligence about mines and mine fields as well as the means of collection of intelligence data.

2. Mine Warfare in Stride

- In stride mine warfare operations imply the ability to rapidly detect, track, and destroy all mines and other obstacles for amphibious operations from long distances over the horizon.

3. Mines and Mine Field Control

- The development of improved mines and their control systems is the focus of this category.

4. Sensors

- This category involves the development of new and improved sensors to sense and detect mines.

5. MCM - Neutralize Mines

- This category deals with all aspects of mine countermeasures with emphasis on the ability to neutralize mines through their detection, classification and detonation.

6. Mine Warfare Surveys

●The emphases under this category are various covert survey operations involving mines and MCM.

7. Platform Survivability

●This category is concerned with all aspects of the survivability of platforms to mine encounters with emphasis on various signatures of the platforms.

8. Mine Warfare Environmental Support

●One of the key environmental factors in MIW is having the knowledge of the ocean bottom topography and mine-like objects.

Round Table Results - The Round Table placed greatest importance on the connectivity of the mine warfare forces with the battle groups to support in stride clearance. There was again a reordering of the categories in the functional area as a result of the consolidated vote.

TABLE V. MINE WARFARE

1. C4I	TIER	96 STRG
a. Develop tactical decision aids (TDAs) to support MIW mission planning and related MIW training as follows: 1. Predict a minefield's boundaries, the mine content within those boundaries, the risk to traffic and the likelihood of success for a given MCM mission. 2. Define optimal minefield boundaries as well as the mine density, configuration and settings needed to achieve a commander's goals. 3. Predict interrelationships of mining intelligence, mine laying and clearing activities, area reconnaissance and naval operations against suspected/known/ unknown minefields, and then predict the likelihood of mission success in various timeframes and also accurately predict the mine risk or probability of safe transit to the tactical commander.	**H**	5.1.b
b. Develop ability to conduct 24 hour enemy mine surveillance.	**H**	5.1.c

2. MINE WARFARE IN STRIDE	TIER	96 STRG
a. Develop the ability to conduct manned or unmanned, in-stride (from over the horizon to the amphibious craft landing zone), clearing and/or breaching of mines and obstacles (cement blocks, barbed wire, etc.)	**H**	5.3.a
b. Develop the capability to conduct mine and obstacle reconnaissance of an amphibious operations area (AOA) during the advance phase of an amphibious operation. Note: A nominal AOA is considered to include 200 nm of coastline, 8 days of required availability, and 50 nm standoff from the beach. 1. Sea 2. Surf-zone 3. Land	**H**	5.3.b

3. MINES AND MINE FIELD CONTROL	TIER	96 STRG
a. Develop the ability to perform remote command and control of individual smart mines that include a re-targeting capability.	**H**	5.5.d
b. Develop mines that are capable of detecting and immobilizing quiet diesel submarines, surface warships and high-speed surface craft operating in water as deep as 500 feet.	**M**	5.5.a
c. Create passive non-destructable technologies for tagging, tracking, and destroying ships and submarines. For example: 1. Clog and/or disrupt onboard cooling and other systems. 2. Enhance bioluminescence that would use organisms to locate and track submarines. 3. Produce a dye/chemical tag that allows tracking of submarines.	**M**	5.5.b
d. Develop a wide area surveillance mine that senses and swims to its target.	**M**	5.5.f
e. Develop smaller mines allowing wide area high volume delivery of all types of mines from aircraft, submarines and artillery/mortars	**L**	5.5.c
f. Develop the ability to emplace, selectively arm, and continuously monitor mine fields.	**L**	5.5.e
g. Develop a mine that is self reloacatable.	**L**	5.5.f

4. SENSORS	TIER	96 STRG
a. Develop sensors with the ability to sense and detect buried mines at sea	**H**	5.6.a
b. Develop sensors with the ability to detect non-metallic mines.	**M**	5.6.b
c. Develop "non-conventional" sensors to detect underwater mines	**M**	5.6.c
d. Develop the capability to detect and avoid mines out to 2000 yards by organic means. (Note: The definition of "organic" depends on the makeup of the functional unit, e.g., ship, task force, carrier battlegroup.)	**M**	5.6.d

5. NEUTRALIZE MINES	TIER	96 STRG
a. Develop the technology to deploy rapid, unmanned mine neutralization system(s) that are effective against 1) bottom, 2) moored and 3) drifting mines, and are low-cost (e.g., expendable), and can find/detect and identify the mine being neutralized.	**H**	5.8.a
b. Develop a remotely operated capability to neutralize mines that : 1. Is easily deployable/controllable from a variety of platforms. 2. Provides high-fidelity emulation of magnetic, electric, acoustic and seismic signatures. 3. Operates clandestinely. 4. Has 24 hour capability. 5. Is effective against bottom, moored and drifting mines	**L**	5.8.c

6. MINE WARFARE SURVEYS	TIER	96 STRG
a. Improve clandestine operations through multi-platform 1. Q-routes survey 2. Wide area detection.	**M**	5.2.a
b. Provide rapidly deployable, 24 hour MCM availability(wide area).	**M**	5.2.b
c. Provide capability for clandestine mine reconnaissance.	**M**	5.2.c

7. PLATFORM SURVIVABILITY	TIER	96 STRG
a. Develop technologies to reduce and/or mask the acoustic, electromagnetic, Underwater Electric Potential (UEP) and pressure signatures of MCM to levels commensurate with current and projected threat.	**L**	5.4.a
b. Improve the survivability of MCM platforms to withstand mine damage.	**L**	5.4.b

8. Mine Warfare Environmental Support	TIER	96 STRG
a. Develop survey technologies to provide knowledge of ocean bottom topography and mine-like objects in potential AOA world wide.	**L**	5.7.a

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Chapter 6

UNDERSEA WARFARE

Introduction - Undersea warfare is the conduct of battle beneath the surface of the oceans with the principle objective of achieving battlespace dominance; that is, to fully neutralize enemy offensive and defensive weapons and systems and allow friendly forces to meet their operational objectives with minimal losses. U.S. submarine operations two decades from now are predicted to include anti-SSBN operations in hostile bastions, anti-SSN/anti-SSGN operations in the open ocean, and a multitude of diverse operations in littoral areas. Littoral operations include ASW, ASuW, surveillance, special warfare, and strike. Obviously, operations in bastions or the open ocean could include ASuW, surveillance, and a variety of other missions. Undersea threats will include air independent diesel electric subs, mini-subs, moored homing torpedoes, mines and other unmanned underwater vehicles. Technology in this area will aid in the development of improved acoustic sensors and arrays, improvements in offensive torpedo performance and other offensive ASW capabilities, improved communications with underway submarines and technology to reduce own sub signature levels. All of this is to be accomplished in an affordable manner.

Requirements Categories - Underlying Undersea Warfare are eight sub-categories which are grouped as follows:

1. Undersea Superiority

2. Offensive ASW

3. Support

4. Strike

5. Survivability

6. Affordability

7. Manning

8. Training

1. Undersea Superiority

•Undersea Superiority involves developing technologies which will improve our undersea defensive capabilities. This includes developing new systems to better neutralize threats posed by hostile subs, torpedoes, mines and UUVs, and neutralizing the adversary's sensor systems and arrays. The most significant submarine requirement which will remain unchanged is stealth. Two decades from now, U.S. submarines must be concerned about their detectable signatures from radiated acoustic noise, reflections from active pulses, and their susceptibility to a variety of non-acoustic sensors which may detect various scars or residue trails. The new Air Independent Propulsion diesel electric submarines will radiate considerably less noise than current vessels. This will cause submarines to get very close before one can detect the presence of another acoustically. As a result passive sonars must be augmented by other long range detection capabilities. Active sonars and non-acoustic systems must be explored. Since stealth remains the cornerstone of submarine operations, active sonar operations must explore bi-static and multi-static systems using other platforms and remotely deployed systems.

2. Offensive ASW

•Because of the expected quietness of future threat submarines, our submarines may encounter these threats at close ranges. Therefore, offensive ASW must develop technologies to provide a quick reaction attack and evasion capability. The submarine which can develop a quick fire control solution, rapidly shoot weapons, and effectively evade will have superiority. A quick fire control solution will be needed. Rapid shooting may involve an automatic weapon aiming and firing system. Evasion may involve sophisticated decoys, countermeasures against incoming weapons, and submarine speed or stealth. Further it will be necessary to improve offensive torpedo performance and signature in both shallow and deep water; to optimize coordinated ASW between platforms and in bi-static modes with deployed sources; and to provide the capability to covertly tag threat submarines and mines. Additionally, the threat of mines, including potential stealthy mines, may require the development of submarine-launched unmanned underwater vehicles (UUVs) as surrogates for the submarine in mined waters. Also critical in the undersea picture is the change in the submarine's customer. Joint Task Group operations have shown that JTG commanders and other authorities want and need data

from the submarine in an understandable and timely form. This emphasizes the need for improved covert high rate communications.

3. Support

●This requirement category addresses developing technologies to support warfighting capabilities in the undersea environment. This includes the development of technologies and systems which support the submarine's warfighting capability such as deployable sensors to detect, track and classify ASW contacts and communicate that information back to the parent submarine, improved SOF vehicle technology, and the capability to assess in real-time, own ship acoustic vulnerability to maintain situational awareness, stealth and tactical control.

4. Strike

●Providing an improved timely and cost effective precision strike capability with high speed strike weapons is a key requirement in Undersea Warfare.

5. Survivability

●With the reduction in the number of submarine platforms, the introduction of quiet diesel-electric submarines by foreign navies, and the increasing threat of mines in the littorals survivability is even more critical. New technologies to reduce own submarine signatures and to improve the submarine's maneuverability and responsiveness and capability to operate at faster speeds and more quietly are required. Also the improvement in the use of distributed architectures, cooperative engagement techniques are key to increased survivability. For the mine threat a likely response will be the submarine launched UUV. This surrogate will need significant endurance, effective navigation, good communications and a variety of mission payload packages.

6. Affordability

●In keeping with the reduced budget levels forecast for the future and the Navy's goals to reduce costs, developing affordable platforms, sensors and weapons systems is a hard requirement.

7. Manning

●In the interest of reducing cost and risk, Manning addresses reducing the manning requirements on ships and submarines.

8. Training

●Improvements in onboard training systems that integrate all ship sensors and fire control systems for more meaningful and realistic training is required.

Round Table Results - The Round Table voting emphasized the undersea superiority, offensive ASW, support enhanced of battlegroup communications (covert and clandestine) and support of operations such as SOF.

TABLE VI. UNDERSEA WARFARE

1. UNDERSEA SUPERIORITY	TIER	96 STRG
a. Develop sensors and processing technology to better neutralize threats posed by hostile subs, mini-subs, moored homing torpedoes and other unmanned underwater vehicles (UUVs) including systems with cooperative engagement architectures as per the following specifications: 1. Develop ASW sensors and processors that can detect and track low- signature subs at tactically significant ranges and speeds. 2. Develop systems to maintain tactical control of engagements. 3. Develop real-time, auto passive ranging and classification systems.	**H**	**6.1.a**

b. Develop technology which will improve capability to neutralize an adversary's sensor systems and arrays: 1. Provide capability to deny the enemy an ability to detect, identify and target friendly submarines through signature control or the use of improved acoustic or non-acoustic countermeasures. 2. Develop improved methods to covertly locate and neutralize enemy sensors and arrays or UUVs. 3. Employ LO technology in the design of submarine sails, rudder, masts, antennas and exposed decks for SSNs that engage in SOF operations. 4. Improve the technology to reduce ships' acoustic signatures by developing quieter propulsors, improved acoustic coatings, machinery silencing techniques, hydroacoustic silencing techniques and/or active noise control methods. 5. Improve the technology to reduce ships' magnetic signatures by developing the capability for closed loop degaussing and active field suppression, and by a greater use of non-magnetic materials and/or variable moment magnets. 6. Develop technologies to reduce and/or mask the electromagnetic, underwater electric potential (UEP) and pressure signatures of submarines to levels commensurate with current and projected threat. 7. Improve the technology to reduce and/or control a submarine's wake signature, possibly via modified hull designs, modified propulsion designs or by surfactants.	**H**	**6.1.b**
c. Develop offboard sensor capability to reduce the risk to the friendly platform and provide a force multiplier. 1. Capabilities required include mine detection, identification and avoidance in the near term, and for the far term, mobile and static for wide-area search and covert surveillance, SOF support, and BDA. 2. Power systems for offboard sensors that provide high endurance, low cost and low impact on the platform.	**H**	**New**
d. Develop technologies which will improve self-defense capability in littoral waters: 1. Develop the capability for automated decoy release and a quick-response counterweapon launch. 2. Develop a robust anti-air capability for use against patrol aircraft. 3. Develop a weapon against light and fast combatants. 4. Improve self-defense capability in littoral waters that would include submarine issues such as improved low speed maneuvering and control, improved station keeping, improved covert bottom profiling, and reduction of signatures such as wake. 5. Evaluate and develop improvements to friendly platform shallow water performance including low speed maneuvering and depth control, station keeping, covert bottom mapping, and wake signatures.	**H**	**6.1.e**

e. Develop technologies which will improve systems to neutralize the threat posed by enemy torpedoes.: 1. Design improved threat detection and alert systems with improved and more automated classification techniques (including underwater IFF), and faster targeting systems, to increase the probability of survival against inbound torpedoes from any aspect angle. 2. Provide the above capability against salvos of torpedoes in all environments and in the presence of countermeasures. 3. Develop improved countermeasures and decoys. 4. Develop improved weapons with better fusing technologies for use against inbound torpedoes.	**M**	**New**
f. Provide technology which will optimize data fusion of sparse information (on board individual ship, submarine or aircraft).	**M**	**6.1.f**

2. OFFENSIVE ASW	**TIER**	**96 STRG**
a. Develop improvements in torpedo technology: 1. Improve torpedo sensor signal-to-noise ratio (S/N) for acoustic detection, classification and homing against submarines in shallow water with low-Doppler returns and a faint acoustic signal strength in a countermeasure rich environment 2. Provide the capability for terminal homing against small, bottomed or near-surface targets with a probability of kill (Pk) of >= X with the automatic selection of hit location. 3. Develop environmentally safe explosives, fuels & propulsion systems. 4. Reduce torpedo's flow, propulsion and machinery noise to make them as quiet as the submarine launch platform. 5. Develop the capability to perform IFF queries to prevent attack against the launching ship while maintaining an open azimuth for attacking the intended target. 6. Develop the capability to perform a quiet torpedo launch without maneuver constraints on the launching platform.	**H**	**6.2.a**
b. Develop technologies to achieve torpedo performance levels (Pk) in shallow water that are equivalent to, or better, than today's capabilities in deep water (without compromising superior performance in deep water).	**H**	**6.2.b**
c. Develop more capable non-acoustic sensors and array handling systems for all ASW platforms. 1. Develop improved remote array handling mechanisms to permit rapid, covert array deployment. 2. Develop more capable, non-acoustic sensors (e.g., electro-optical, EUP, electromagnetic, and infrared), to include outboard and offboard sensors.	**H**	**New**
d. Develop technology which will provide Maritime Patrol Aircraft (MPA) an effective, shallow water, ASW capability.	**M**	**6.2.g**
e. Develop technologies to optimize coordinated ASW between platforms	**L**	**6.2.c**

3. SUPPORT	TIER	96 STRG
a. Develop technology which can provide continuous low-to-medium secure communications at speed and depth. Communications should have high data rate, bi-directional, telemetry to and from submerged submarines.	**H**	**6.3.a**
b. Technologies that will improve the capability of the submarine to deliver and support SOF forces are needed including improved communication, surveillance capability, platform speed and depth control, and increased payload.	**H**	**6.3.g**
c. Technologies are required which can provide intermittent capability for high data rate communication connectivity to support maintenance of the joint tactical picture and participation in the Joint Targeting Network (JTN) at periscope depth.	**M**	**6.3.c**
d. Develop technology for real-time assessment capability of acoustic vulnerabilities and environment to maintain situational awareness, stealth, and tactical control.	**M**	**6.3.i**
e. Provide technology for improved underwater platform survivability during communications. 1. Develop techniques that allow communications reception with conformal antennae. 2. Develop technologies to determine the terrain covertly in proximity of submarines. 3. Develop covert internal submarine navigational systems. 4. Develop technologies to minimize active emissions in submarine communications.	**L**	**6.3.b**
f. Improve the resolution of onboard oceanographic and atmospheric analysis and forecasting models and provide these improved models to the ship's weapon system platforms.	**L**	**6.3.e**
g. Develop technology for a shipboard capability for small object avoidance (e.g., floating mine).	**L**	**6.3.f**
h. Develop an organic and deployable off-board sensor to detect, track, classify and communicate ASW contacts to parent submarine.	**L**	**6.3.h**
i. Technologies that increase the effectiveness of covert mining are needed in the long term.	**L**	**New**

4. STRIKE	TIER	96 STRG
a. Provide technologies that will enable timely and cost effective precision strike capability improvement: reduced cost; high speed strike weapons; rapid mission planning; and targeting/re- targeting.	**H**	**6.4.a**

5. SURVIVABILITY	TIER	96 STRG
a. Provide technologies which will improve own ship survivability through the use of distributed architectures, cooperative engagement techniques, improved platform maneuverability and responsiveness with improvements in platform-specific Hull, Mechanical and Electrical (HM&E) and combat systems technology.	**M**	**6.8.b**
b. Develop technologies to allow submarines to operate more quietly at higher tactical speeds.	**M**	**6.8.c**

6. AFFORDABILITY	TIER	96 STRG
a. Develop technologies that will make platforms, sensors, and weapons more affordable.	M	6.7.a

7. MANNING	TIER	96 STRG
a. Technologies that will reduce battlestation manning requirements on submarines	L	6.5.a

8. TRAINING	TIER	96 STRG
a. Integrate the global atmospheric and ocean models into a Defense Simulation Network and then utilize the models for high fidelity simulations to aid in training and to develop improved sensors, weapons and platforms.	L	New

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Chapter 7

AMPHIBIOUS WARFARE

Introduction - This chapter was substantially rewritten during the Round Table. Major changes occurred in both individual requirements and in requirements categories. This reflects the increasing maturity of the operational concepts of ship to objective maneuver and their shaping of the requirements set. Increased emphasis has been placed on maneuver, logistics for where and as needed delivery, and precise fire support. Amphibious warfare is the ability to engage the enemy from the sea, project power ashore and achieve battlespace dominance in the world's littorals. This battlespace dominance allows U.S. and allied ships to operate freely, and provides friendly forces with the freedom of action to make the beaches and surrounding areas safe for landing by amphibious forces.

Operations in the Amphibious Operational Area (AOA) require combat forces to transition equipment ashore with speed in order to minimize risk to the transitioning forces. Threats to amphibious forces include sea/land mines, land based cruise missiles and artillery sites and small arms fire. Technology development in this area will lead to improved Naval Surface Fire Support (NSFS) systems, SOF capabilities, high speed transporter craft and logistics systems, and improved personnel protection and improved individual warfighting capabilities for Marines ashore.

Requirements Categories - The required capabilities have been grouped into Warfighting Imperatives as follows:

1. Maneuver

2. Logistics

3. Firepower

4. Naval Special Warfare Operations

5. Training and Education

6. Command and Control

1. Maneuver

•The Round Table identified **seabase-to-objective maneuver** and **mobility** as specific capabilities required to complete the mission. These two specific capabilities have been consolidated into the single imperative of MANEUVER. The imperative has four areas of interest for which S&T investments must be made: Surface Mobility Technology, Mine Detection Technology, Land Mine Countermeasures Technology, and MAGTF Survivability.

•The Surface Mobility Technology effort examines the many challenges Operational Maneuver from the Sea (OMFTS) faces such as maintaining operational tempo, operating over greater stand-off distances, and projecting more power directly to the objective area. In addition, many threats such as shore-to-ship missiles, mines, and direct-fire weapons must be countered or avoided when operating in the littoral area. To overcome these hurdles and successfully execute OMFTS, new technologies must be developed, along with operationally feasible concepts, to meet the system deficiencies which currently exist or are anticipated to exist based on threat analysis and the proliferation of technology world-wide. These technologies include new high risk/high payoff technologies such as electric/hybrid electric vehicle systems, improved mobility components, efficient land and water propulsion systems, predictive mobility analysis tools, and more maintainable and affordable systems.

•Mine and obstacle detection technology must address the urgent and continuing need for the capability of remotely detecting all types of land mines during operations from the surf zone/beach area to inland battlefields. Conventional land mine detection, requiring man-portable detectors and human operators, is slow, presents high risk, and is nonfunctional in the surf zone. The operational deficiency is that no standoff mine detection capability currently exists. The need is to develop and demonstrate technology to provide real-time, day/night detection, and surveillance capability in order to remotely detect current and future mine threats on the battlefield. This capability will provide a unit commander the information required to make timely decisions on assault/maneuver routes and effective deployment of countermeasures, thus, significantly enhancing ground combat unit mobility.

•Land mine countermeasures technology must address means for rapid neutralization of mines, minefields, booby traps and other obstacles in the surf zone/beach areas to inland battlefields to include advanced threat wide area mines. This

requires optimization of advanced distributed explosive technologies to attack a wide range of sophisticated and hardened mines by means of destructive projectiles and other advanced kill mechanisms to attack the main charge and/or sensor package, regardless of fuze type.

●Survivability technology must address survivability of personnel and equipment assets in all levels of combat and physical environments.

2. Logistics

●This warfighting need shows up in the capabilities and supporting functions identified across all imperatives. The capability need can be described in four areas as follows: engineering for seabasing sustainment; engineering/supply/support services; logistics C2 and transportation, maintenance and corrosion control technologies.

●Seabasing sustainment focuses on logistics operations that concern offload, days of supply, and C2 from a distance proportionate to Operational Maneuver from the Sea doctrine. Not all of these are S&T issues but may have implications for S&T developments.

●Engineering/supply/support services examines the engineering mission of the future and technologies to support seabased combat service support.

●Logistics C2 addresses the recent emphasis that with increasing distances of OMFTS and increasing amounts of data, it is necessary to provide tactical logistics C2 with vigor. The goals are to provide intelligent C2 to forward areas, and take full advantage of lessons learned at the Combat Service Support Detachment (CSSD) level.

●Transportation, maintenance, and corrosion control technologies deal with those areas of the logistical concept of operations requiring the movement and transfer of material from seabased operations afloat to inland objective areas. Historically, surface sustainment assets have been slow swimming ships/vehicles with limited payload and range. Other drawbacks include non-amphibious operations, poor amphibious ship interface, large footprint, non-organic handling equipment, and lack of stealth technology. Enhanced mobility, range, corrosion prevention, reliability and maintainability, lift capacity, and self load/unload capability are required - all at an affordable price.

3. Firepower

●The Roundtable identified several important capabilities necessary for amphibious operations and expeditionary warfare. These capabilities are specified broadly in order to allow prudent pursuit of technologies that can be developed and applied in a systematic and synergetic manner to accommodate both ongoing, emerging, and joint investments. Capabilities and supporting functions are sought in the two major areas of targeting sensors and weaponry.

●Targeting sensors technology focuses on the development of innovative sensor technologies that enhance the engagement performance of direct and indirect fire weapons for the conduct of maneuver warfare. Earliest possible target acquisition, increased first round hit probability, and successful Identification Friend or Foe (IFF) are salient goals.

●Weaponry focuses on the development of technologies that increase the lethality, and operational effectiveness including improved target designation and volumetric lethality against area targets, advanced energetic material for multiple munition use, range, and accuracy.

4. Naval Special Warfare Operations

●Support for Naval Special Warfare Operations is required in any amphibious operation. Improvements in host ship Special Warfare Operations capabilities including covert communications capability with the Naval Special Warfare Operations units is required. Technology development is also needed for Special Warfare Operations unit equipment including imaging sensors, control of electromagnetic and acoustic signatures of equipment, and swimmer delivery vehicles. The development of a capability to conduct infiltration in lieu of amphibious operations with total surprise is also required.

5. Training and Education

●This is an area of over-arching concern to the Round Table and is addressed extensively in Chapter 10 - Training. Items listed in this chapter seek to emphasize issues critical to the OMFTS concept of operations.

6. Command and Control

●Command and Control is also considered by the Round Table as an overarching area that is critical to the integration of other capabilities. It is also the technology area that is receiving tremendous attention from the other services as well as from key agencies such as the Defense Advanced Research Projects Agency (DARPA), and from commercial, educational and industrial sectors. It is critical in future scenarios that the amphibious forces be fully interoperable with the battle force C^4I and ISR systems to insure full battlespace awareness in the AOA. They must also have a means to insure DBA/DBK to reduce the overall operational risk.

Round Table Results - As discussed above, this chapter was substantially rewritten during the Round Table. Voting results ranked maneuver and logistics as the most critical areas, with strong emphasis also on firepower and Naval special operations forces.

TABLE VII. AMPHIBIOUS WARFARE TECHNOLOGY AREAS

1. Maneuver	TIER	96 STRG
a. Develop technologies which will enable in-stride obstacle breaching while under fire.	**H**	**New**
b. Provide the technology to improve vehicle performance in the following areas: 1. Survivable to blast/kinetic. 2. Signature reduction. 3. Increase range/speed. 4. Increase component commonality among ground vehicle set.	**H**	**New**
c. Develop technology for improved lightweight body armor.	**H**	**New**
d. Develop technology which will enable full recon in surf/beach zone.	**H**	**New**
e. Develop nonmetallic mine detection.	**H**	**New**
f. Develop high area rate standoff reconnaissance.	**M**	**New**
g. Develop breaching assets as mobile as the force.	**M**	**New**
h. Provide technological options to implement operational concepts for maneuver warfare emerging from OMFTS and STOM, to include ship to objective movement and ground mobility. 1. Enhance operational mobility as distinct from tactical or strategic mobility.	**M**	**New**
i. Develop technology which will enable in-stride gap crossing.	**L**	**New**
j. Develop modular weapons/combat support transport. i.e., modularity among mission specific gound vehicles.	**L**	**New**

2. LOGISTICS	TIER	96 STRG
a. Develop capability to improve aerial resupply for expeditionary forces ashore to include emergency and deliberate resupply missions.	**H**	**New**
b. Develop improved general engineering technologies to support seabasing in the areas of: material handling; advanced mobile electric power systems, water purification and packaging; advanced washdown technologies; and new rapid landing zone construction emplacement technology.	**H**	**New**
c. Develop new materials and processes to provide order of magnitude improvements in clothing and individual equipment for Marine Expeditionary Forces.	**H**	**New**
d. Develop Logistics Information Resources Theater Medical Information Program (TMIP) technologies to improve: 1. Combat casualty care 2. Patient regulation and evacuation 3. Medical logistics 4. Command and control 5. Medical threat/intelligence/surveillance	**M**	**New**
e. Develop technologies which will provide the capability for advanced logistics reconnaissance to determine trafficability and sea state impacts on throughput.	**M**	**New**
f. Develop the technology for order of magnitude improvement in amphibious lift.	**M**	**New**
g. Develop enhanced services related technologies to support seabasing of expeditionary forces in areas such as: personal tracking and rapid manifesting; military police and traffic control; postal and administrative services; and civilian detainee handling.	**M**	**New**
h. Provide technologies to reduce logistics requirements for forces ashore. 1. Power performance vs. Fuel consumption. 2. Power performance vs. Fuel contaminant/degradation tolerance. 3. Man-hour intensive maintenance vs. Material intensive maintenance.	**M**	**New**
i. Develop technology to recover and remove major end items of equipment to either shore or seaborn maintenance facilities (i.e., AAAV instream recovery).	**L**	**New**
j. Develop Logistics Information Resources systems technology to improve logistics planning and execution integration into MAGTF operations.	**L**	**New**

3. FIREPOWER	TIER	96 STRG
a. Develop technology to enable sensor fusion 1. For ashore weapons 2. Between ashore and afloat weapons	**H**	**New**
b. Develop fire support technology options for capabilities in support of OMFTS, emphasizing the tradeoffs between the following elements of naval fires: 1. Target sets and target vulnerabilities, 2. Ordnance types, 3. Targeting sensors and sensor platforms, 4. Data processing and communications systems, 5. Delivery systems, 6. Platform requirements, 7. Logistics requirements, 8. Costs.	**H**	**New**
c. Provide technology for Non Lethal Short-Range Single Encounter Weapons	**M**	**7.5.f**
d. Develop technologies and systems concepts for surveillance, reconnaissance, target acquisition, fire control, and BDA in support of the NOC and OMFTS, i.e., an operational requirement exists for a virtual line of sight weapon for use in an anti-armour role.	**M**	**New**
e. Develop very Low Observable Air Target Detection/tracking	**L**	**New**
f. Provide technology to improve Queuing of Man portable AAW Weapons Systems (sensors only)	**L**	**New**
g. Identify common requirements elements between Table III.1 (Air Warfare, Precision Strike), Table IV (Surface Warfare, Naval Surface Fire Support), and Table IV (Surface Warfare, Precision Strike).	**L**	**New**

4. Naval Special Warfare Operations	TIER	96 STRG
a. Develop man portable equipment technology to detect and locate weapons of mass destruction.	**H**	**New**
b. Develop technology to conduct operations in the Operations Other Than War (OOTW) environment.	**H**	**New**
c. Develop or improve Naval Special Warfare capabilities listed below: 1. Provide the capability to covertly communicate with Naval Special Warfare units from a host submarine throughout the period from egress to recovery. 2. Improve Naval Special Warfare sensors to covertly image in any environment, e.g., dark and turbid waters, surf zone, etc. 3. Control Naval Special Warfare equipment signatures (including Swimmer Delivery Vehicles (SDV) to be compatible with mission requirements, e.g., no or low magnetic signature in proximity of minefield, and to be equivalent to or less than the host platform's as a means to prevent counter-detection. 4. Improve capability to locate and relocate stationary and mobile targets of interest both afloat and ashore.	**M**	**New**
d. Develop technology to conduct infiltration with total surprise in lieu of amphibious operations.	**M**	**New**
e. Develop Naval special Warfare capabilities to counter environmental destruction and degradation, such as oil well shutoffs, chemical containment and neutralization, fire retardant, etc.	**M**	**New**

5. TRAINING AND EDUCATION	TIER	96 STRG
a. Develop Training Systems and Delivery Technologies with the following characteristics: 1. Embedded and/or appended training capability for all operational systems possible. 2. Capability to enhance live fire and field maneuver training. 3. Capability to rapidly generate simulated training situations, missions, and scenarios. 4. Low cost/small sized simulation generation platforms. 5. Adaptive automated forces for simulations. 6. Capability for automated and custom training design and setup.	**M**	**New**
b. Develop training Systems and Technologies to include: 1. Evaluating individual and group training needs. 2. Decision making training.	**L**	**New**
c. Develop Training Systems Integration technologies that are: 1. Unit, site, level and system interoperability capable. 2. Environmentally compatible.	**L**	**New**

6. Command and Control	TIER	96 STRG
a. Develop technology for land/sea preview/rehearsal, all levels within 48 hours of tasking.	M	New
b. Develop Merged Modeling, Simulation and C2 systems.	L	New

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Chapter 8

LOGISTICS SUPPORT

Introduction - Logistic support for the purposes of identifying S&T requirements, focuses on developing and maintaining an affordable logistical support capability that enables the rapid deployment and sustainment of U.S. combat forces. Technology in this area aids in the enhancement of our strategic sealift capabilities; improvements to the Logistics Over The Shore (LOTS) to increase throughput in higher sea states; new salvage technologies and systems; improvements to the combat logistics force ships; equipment improvements to reduce maintenance requirements, increase life cycles and reduce material failures; advanced integrated logistics systems; and just-in-time logistics.

Requirements Categories - Underlying Logistics Support are ten sub-categories which are grouped as follows:

1. Affordability

2. Maintenance

3. Strategic Sealift

4. Joint Logistics Over The Shore (JLOTS)

5. Sea-Based Logistics

6. Combat Logistics Force (CLF)/Underway Replenishment (UNREP)

7. Vulnerability

8. Salvage Systems

9. Infrastructure

10. Energy

1. Affordability

●Affordability includes new technologies to increase life cycles and modernize all systems while maintaining or increasing capability. This means the development of methodologies, processes and techniques to make current and future weapons systems and infrastructure more affordable.

2. Maintenance

●Maintenance and repair of equipment is costly but key in the readiness of combat forces. Navy's reduced budgets necessitate cutting weapons systems maintenance life cycle costs. Some ways to reduce maintenance costs include designing equipment with more diagnostics, self repair and fault tolerant capabilities, developing advanced materials with lower failure rates and using new failure prediction techniques to determine probable time to failure.

3. Strategic Sealift

●Strategic sealift is required to support deployments and sustain operations of U.S. combat forces. To this end, it is critical to have self-sustaining, high speed, large capacity ships to enable rapid surge deployment of critical combat forces and supplies. Improved high speed sealift ships could be used to augment strategic airlift to accommodate just-in-time logistics. These vehicles can be both organic assets or converted commercial vessels.

4. Joint Logistics Over The Shore (JLOTS)

●JLOTS provides the capability to quickly move large quantities of bulk cargo and fuels from ship to the shore to support the landing forces. Analysis of sea state patterns indicates in certain CINC Area of Responsibilities (AORs) sea state 3 occurs up to 50 percent of the time. To significantly enhance this JLOTS capability it is critical to develop JLOTS systems that can safely and productively operate through sea state three.

5. Sea-Based Logistics

●Improvements in Sea-Based Logistics include total asset visibility and tracking from manufacturer to the end user. Development of just in time logistics systems can reduce the inventories and personnel required to support a given force and thereby increase the efficiency and reduce the costs of the total logistics support force.

6. Combat Logistics Force / UNREP

●The combat logistics force consists of those ships and vessels used for re-supplying ships at-sea. Underway replenishment is key to the sustainment of at-sea forces. Increasing the flexibility, capacity, cargo handling and transfer rates reduces UNREP time and thereby the vulnerability of the battle force. Additionally, an underway vertical launch system (VLS) re-arm capability is required for combatants.

7. Vulnerability

●Damage control, damage assessment and materials resistant to fire are critical in the reduced manning environment planned for future combatants.

8. Salvage Systems

●Salvage systems are necessary to support the recovery of Naval vessels, aircraft and other assets in the sea environment including the recovery of trapped personnel. Salvage also includes the rapid clearing of blocked chokepoints critical to combat operations.

9. Infrastructure

●Infrastructure is always a major component of any logistics system. Investments in infrastructure improvements are required to standardize lighter, smaller, easier to handle containers and logistics handling and control systems. New materials and maintenance procedures are also required to reduce facilities infrastructure life-cycle costs.

10. Energy

●Energy consumption and attendant issues of environmental impacts and operational flexibility require ongoing work on efficiencies and monitoring systems.

Round Table Results -Logistics is one of the critical enabling areas which has major impact across all warfare areas. This is especially true due to the potential impact on operational budgets through improved maintenance technologies, and materiel affordability programs. The Round Table gave the majority of High rankings to these areas of maintenance, affordability, and to the areas of strategic lift and JLOTS which are key to ship to objective maneuver concepts of operations. There was a great deal of coordination with the amphibious functional area on these issues.

TABLE VIII. LOGISTICS SUPPORT

1. AFFORDABILITY	TIER	96 STRG
a. Develop technologies, methodologies, processes and techniques to make current and future weapons systems and infrastructure more affordable: 1. Develop system designs and techniques to reduce/minimize life cycle costs, (e.g., corrosion prevention, structural loading and response analysis models and concepts for multifunctional applications). 2. Develop new/better operations research techniques to optimize logistics force structure.	**H**	**8.1.a**
b. Develop technologies that provide for life cycle extension and/or modernization of all systems/infrastructure, e.g., machinery, electronics, platforms, buildings/piers, etc.	**H**	**8.1.b**
c. Develop technology to improve component reliability as a method to reduce overall life-cycle costs for sea-based logistics.	**H**	**8.1.c**

2. MAINTENANCE	TIER	96 STRG
a. Develop condition-based maintenance technologies to provide capabilities (diagnostic and prognostic) for all naval platforms and systems (to include land based systems). Provide improved non-destructive inspection and diagnostics for engines, machinery systems, and structural components. 1. Develop embedded self-diagnostics.	**H**	**8.6.a**
b. Develop technologies which will improve capability for corrosion detection/inspection, preservation, repair, and elimination. 1. Materials and coatings engineered for the life of the system. 2. Low-cost/low-manpower and/or no surface preparation. 3. Alternative concepts for corrosion mitigation. 4. Non-intrusive detection.	**H**	**New**
c. Develop new technologies to enhance equipment maintenance and overhaul with goal of maintenance self-sufficiency among naval forces: 1. On-line technical assistance at-sea and ashore. 2. Improved in-theater and shipboard low observable material/composite repair and performance verification repair capabilities. 3. Develop and employ fault-tolerant systems and equipment. 4. Develop auto-repairing equipment/systems. 5. Develop multi-function equipment with common components	**H**	**8.6.e**
d. Provide technologies which will improve the following maintenance and repair capabilities: 1. Open-ocean underwater BDA in sea state 3. 2. Underwater joining and cutting techniques for patching battle damage.	**M**	**8.6.b**

e. Provide technologies which will allow increased reliability, maintainability and availability into equipment through: 1. Interchangeable systems. 2. Modular systems. 3. Non-fluid cooling and lubricating. 4. Design analysis tools	**M**	**8.6.f**
f. Develop more durable materials which require less maintenance.	**M**	**8.6.g**
g. Develop technology for a real-time logistics interface that ensures products reflect actual system configuration: 1. 100% accuracy of product technical and training manuals, maintenance capability, piece parts, etc. 2. In situ validation. 3. Automated, simultaneous, low-cost, rapid, concurrent update.	**L**	**8.6.i**

3. STRATEGIC SEALIFT	TIER	96 STRG
a. Develop technologies to improve sealift platform concepts, design and equipment technology to yield significantly higher cargo transport rates (High value, time critical goods require timely delivery).	**H**	**8.2.a**
b. Improve cargo-handling technology that will provide capability to reduce time and cost to load/offload sealift platforms including offload capabilities at piers or via JLOTS through sea state 3: 1. Develop technology to increase cargo density. 2. Integrate in-transit visibility (ITV) technology and automated cargo- handling systems into sealift platforms. 3. Identify alternative, self-sustaining sealift platforms. 4. Integrate sealift platform concepts with JLOTS requirements. 5. Optimize cargo movement within sealift platforms to minimize offload times and provide selective offload capabilities. 6. Improve the mooring and anchoring system of ship-to-pontoon, enabling cargo transfer in higher Sea States. 7 7. Explore technologies to improve the Offshore Petroleum Discharge System (OPDS) capability. 8. Improve capability to handle containerized ammunition.	**H**	**8.2.b**
c. Provide technology that will improve sealift platform storage capability, inventory management and environmental control, and reduce maintenance of systems and stowage in long- term lay-up.	**H**	**8.2.d**
d. Develop technologies which will improve sealift platform regeneration capability to include reduced turn-around time.	**L**	**8.2.c**
e. Develop dual-use technologies and platform concepts that improve commercial viability of military useful platforms and commercial vessels: 1. Develop augmentation systems which provide enhanced cargo handling capabilities on existing and future merchant ships. 2. Develop augmentation systems which provide enhanced fuel product transport and handling on existing and future merchant ships. 3. Develop and demonstrate cargo and terminal control systems for use in conjunction with augmented sealift support platforms. 4. Expand underway replenishment capability.	**L**	**8.2.e**
f. Develop improved materials to reduce weight and improve performance while reducing fuel costs.	**L**	**8.2.f**
g. Improve sealift platform deactivation and lay-up technology to preserve and store platform and equipment to maintain its ability for rapid recall.	**L**	**8.2.g**

4. JOINT LOGISTICS OVER THE SHORE (JLOTS)	TIER	96 STRG
a. Develop throughput technology to: 1. Increase ability to operate through Sea State 3 in all phases of ship to shore cargo movement. 2. Provide a rapidly deployable bulk fuel delivery system to support the assault echelon and JLOTS which can be installed within 12 hours in Sea State 4 and provides up to 1.2M gallons per day. 3. Extend standoff distances from the shore that support Operational Maneuver from the Sea (OMFTS). 4. Integrate LOTS capability with offshore basing and portable ports.	**H**	**8.3.b**
b. Develop technology to reduce the effect of sea states surrounding a seabase to a value less than or equal to 3, irrespective of the actual value of the sea state surrounding the seabase.	**H**	**8.3.c**
c. Develop JLOTS deployment and retrieval technology to: 1. Reduce installation and retrieval times of JLOTS subsystems with a goal of at least 25-50% of established doctrine.	**M**	**8.3.a**
d. Develop the technology to improve mechanized cargo/weapons handling from sea to shore.	**M**	**8.3.e**
e. Improve or develop advanced modeling and simulation technology to: 1. Develop operations analysis techniques to maximize effective use of JLOTS assets. 2. Develop analytical tools to support design, assessment and acquisition of future JLOTS systems.	**L**	**8.3.d**

5. SEA-BASED LOGISTICS	TIER	96 STRG
a. Develop technologies to support Operational Maneuver from the Sea (OMFTS) and minimize combat logistics footprint ashore. 1. Develop capability to perform selective offload from sealift and amphibious ships.	**H**	**8.8.c**

b. Develop technologies and system designs to provide MPF 2010 platforms with the capability to marshal, stage, assemble, or mission configure forces through: 1. Space to accommodate selective offload and reconfiguration of supplies and equipment. 2. Capability to transfer equipment from MPS to amphibious ships while underway (to include major end items such as AAAVs, tanks, etc.) 3. Designs to provide flexible expeditionary force packagin and embarkation planning for seabase to objective delivery. 4. Capability to receive and transfer resources via air and surface systems. 5. Capability to conduct arrival and assembly operations afloat. 6. Develop intermodal transhipment systems from seabased platforms to units ashore.	**M**	**New**
c. Develop technologies for modular capability to include: 1. Use aboard the seabase. 2. Deploy same modular capability to the shore/inland. 3. Reconstitution of modules deployed to the shore/inland. 4. Continued functionality of the sea platform in the absence of same modules.	**M**	**New**
d. Develop technologies to support Ship to Objective Maneuver (STOM) 1. Develop the technology to an advanced logistics ammunition transporter to operate in tandem with the Advanced Amphibious Assault Vehicle (AAAV). 2. Develop technology for an advanced, efficient, high-speed transporter that can carry two tanks from seaborne platforms to the shore. 3. Develop technology to recover and remove major end items of equipment to either shore or seaborne maintenance facilities. 4. Develop capability to configure flexible packaging systems compatible with AAAV and MV-22 and system capabilities that deliver mission configured loads to the objective area whether by surface or air. 5. Develop improved supply technologies for seabased power projection and sustainment of forces ashore in all commodity areas and processes.	**M**	**New**

e. Provide technology to enable total asset visibility and accessibility from manufacturer to end user. 1. Status of personnel in-process and in-transit 2. Status of equipment (to include predictive maintenance capability). 3. Status of supplies in-process, in-transit and in-storage (to include manufacturer to user) 4. Flow of forces with distribution and delivery of assets into theater. 5. Linkage to operational planning software. 6. Rapidly move resources to using units and reflect receipts in real time.	**L**	**8.8.a**
f. Develop technology to provide capability for just-in-time precision responsive logistics with: 1. A decision analysis support system for integrated maintenance, supply, configuration, and data. 2. Single, simplified, standardized accounting for property and financial data for ashore/afloat assets. 3. A reduction in consumables. 4. Disposable technology (replace vs. Repair)	**L**	**8.8.b**

6. COMBAT LOGISTICS FORCE (CLF)/UNDERWAY REPLENISHMENT (UNREP)/AND MPF 2010	TIER	96 STRG
a. Develop technologies to expand underway replenishment (UNREP) capability for station and shuttle ships: 1. Increase all types of cargo throughput delivery capability and at the same time reduce UNREP manning requirements. 2. Optimize ship separation between Combat Logistic Force and receiving ship. 3. Provide stowage, strike up and down, deck handling and transfer capability during sea state 5 and icing conditions. 4. Improve receipt and strikedown rates to match Combat Logistic Force ship delivery rate. 5. Integrate ITV technology and automated cargo-handling systems. 6. Optimize cargo movement within Combat Logistic Force and MPF 2010 platforms to minimize offload times and provide selective offload capabilities.	**H**	**8.5.a**
b. Improve interoperability of CLF and other Naval logistics platfoms in joint and combined operations.	**M**	**8.10.a**
c. Develop technologies and techniques to reduce UNREP time, (e.g., concurrent single-spot arming, refueling and inspection.)	**L**	**8.5.b**
d. Develop technologies which will decrease cycle time for re-supply: 1. Decrease turn around time for re- supply ships, e.g., automated handling/management and ship design.	**L**	**8.5.c**
e. Develop technologies which will maximize cargo and weapons stowage and handling capability: 1. On and between decks/holds. 2. Flexible storage. 3. Reduced explosive arc. 4. Provide selective offload.	**L**	**8.5.d**

7. VULNERABILITY	TIER	96 STRG
a. Develop technologies to maximize fire-fighting capability through: 1. Low-combustibility fuels and fuel systems. 2. Adequate fire suppression and reflash systems. 3. Improved fuel containment. 4. Effective, safe and environmentally sound HALON and AFFF replacement. 5. Fire source diagnostic systems. 6. Nonflammable, non-toxic hydraulic fluid that is compatible with existing systems. 7. Reduced weight of fire fighting ensemble. 8. Heat-reactive bulkheads. 9. Full fire-fighting potential of fog stream application.	**M**	**8.9.a**
b. Develop listed capabilities for Sealift and Combat Logistics Force platforms in order to decrease vulnerability: 1. Provide battle damage assessment and containment capability including limiting loss of critical cargo and preventing sympathetic detonations. 2. Provide an automated, environmentally safe fire fighting system for sealift concept. 3. Provide damage-resistant, high- performance magazines/cargo holds. 4. Develop damage-tolerant designs. 5. Develop a real-time hull integrity monitoring system. 6. Explore technologies to reduce signatures and provide effective countermeasures. 7. Explore affordable, modular alternatives to detect, identify and counter prevalent air, surface and subsurface threats.	**M**	**8.9.b**
c. Develop improved shipping containers/systems technologies that are lightweight, high-strength, low-volume, shock-absorbent and non-toxic.	**L**	**8.9.c**
d. Develop reduced dependency on MoGas equipment.	**L**	**8.9.d**

8. SALVAGE SYSTEMS	TIER	96 STRG
a. Explore technologies to provide improvements to the following salvage capabilities: 1. Lightweight beach gear. 2. Rapidly deployable, easily relocatable, salvage lift (>500 tons). 3. Environmentally safe flotation foam for use in salvage operations. 4. Rapid emergency towing system. 5. Method to identify, track and retrieve salvage equipment, materials and supplies brought to an AOA from many sources. 6. Lightweight, low-maintenance towing hawser. 7. Improved, environmentally sound, off- ship fire-fighting capability. 8. Autonomous underwater search system. 9. Fly-away, deep-ocean salvage system capable of 15 tons lift. 10. Remotely operated cable-splicing vehicle capability. 11. High-rate, oil-pollution containment and abatement system for operating up through Sea State 2.	**M**	**8.4.a**
b. Develop technologies for rapidly deployable, easily relocatable salvage lift capability (> 5000 tons). 1. Develop technologies for a rapidly deployable, chokepoint salvage clearance system.	**M**	**8.4.b**

9. INFRASTRUCTURE	TIER	96 STRG
a. Explore technologies to Minimize logistics footprint without loss of capability: 1. Develop equipment and methods to reduce personnel requirements. 2. Improve the efficiency of energy- consuming systems. 3. Reduce equipment size, weight and volume without loss of capability. 4. Develop methods to efficiently preposition and deliver to forces ashore needed supplies and equipment.	**M**	**8.7.a**
b. Develop concepts, materials and techniques that permit reduced facilities investment: 1. Develop alternative construction materials and concepts. 2. Develop techniques that support timely condition assessment and condition-based maintenance. 3. Develop cost-effective concepts for multi-functional facilities.	**M**	**8.7.c**
c. Develop technologies which will provide a standardized, adaptable, integrated logistics system with: 1. Decision analysis support system for integrated maintenance, supply, configuration and data. 2. Real-time interface with transportation system.	**L**	**8.7.b**

10. ENERGY	TIER	96 STRG
a. Provide technologies which will increase energy efficiency of naval systems and equipment: 1. Improve fuel economy. 2. Real-time efficiency measurement. 3. Effective biological-fouling control to increase hull efficiency. 4. Propellant and explosives recycling or reuse.	**M**	**8.10.c**
b. Develop technologies which will ensure fuel availability and quality, without increasing cost, while increasing performance, safety and reliability: 1. Improve thermal stability 2. Develop non-toxic environmental friendly additives 3. Develop in-line purification. 4. Develop portable, miniaturized fuel quality analyzer. 5. Stabilization additives for diesel and crude fuels.	**M**	**8.10.b**

Chapter 9

MANPOWER/PERSONNEL

Introduction - The objective of the Manpower and Personnel Mission Area, and it's closely linked partner, Training, is to deliver the right person, at the right time and the right place with the required training and skills to satisfy Navy warfighting requirements. A prerequisite to accomplishing this objective is effective Human System Integration (HIS) which is the incorporation of human performance capabilities and constraints into the task analysis and function allocation process conducted during system design.

Manpower, Human Performance and Training are interdependent both from an operational and S&T standpoint. The Human Factors analysis of a new system and the allocation of tasks between the human and the hardware dictate the number and skill level of required personnel. Conversely, effective training delivery and management of the personnel resource determines the limits of optimal human performance and it's affordability. It is important, therefore, that S&T products be implemented in an integrated fashion and that the underlying technologies supporting these areas be cooperatively applied to solving similar problems.

The S&T challenge in this mission area is to focus investment on the interrelated supporting technologies of decision support, human centric design, task analysis, performance measurement and testing, resource utilization modeling, distributed and automated learning, synthetic environments and embedded training.

The payoff of integrating these supporting technologies will be an improvement in personnel readiness and highly leveraged cost avoidance due to the large TOA in Navy manpower and training.

Requirements Categories - Manpower and Personnel S&T issues fit into two sub- categories:

1. Human Performance

2. Personnel Management.

Linkages to Other Functional Areas

1. Human Performance

●Human Performance has been designated as a key overarching S&T issue for the Navy of the future. National defense policies of technological superiority, reduced manning and an affordable force further dictate that Human Performance will become a critical component in the accomplishment of Navy warfighting objectives.

●The Human Performance vision of the future is to understand and incorporate human cognitive capabilities in an integrated and seamless fashion into Navy systems to enable superior situational awareness, faster response time qand precise execution in an affordable manner.

●In a technology-dependent Navy, battlespace dominance will be a function of superior situational awareness, rapid access to data and quick-reaction decision making. The contribution to be made by Human Performance technology will be based on a better understanding of cognitive processes and the ability to integrate and leverage these capabilities into warfighting systems.

●The major thrusts in this area will continue to be expanding capability in Decision Support, Performance Enhancement and presentation of Data. A new effort, Human-Centric Design of systems will increase emphasis on reducing manning early in system design. It will provide hardware engineers with a data base of human capabilities and characteristics that will facilitate the HIS aspects of new acquisitions. This thrust will also focus on technology supporting task analysis, function allocation and automation and the resultant impact on training, skills and manpower requirements determination.

2. Personnel Management

●The Personnel Management vision of the future is to improve readiness and sailors quality of life by placing the right persons with the right skills in the right jobs at the right time, while allowing them direct participation in their assignment process.

●This category addresses DON's ability to achieve personnel readiness - to place the right personnel in the right job at the right time, and do it within budget. The path to personnel readiness is a complex process that begins with recruiting of quality people, proceeds through selection and classification into skills, initial and advanced training, management of the inventory of trained personnel, career and quality of life, and on to the distribution and assignment of personnel to jobs. This military force management process must also reflect shifting resource constraints and major societal changes.

●A major thrust in this area will be development of a new distribution system that will make accurate, rapid personnel assignments while allowing sailors direct participation in their assignment process. This thrust will use the latest technology to provide the capability for each sailor to have direct input to his/her assignment process. It will provide managers with instant access, retrieval and analysis of recruiting, training, detailing and billet data. The sailors will know immediately what their next assignment will be, what training is required and all other pertinent planning and move data. Another major thrust will be performance measuring and testing. The ability to accurately match recruits capabilities and desires to Navy jobs will reduce attrition, training costs and improve readiness and sailors' quality of life.

Round Table Results - The High priority band for Manpower / Personnel is dominated by man-machine interface issues. Reduced manning and manpower prediction and management models are also given high rankings. This distribution amplifies the concern for more efficient use of manpower as a key to reducing MPN budgets and also as a key to effective use of the high technology systems planned for the future.

TABLE IX. MANPOWER / PERSONNEL TECHNOLOGY AREAS

1. HUMAN PERFORMANCE	TIER	96 STRG
a. Decision Support: Develop methodologies or technologies to improve individual decision making. 1. Model and develop design characteristics of the cognitive process. 2. Reduce human information processing workload. 3. Enhance decision making under complex conditions, with sparse and/or ambiguous data. 4. Develop real-time modeling and simulation for course of action evaluation/selection	**H**	**9.1.a**
b. Performance Enhancement: Develop methodologies or technologies to enhance individual and team effectiveness: 1. Determine guidelines for optimum human/automation workload mix: dynamic function allocation. 2. Enhance physical capability with automation and tele- operations. 3. Enhance decision making capability with artificial intelligence/expert systems. 4. Enable implementation of Adaptive Automation in the Cockpit. 5. Improve ability of operators to detect impending problems/crises. 6. Evaluate impact upon performance of color vision.	**H**	**9.1.b**
c. Data Presentation/Manipulation: Develop technology for cognitive- friendly data/information, to include: 1. Critical information fusion for ease of comprehension that is relevant, timely and prioritized. 2. Tactical/situational awareness (individual and collaborative); exploit VE (virtual environment) and multimedia for visualization. 3. Reconfigurable data extraction filters and rapid browsing capability; intelligent agents. 4. Improved team/joint management tools for collaboration. 5. Advanced alerting systems for naval tactical console operators.	**H**	**9.1.c**
d. Incorporate Human-centric design into new systems acquisition. 1. Model human capabilities and limitations in support of design for human performance in early phases of ship acquisition. 2. Enable dynamic reallocation of automated vs human functions. 3. Provide seamless integration of decision support systems(DSS) into reduced manning watchstander positions. 4. Develop collaborative and intelligent aids for mobile watchstanders and emergency personnel.	**H**	**New**

2. PERSONNEL MANAGEMENT	TIER	96 STRG
a. Create technologies and methodologies to support a personnel distribution system for Active/Reserve Forces aligning the right sailors with the right jobs at the right time that incorporates flexibility, market-based principles, and is responsive to changing Navy roles. The new system should, 1. exploit advances in communications, decision support, computing, database, and advertising technologies, 2. accommodate both the Navy's need for continuous readiness with the sailor's need for stability and quality of life, and 3. handle fluctuations in personnel and distribution policies and budgets.	**H**	**New**
b. Develop decision support models and metrics that address the human resources to readiness" issues: 1. Optimization of end-strength. 2. Impact of manning changes (increases and decreases) on readiness. 3. Assessment and optimization of policy changes throughout the manpower/personnel spectrum.	**H**	**9.2.a**
c. Develop predictive models to determine impact of satisfiers/disatisfiers such as special pays, home-basing, OPTEMPO/PERSTEMPO on personnel retention.	**M**	**9.2.b**
d. Develop a predictive instrument that has accurate measures of personnel tempo (PERSTEMPO), to better support personnel assignment decisions. System should maximize unit cohesion while addressing issues such as: 1. Accurately measuring impact of personnel experience on fleet performance/readiness. 2. Determining Impact of skill deterioration determination and training capability. 3. Developing a longer (18-24 month), reliable and accurate requisition system.	**M**	**New**
e. Develop testing and personnel assessment tools that: 1. Radically extend the ability to explain recruits' aptitudes reducing attrition at later, more costly stages of training. 2. Accurately measure personnel attributes at each stage of a sailor's career. 3. Assess the desirability of recruiting sailors with pre-service criminal violations and project propensity for such individuals to succeed in the Navy. 4. Provide a medium for recruiters that will allow potential recruits to better visualize/experience the various types of work involved in a particular Navy rating to improve person/job match and personnel productivity. 5. Explore multiple approaches (i.e., multimedia, virtual reality).	**M**	**New**
f. Develop a predictive instrument and assignment model that determines best unit assignment for individuals to maximize unit readiness.	**L**	**9.2.c**
g. Develop manpower estimation tools for acquisition of new systems.	**L**	**9.2.d**
h. Evaluate/develop survey technologies and methodologies that will allow for rapid, timely and accurate responses to potential policy issues requiring opinions of sailors and officers.	**L**	**New**

i. Evaluate/develop the capability to accurately understand and measure impact of demographic diversity on recruiting, retention, manning and readiness.	**L**	**New**
j. Improve the civilian personnel planning process by developing decision support technologies/systems that will allow integrated planning at the skill level (series and grade).	**L**	**New**

3. LINKAGES TO OTHER FUNCTIONAL AREAS	**TIER**	**96 STRG**
a. Manning - Coordinate with Warfare Sponsors in the develop of systems, processes, and technologies that result in reduced manpower requirements.	**H**	**New**
Chapter 1, C4 -- 3. MAN-MACHINE INTERFACE **b. Develop technology for display functionality that is automatically configurable to the user's (warfighter's) needs with minimum man- machine interface.** 1. System must be capable of providing automatic correlation /data fusion of organic and non-organic information. 2. System must manage, store, retrieve, and disseminate relevant contact data for timely, optimized and prioritized data display. 3. Man-machine interface must minimize human interaction in order to produce an optimized display for the tactical situation.	**H**	**1.5.a**
c. Develop tools to allow the analyst to access/manipulate/analyze data more efficiently. 1. Develop capability to retrieve data for fast browsing of data. 2. Develop capability for automated screening/filtering of data. 3. Provide automated capability to recognize target / signal of interest. 4. Provide automated capability to detect/flag changes in area of interest. 5. Adaptive output including multimedia to attract immediate attention of users when necessary but not distracting to the user.	**H**	**1.5.b** **b.2 correlates to 96 STRG 1.6.f**
d. Design "expert agents" as tactical aids that support the employment of weapons and provide an as-soon-as-possible reaction time while enabling correct, flexible decision making and control of weapons.	**H**	**1.5.e**

e. Develop mission planning methodologies and technologies which are simple and easy to use, traceable to commander's requirements, doctrinally correct, and provide for collaborative planning at all levels. 1. All levels share a common planning core in a common operating environment. 2. Sufficient independence of operation environment to permit easy migration to other environments as technology advances. 3. Automatic update (< 2 hrs) of plans to/from next level up/down. Real time, concurrent update to/from next level. 4. Define littoral battlespace in terms of meteorological / oceanographic / MC&G parameters. 5. Develop collaborative planning systems that allow joint/combined forces to operate as effectively as a single unit. 6. Develop systems that simplify the replacement of similar systems from other countries or services. 7. Develop functional modeling techniques to support virtual reality and incorporate them into planning, training, and assessment processes.	**H**	**1.5.f**
f. Develop technologies to support integration and development of enhanced modular combat operations centers with standardized procedures and advanced technology displays of tailored information.	**M**	**1.5.g**
g. Develop better ways to visualize information in order to enhance pattern recognition.	**M**	**1.5.h**
h. Develop technologies for voice recognition systems which will be effective in the naval environment.	**M**	**1.5.i**
i. Model the cognitive process to deliver information in such a way to complement the way the brain works and prevent information overload.	**M**	**1.5.k**
j. Develop technologies and methodologies to translate text and speech among several foreign languages and alphabets.	**M**	**1.6.a**
k. Develop technologies to provide aircraft avionics with a virtual reality interface and the capability to learn from the operator.	**L**	**1.5.c**
l. Develop 3-D display Technology for the naval environment.	**L**	**1.5.j**
m. Develop technologies for the miniaturization of C4 equipment to maximize portability and match physical limitations of users.	**L**	**1.5.l**

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Chapter 10

TRAINING

Introduction - The Navy's training vision is to be capable of delivering quality training to the right people at the right time and at the right place as part of a career long training continuum supporting Navy operational readiness and personnel excellence. Training in the future must be closely coordinated with manpower, personnel and human performance initiatives in order that the Navy have a cohesive approach to reducing manpower costs while increasing training efficiencies and effectiveness. Changes in force structure will mean fewer people to do more complex jobs, coupled with the requirement for swift, short-notice response. Emphasis on affordability and readiness is key to the Navy's training continuum.

Training includes all training required to maintain fleet and shore-establishment readiness. It includes the schools, classrooms, other training facilities, instructional aids and support systems, training simulators and stimulators, training services, mission rehearsal systems, support personnel and instructors/staff. It also includes simulation for training and mission rehearsal as well as for defining S&T requirements. Training must be adaptable, responsive, global, efficient and consistent.

Technology for training focuses on the development, deliverly,conduct and management of instructional programs and on the development of simulators, training devices and other training systems. To maintain a high state of readiness we must develop not only new ways for people to learn and to retain that learning in a variety of environments, but also to capture the knowledge and skills of experts and make them readily accessible to sailors when they need them. Navy training is an investment in readiness. Our training must move from the traditional centralized residential schoolhouse training to distributed interactive environments. Technology requirements for training will be driven by the need to provide cost efficient, quality training for individual skill trainng, team training, battle force/battle group trianing as well as Joint combined operations.

The benefits of focusing S&T investment on the interdependent manpower, personnel, training and human performance mission areas will include enhanced personnel readiness at lower cost with effective training delivered where and when required.

Requirements Categories - Underlying Training are three sub-categories which are grouped as follows:

1. Training Strategies and Methods

2. Instruction Delivery

3. Management of Training Resources

Linkages to Other Functional Areas

1. Training Strategies and Methods

- This category involves strategies and methods which will result in the ability to train more rapidly and effectively and yet be able to make timely changes in training methods and materials.

2. Instruction Delivery

- Instruction delivery addresses requirements for effective training in dispersed geographic areas, in a variety of environments and at affordable cost.

3. Management of Training Resources

- This category focuses on management of resources for greater effectiveness with a smaller training establishment as the Navy becomes smaller.

Round Table I Results - The Round Table High rankings placed emphasis on embedded and on-demand training capabilities for shore based, ship board and forward deployed forces with the capability for large scale linking for tactical training between platforms and commands.

TABLE X. TRAINING

1. TRAINING STRATEGIES AND METHODS	TIER	96 STRG
a. Innovate and optimize instructional approaches (e.g., on-demand and just-in- time training) for initial, replacement, refresher and joint training: 1. Develop training based on fleet-based common tactical picture. 2. Combine real-life training with realistic simulation and stimulation. 3. Examine methodologies and technologies such as media options and gaming, conduct cost-benefit and risk assessment and risk management analyses, and assess applicability to specific job performance goals. 4. Develop advanced technologies (e.g., virtual reality) to make simulation more realistic. 5. Develop improved techniques to support embedded training. 6. Make training fun and relevant.	**H**	**10.1.a**
b. Develop *in situ* training to reduce training time away from unit and increase number of people receiving the training and proficiency.	**H**	**10.1.f**
c. Improve capability to evaluate training. Provide: 1. Methods to evaluate individual and group performance and proficiency. 2. Methods to rate course/exercise effectiveness.	**H**	**10.1.g**
d. Develop models and technologies to optimize human ability to learn through understanding how people learn and how instructional devices and job performance aids can augment and enhance these learning capabilities. Develop cognitive learning techniques.	**H**	**10.1.h**
e. Develop the technologies to allow forward presence forces to conduct appropriate training and exercises.	**M**	**10.1.d**
f. Correlate changes in training to mission effectiveness.	**M**	**10.1.c**
g. Develop complements to live-fire training.	**M**	**10.1.e**

2. INSTRUCTION DELIVERY	TIER	96 STRG
a. Develop 3-D virtual reality simulators for naval environments.	**H**	**10.2.a**
b. Provide technologies to support realistic, large- scale naval and joint tactical training: 1. Link wide range of geographically dispersed units, platforms, weapon systems, models, simulators and databases to exercise all elements. 2. Maximize performance under highly stressful conditions. 3. Provide timely post-ex evaluation and diagnostic feedback to all hands. 4. Provide for rapid development and modification of complex scenarios. 5. Increase interoperability for joint training. 6. Enhance systems to optimize utilization of system sensors in targets and training. 7. Develop techniques for brigade (BG) and Joint Task Force (JTF) level simulation and stimulation.	**H**	**10.2.d**
c. Develop shipboard training technologies and methodologies, such as embedded training, as an increasingly important means of delivering individual and team training.	**H**	**10.2.g**
d. Enhance ability to provide individual and group training and mission rehearsal: 1. Maximize student comprehension and retention. 2. Provide deployable, reconfigurable training systems. 3. Optimize balance and interface between shore and fleet training. 4. Develop common architectures for training systems.	**M**	**10.2.c**
e. Develop capability to measure and maintain unit individual proficiency at all tasks: 1. Provide capability for training on demand. 2. Provide capability to customize training to missions and environments. 3. Provide capability to customize training to individuals.	**M**	**10.2.e**
f. Develop reconfigurable and adaptive training systems technologies for both individual and groups.	**M**	**10.2.h**
g. Provide student and team instruction techniques to deliver effective, just-in-time training anywhere on demand.	**M**	**10.2.b**
h. Develop technologies to enhance onboard training systems that integrate all ship sensors and fire control systems.	**L**	**New**
i. Develop improved technologies to enhance range training capabilities	**L**	**New**
j. Develop training technology for medical personnel such as: Just-in-time, enroute training, onsite refresher trauma training, virtual reality training.	**L**	**New**

3. MANAGEMENT OF TRAINING RESOURCES	TIER	96 STRG
a. Develop methodologies and technologies to optimize development and maintenance of instructional materials: 1. Develop techniques for task analysis, objective setting, media selection, curriculum development, and effectiveness measurement. 2. Improve writing and content of instructional materials. 3. Reduce reliance on paper-based technical and training materials. 4. Develop dynamic, real-time life-cycle management of materials. 5. Ensure adaptability to advancing technology and methodology.	**L**	**10.3.c**

4. LINKAGES TO OTHER FUNCTIONAL AREAS	TIER	96 STRG
Chapter 1, C4 -- 6. COMMAND AND CONTROL **b. Develop technologies for timely battle management capability for joint/combined operations.** 1. Provide planning information that is automated 2. Develop systems that provide initial capability for interactive dissemination with low data rate/video/imagery capability 3. Provide initial rehearsal capability that has a low data rate/ video/imagery exchange 4. Real time dissemination of time-critical orders. 5. Horizontally and vertically concurrent in real time. 6. Prioritization of actions or decisions required.	**M**	**1.1.k**
Chapter 3, AIR WARFARE -- 4. MISSION REHEARSAL AND ASSESSMENT **a. Develop realistic scene generation** 1. Improve image quality 2. Enable high speed, all altitude "Fly through" 3. Develop small, field deployable systems	**L**	**New**
b. Develop an imbedded training capability in aircraft platforms 1. Direct digital mission recording and analysis 2. Performance measurement	**L**	**New**

Chapter 5, MINE WARFARE -- 4. PLATFORM SURVIVABILITY **a. Develop tactical decision aids (TDAs) to support MIW mission planning and related MIW training as follows:** 1. Predict a minefield's boundaries, the mine content within those boundaries, the risk to traffic and the likelihood of success for a given MCM mission. 2. Define optimal minefield boundaries as well as the mine density, configuration and settings needed to achieve a commander's goals. 3. Predict interrelationships of mining intelligence, mine laying and clearing activities, area reconnaissance and naval operations against suspected/known/ unknown minefields, and then predict the likelihood of mission success in various timeframes and also accurately predict the mine risk or probability of safe transit to the tactical commander.	**H**	**5.1.B**
Chapter 6, UNDERSEA WARFARE -- 8. TRAINING **a. Integrate the global atmospheric and ocean models into a Defense Simulation Network and then utilize the models for high fidelity simulations to aid in training and to develop improved sensors, weapons and platforms.**	**L**	**New**
Chapter 7, AMPHIBIOUS WARFARE -- 5. TRAINING AND EDUCATION **a. Develop training systems and delivery technologies with the following characteristics:** 1. Embedded and/or appended training capability for all operational systems possible. 2. Capability to enhance live fire and field maneuver training. 3. Capability to rapidly generate simulated training situations, missions, and scenarios. 4. Low cost/small sized simulation generation platforms. 5. Adaptive automated forces for simulations. 6. Capability for automated and custom training design and setup.	**M**	**New**
b. Develop training strategies, concepts, methodologies, and analysis for: 1. Evaluating individual and group training needs. 2. Decision making training.	**L**	**New**
c. Develop training systems integration technologies that are: 1. Unit, site, level and system interoperability capable. 2. Environmentally compatible.	**L**	**New**

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Chapter 11

MEDICAL/PERSONNEL PROTECTION

Introduction - The objectives of medical technology area are to maximize health, safety and mission performance of military personnel. Traditional roles have centered around supporting the combat readiness of the Navy and Marine Corps by supporting global medical requirements to accomplish the missions. As the nature of deployment for combat troops changes, so must medical support. Consequently, preventive medicine practiced on collective and individual levels, aerospace medicine, human factors and human capabilities in relation to new weapons and platforms are emphasized.

Navy medicine encompasses aspects of medical practice from basic research to mass casualty treatment. From pure research to battlefield medicine of the most basic nature, medical developments affect the capability of Navy personnel to accomplish the mission. The S&T Round Table considered many areas within its functional area in the early stages of the round table process. After review of the FY 95 medical functional architecture, other medical requirements were added to complete a list relevant to current needs.

For 1997 the Medical community used the Vanguard 96 Medical wargame and a subsequent requirements workshop to review, validate and update the requirements from the 96 STRG. This process resulted in significant improvements to the requirements set, and because of its advanced state of preparation and consensus the Medical chapter was used to lead off the Round Table process while participants learned the new groupware and voting systems.

Requirements Categories - This list, comprising five categories pertaining to medicine and the protection of military personnel, spans traditional areas of concern:

1. Combat Casualty Care - Casualty Management

2. Operational Medicine - Assessment & Detection

3. Combat Casualty Care - Delivery and Treatment

4. Operational Medicine - Prevention

5. Operational Medicine - Treatment

1. Combat Casualty Care - Casualty Management

- This category addresses those requirements for development of improved management of operational casualties, including Special Operations Forces, through improved afloat medical facilities, and treatment regimens.

2. Operational Medicine - Assessment & Detection

- This category includes those requirements needed to detect and assess operational and occupational health threats. Operational health threats include chemical and biological weapons and non-lethal weapons. This category address occupational health threats including radio frequency radiation, industrial chemicals, and noise.

3. Combat Casualty Care - Delivery and Treatment

- Combat Casualty Care - Delivery and Treatment includes those requirements for the development of products and treatment regimens to decrease morbidity and mortality of combat injuries.

4. Operational Medicine - Prevention

- Operational Medicine - Prevention addresses prevention of operational and occupational health threats through vaccine development, disease identification, and risk prevention.

5. Operational Medicine - Treatment

- This category addresses those requirements for development of neutralization and treatment of operational and occupational health threats including neutralization of chemical and biological agents, countermeasures for performance degradation, and limiting effects of Navy specific hazardous materials.

Round Table Results - The review and discussion at the Round Table amplified results from the Vanguard wargame. The High priority category is dominated by combat casualty care issues and technologies to detect and mitigate chemical and biological threats.

TABLE XI. MEDICAL / PERSONNEL PROTECTION

1. COMBAT CASUALTY CARE -CASUALTY MANAGEMENT	TIER	96 STRG
a. Improve management protocols for operational casualties in Naval Expeditionary Forces and small unit operations. 1. Develop a "smart splint" 2. Develop an analgesia without central nervous system depression.	**H**	**11.4.a**
b. Develop technologies to improve connectivity and information management in the medical facility. Ensure connectivity to Command C4I. (Link to C4I requirements). 1. Develop field methods to electronically track casualties and monitor treatment rendered.	**H**	**11.4.b**
c. Improve mass casualty management (to include war game modeling and simulation) that includes echelon I, II, and NBC.	**H**	**11.4.c**
d. Develop medical training technologies, (e.g. for Independent Duty Corpsman.) Link to Training Support Technology Areas. 1. Develop tactical corpsman/M.O computer game that teaches realistic casualty treatment/evacuation using only equipment and medications available at echelon. 2. Provide specific mission rehearsal training and simulations. 3. Provide specific medical specialty training (e.g. anesthestist). 4. Provide medical refresher training. 5. Provide on-demand and just-in-time training.	**H**	**New**

2. OPERATIONAL MEDICINE - ASSESSMENT AND DETECTION	TIER	96 STRG
a. Determine bio-effects of non-lethal technologies that affect bodily functions, such as brain waves, hearing, vision, low frequency water-borne sound.	**H**	**11.1.a**
b. Develop technologies for more sophisticated chemical/biological agents (weaponized and non-weaponized) detectors suitable for individuals and equipment for land, sea, and air applications.	**H**	**11.1.c**
c. Develop technologies for expert medical systems (e.g. a Smart Medical Department) to accomplish surveillance, analysis, and monitoring of shipboard environment to include: BW/CW agents, air quality, temperature, water quality, radiation, toxic hazards, etc.	**H**	**11.1.h**
d. Identify and evaluate reproductive hazards in men and women in operational environments.	**M**	**11.1.d**
e. Improve medical criteria for Naval duty in operational environments: 1. Develop validated mannequin/engineering model for cockpit development. 2. Develop anthropometric gender- neutral safety limits. 3. Provide gender-neutral anthropometric requirements for cockpit. 4. Reduce neck and back strain in combat aviators. 5. Develop safe ejection criteria for next generation aircraft. 6. Evaluate effects of corneal surgery, e.g. photo refractive keratectomy (PRK), on aviation and diving mission performance. 7. Improve predictive mechanics of psychological/ sociological/medical adaptability & screening. 8. Develop methods to screen for susceptibility to spatial disorientation 9. Develop gender neutral physical readiness requirements criteria.	**M**	**11.1.e**
f. Identify issues associated with women in operational environments. 1. Evaluate epidemiological data and provide tools regarding medical impact of women at sea. 2. Identify issues associated with women in aviation. 3. Provide user-accepted urinary collection devices. 4. Establish impact acceleration limits for females (cadaveric studies). 5. Determine ejection escape induced hazards.	**M**	**11.1.f**
g. Develop measures and quantification of Radio Frequency (RF) and microwave energy absorption in humans to establish safe exposure limits.	**M**	**11.1.i**
h. Develop reagents with longer shelf lives, reduced refrigeration requirements.	**M**	**11.1.k**
i. Automate/enhance laboratory procedures for independent duty corpsmen. 1. Rapid field diagnostics (e.g. a dipstick for Malaria) 2. Metabolic sensors.	**M**	**11.1.l**
j. Optimize physical fitness programs to minimize injury and sustain/enhance performance.	**L**	**11.1.g**

3. COMBAT CASUALTY CARE - DELIVERY AND TREATMENT	TIER	96 STRG
a. Develop improved blood products and blood substitutes. 1. Increase reconstitution throughput of blood products and blood substitutes. 2. Eliminate immuno-reactivity in emergency transfusion.	H	11.5.a
b. Develop techniques for immune modulation.	H	New
c. Develop early detection and location capability for incapacitated and injured personnel. 1. Real-time, in situ portable life sign monitor. 2. Remote sensing of medical data (vital signs monitor). 3. Identification Friend or Foe (IFF) capability desired.	H	11.5.g
d. Develop rapid non-invasive blood chemistry monitoring.	M	11.5.b
e. Develop improved wound debridement and wound healing technologies.	M	11.5.c
f. Develop technologies for the shipboard manufacture of injectable fluids to reduce logistical burden.	M	11.5.f
g. Develop organ replacement therapy for operational injuries.	L	11.5.d
h. Develop treatments for laser eye injuries.	L	11.5.e
i. Develop a safe medical quality oxygen (O2) generating and distribution system for shipboard and field use.	L	New
j. Develop protocols for optimum resuscitation as a function of time to definitive surgical intervention. 1. Provide trauma and transport life support care litter capability. 2. Develop capability for forward resuscitative surgery. 3. develop capability for portable (17-20 pound) life support diagnostics.	L	11.3.g

4. OPERATIONAL MEDICINE - PREVENTION	TIER	96 STRG
a. Create a universal vaccine for biological warfare agents with no side effects	**H**	**11.2.a**
b. Develop technologies for lightweight, user-friendly, and reusable Military Operations Protective Posture (MOPP) gear. Develop passive systems for personnel defense. 1. Implement advanced respiratory protection and antibody development. 2. Develop agent-impermeable membranes. 3. Improve body armor. 4. Determine personal and collective protective equipment requirements for protection from chemical, biological and radiological attack.	**H**	**11.2.e**
c. Eliminate human factors errors/problems that put personnel at risk. 1. Develop predictive models of mishaps arising from human error. 2. Develop deployable human impairment testing systems. 3. Develop improved cognitive performance monitors in naval operations. 4. Develop automatic pilot physiological monitoring and feedback system. 5. Develop human factors hazards assessments and countermeasures for risks from emersion in or transition to/from virtual environments. 6. Evaluate human factors contributing to excessive risk in the flight deck environment and develop strategies to mitigate those risks. 7. Provide alternative methods for maintaining spatial orientation. 8. Optimize countermeasures for air sickness and simulator sickness.	**M**	**11.2.b**
d. Improve identification/prevention/treatment of new or re-emerging military relevant diseases.	**M**	**11.2.c**
e. Refine metrics to determine effect of military chemical, biological, and protective gear on individual performance.	**M**	**11.2.d**
f. Develop technologies to minimize thermal effects on human physiology (undersea, aerial, surface).	**M**	**11.2.g**
g. Develop non-corrosive, reusable agents for equipment and self-decontamination	**M**	**New**
h. Develop improved predictive models for the prevention and treatment of dental emergencies.	**L**	**11.2.h**

5. OPERATIONAL MEDICINE -- TREATMENT	TIER	96 STRG
a. Create technologies for systems to neutralize chemical/biological agents rather than just using physical shielding (MOPP)	**H**	**11.3.a**
b. Develop countermeasures for performance degradation due to environmental factors (e.g., fatigue, thermal stress, combat stress, and including the CBR environment.).	**H**	**11.3.e**
c. Develop potable water contamination indicator technology.	**M**	**11.3.b**
d. Develop an orally administered insect repellent.	**M**	**11.3.f**
e. Develop methods to decrease/treat decompression sickness and to predict/prevent oxygen toxicity. 1. Identify basic mechanisms of oxygen toxicity and decompression sickness. 2. Increase multi-level repetitive diving duration and decrease decompression requirements. 3. Integrate oxygen O2 and carbon dioxide (CO2) machine sensors with human sensors for multi-level diving.	**L**	**11.3.d**
f. Determine optimum fluid resuscitation as a function of time to definitive surgical intervention.	**L**	**11.3.g**
g. Develop performance enhancing drugs/diet/equipment	**L**	**New**
h. Develop protocols for optimum resuscitation as a function of time to definitive surgical intervention.	**L**	**New**

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Chapter 12

BATTLESPACE ENVIRONMENT AND SUPPORT

Introduction - Battlespace Environment and Support focuses on the development of technologies, models and systems to provide environmental information, Precise Timing and Astrometry (PTA), and meteorological and oceanographic forecasts and weapons effects data to Naval Forces afloat and ashore in support of their operations. This includes the capability to generate current and future weather forecasts and get them to the forces that need them in real-time. Technology development in this area will aid in the development of meteorological and oceanographic models capable of providing forecasts well into the future and sensors to provide inputs into these models.

Environmental Support develops processes and materials which are environmentally safe and compliant for the operating forces and the geographical locations in which U.S. Navy and Marine Corps forces operate. Technology in this area will aid in the development and transition of new Meteorological and Oceanographic (METOC) options and capabilities for data acquisition, assimilation, and applications to provide real time characterization and knowledge of the battlespace environment for our Naval and Joint forces. This includes METOC models capable of providing forecasts well into the future and multiple sensor packages to provide inputs into these models.

In addition, precise time and astrometric data are necessary to accurately fix positions in four dimensional space of the warfighter and targets to maximize damage to the targets while minimizing collateral damage. For example, more precise timing and astrometric star data can significantly improve navigation, and geopositioning via space surveillance systems.

Environmental Support develops processes and materials which are environmentally safe and compliant for the operating forces and the geographical locations in which U.S. Navy and Marine Corps forces operate. Technology in this area will aid in the development of sensors and systems to detect and safely process environmentally hazardous materials and emissions. It will also aid in the development of new materials and processes used in weapons systems, ships, submarines, aircraft and shore facilities that are environmentally friendly.

Requirements Categories - Underlying Environmental Support are four sub-categories which are grouped as follows:

1. Meteorological and Oceanographic Support (METOC)

2. Environmental Sensors and Processes

3. Environmentally Compliant Platforms

4. Materials Management

Linkages to Other Functional Areas

1. Meteorological and Oceanographic Support (METOC)

•To be able to provide the most accurate meteorological and oceanographic forecasts in real-time, high resolution, advanced simulation forecasting models need to be developed that will support forecasts out well into the future. These forecasting models must be able to support both open ocean and littoral areas including undersea. They also require sensor systems, both on-board and deployable, that can provide real-time inputs. Finally, technology is required to develop the capability to assist in environmental mine warfare to monitor the natural forces acting upon mines while they are deployed and then provide an analysis of that information.

2. Environmental Sensors and Processes

•The Navy must reduce the amount of hazardous emissions and use of hazardous materials in its operations to meet the target of developing environmentally sound weapon systems. Emissions range from liquids, aerosols and gases to acoustics. It is necessary to develop new processes to eliminate or minimize hazardous emissions and develop new materials/processes to reduce/eliminate the use of hazardous materials. New methods for the safe testing of weapons are required to reduce the environmental impact of testing.

3. Materials Management

•Materials management involves the safe handling and disposition of hazardous materials and wastes (cradle to grave

design and acquisition). Such materials and wastes include cleaning and de-greasing agents used in hull cleaning and blasting, shipboard coatings and paints, ozone-depleting substances, marine sludge and sediments from remediation and reclamation and hazardous waste destruction. The focus of this sub-category is on the identification of problems and its elimination through material substitution and process changes.

4. Environmentally Compliant Platforms

•To insure it operates environmentally compliant platforms, the Navy must develop processes and systems for control, treatment, and destruction of shipboard wastes including solids, plastics, sewage, power plant emissions and oil and non-oily liquid wastes. It must also develop techniques to prevent the incidental intake and transport of non-indigenous marine species in ballast water.

Round Table Results - The Round Table rankings placed emphasis on the knowledge and prediction of the battlespace environment and the development of organic sensors and systems for in situ measurement and connectivity to weapons systems and tactical decision aids.

TABLE XII. BATTLESPACE ENVIRONMENT AND SUPPORT

1. METEOROLOGICAL AND OCEANOGRAPHIC SUPPORT (METOC)	TIER	96 STRG
a. Provide the technologies to enable real-time weather forecasting and "now casting." Key weather parameters can include factors such as precipitation, visibility, fog, cloud cover and heights, aerosols, as well as terrain-induced mesoscale and microscale circulation patterns and anomalies. 1. Develop 3-D models and simulations of containment and dispersion effects in the marine environment. 2. Develop environmental warfare countermeasures to include dispersion and effects models.	**H**	**12.4.a**
b. Develop organic, high-resolution, fully functional oceanographic and meteorological models of the littoral region, e.g., from the shelf break to the beach and including estuarine areas that can assimilate multi- sensor data, are re-locatable, may be coupled or nested, and are seamless at all boundaries between models.	**H**	**12.4.c**
c. Improve the resolution of oceanographic and atmospheric analysis and forecasting models and provide these improved models on board ship for use in sensor and weapon system employment, and as tools to help develop new systems (i.e., LFA) and to maintain battlespace dominance.	**H**	**12.4.g**
d. Develop the technologies to provide organic, high-resolution, fully functional oceanographic and meteorological analyses, or "now casts," of the littoral region, even for those denied areas where direct measurements are not possible.	**H**	**12.4.e**
e. Develop technologies to provide the capability to perform the following real-time, in situ, environmental monitoring and analysis of the natural forces that act upon platforms/weapons while they are deployed: 1. Monitor and measure relevant in-situ geophysical, marine biological, magnetic, optical, oceanographic, hydrographic and meteorological parameters. 2. Link these data in real-time with historical databases of related data to provide real time display. 3. Provide instantaneous analysis in an understandable format to the task force commander and other local or remote users.	**H**	**12.4.j**

f. Develop technologies for an onboard and deployable suite of sensors (possibly including UUVs) to sample the undersea environment in any given area, including a rapid survey for bathymetry and bottom analysis, and then communicate this in situ oceanographic and atmospheric information to ships and primary production centers in real-time.	**M**	**12.4.f**
g. Improve the scientific understanding of the environmental physics of the littoral environment to aid in: 1. The design of remote sensors, in situ sensors and undersea weapons. 2. Sensor and weapon prediction performance models. 3. Non-acoustic methods of submarine and mine detection.	**M**	**12.4.d**
h. Develop a more complete understanding of the physics involved in monitoring the environmental parameters associated with MCM, and in the physics associated with sensor vs. mine vs. environment interactions, effects on performance and overall system effectiveness.	**M**	**12.4.i**
i. Improve battlespace atmospheric (WX) characterizations to support precision weapon delivery, cruise missile strike, target identification, BDA. and reconnaissance	**M**	**New**
j. Provide observation strategy for atmospheric moisture and temperature profiles to collect real time data for littoral warfare and the initiation of air/sea models.	**M**	**New**
k. Develop technologies for an effective communication architecture to provide on scene commanders and theater operations managers with timely and detailed environmental characterizations for the highest priority areas of regional conflict.	**L**	**12.4.b**
l. Develop global oceanographic and meteorological forecast models that are accurate out to X days and can be used with the littoral seas models and with other higher resolution models of regional areas.	**L**	**12.4.h**

2. ENVIRONMENTAL SENSORS AND PROCESSES	**TIER**	**96 STRG**
a. Determine the effects of acoustic and other emissions on marine mammals and threatened/endangered species: 1. LFA effects 2. Technology to assess and mitigate effects of operations on endangered species	**H**	**12.1.d**
b. Develop materials, processes and sensors for improved sensing and monitoring of systems in marine environments.	**H**	**12.1.g**
c. Develop a Navy unique knowledge base to address and support operations specifically driving compliance/legal mandates.	**M**	**12.1.a**
d. Develop technologies to improve procedures for blast-noise mitigation on test ranges	**M**	**12.1.e**
e. Develop technologies to support Special Operations Forces (SOF) capabilities to counter environmental destruction and degradation, such as oil well shutoffs, chemical containment and neutralization, fire retardant, etc.	**M**	**12.1.f**
f. Develop technologies to reduce environmental effects of weapons testing	**M**	**12.1.m**
g. Develop methods to acoustically detect and track marine mammals to ranges of 10nm	**M**	**New**
h. Develop improved processes for waste minimization, in ordnance manufacturing and demilitarization.	**L**	**12.1.l**
i. Develop real-time, in situ sensors to measure Navy unique effluents.	**L**	**12.1.o**

3. ENVIRONMENTALLY COMPLIANT PLATFORMS	TIER	96 STRG
a. Develop processes for treatment and destruction of shipboard solid, hazardous, medical and plastic waste.	**H**	**12.3.a**
b. Develop processes for the treatment and destruction of shipboard gray and black liquid waste.	**M**	**12.3.c**
c. Develop processes for control, treatment and destruction of oily liquid waste: 1. Improved oil-water separation. 2. Sensors which will not be masked by contaminated (i.e., AFFF) oily bilge water. 3. High volume oil-water separators for aviation wash racks. 4. Improved bilge water containment and treatment.	**M**	**12.3.e**
d. Develop technology to reduce incidental intake and transport of non-indigenous marine species in ballast water.	**L**	**12.3.f**
e. Develop technologies for a system to prevent discharge of fuel entrapped in compensating ballast water from fuel system.	**L**	**12.3.g**

4. MATERIALS MANAGEMENT	TIER	96 STRG
a. Develop technologies to control or reduce emissions from coatings, strippers and cleaners.	**H**	**12.2.c**
b. Develop technologies for improved marine sediment/dredge spoil decontamination, remediation and reclamation.	**M**	**12.2.b**
c. Develop improved coatings and coating techniques: 1. More durable non-skid systems. 2. Advanced development of anti- fouling/fouling release hull coatings. 3. Improved paint stripping and blast media technologies. 4. Environmentally benign internal/external anti-fouling coatings.	**M**	**12.2.e**
d. Develop technologies for alternative refrigeration/cooling equipment	**L**	**New**

5. LINKAGES TO OTHER FUNCTIONAL AREAS	TIER	96 STRG
a. Develop high-resolution dynamic access to world wide digital ocean bottom topography data bases such that operators can update standard products with locally acquired information from special reconnaissance or other sources. Include mine-like objects and surf zone bathymetry to support amphibious assaults and Operations Other Than War (OOTW).	M	5.7.a
b. Provide navigational and geopositioning accuracy at the meter level via improved time (UTC-USNO) and time dissemination.	M	1.7.a
c. Provide accurate geopositioning (4 meter level) to all theater and allied users via space based assets using improved astrometric catalogs. Provide Global Positioning System (GPS) back-up system via improved multi-wavelength (optical/infrared) star positions.	M	1.7.a
d. Define distribution and dynamics of bioluminescent organisms and advise of signature effects and other risks from toxic and hazardous marine species. Examine layer formation of interest in optics and ecology of blooms, chemistry of marine aerosols, surfactants and colored dissolved material.	M	7.2/7.3

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Appendix 1

List of Acronyms

You can Scroll down or click once on the first letter of the acronym

[A][B][C][D] [E][F][G][H][I] [J][K][L][M][N] [O][P][Q][R][S] [T][U][V][W]

•A•

A/D - Analog to Digital

AO - Area of Operations

AAA - Anti-Aircraft Artillery

AAAV - Advanced Amphibious Assault Vehicle

AAM - Air-to-Air Missile

AAW - Anti-Air Warfare

ADC - Automated Damage Control

AEW - Airborne Early Warning

AFFF - Aqueous Fire Fighting Foam

AOA - Amphibious Operating Area

AOR - Area of Responsibility

APAR - Active Phased Array Radar

ASCM - Anti-Ship Cruise Missile

ASTOVL - Advanced Short Take-Off, Vertical Landing

ASuW - Anti-Surface Warfare

ASW - Anti-Submarine Warfare

ATDG - Advanced Technology Demonstration Guidance

ATO - Air Tasking Order

ADC - Automated Damage Control

•B•

BDA - Battle/Bomb Damage Assessment

BDI - Battle Damage Information

BG - Brigade/Battle Group

BLT - Battalion Landing Team

•C•

C2W - Command and Control Warfare

C4 - Command, Control, Communications and Computers

C4I - Command, Control, Communications, Computers &Intelligence

CBM - Conditioned Based Maintenance

CBR - Chemical, Biological, Radiation

CCM - Counter-Countermeasures

CEC - Cooperative Engagement Capability

CEP - Circular Error Probability

CFC - Chlorofluorocarbons

CID - Combat ID

CINC - Commander In Chief

CINCLANTFLT -Commander In Chief, Atlantic Fleet

CINCPACFLT -Commander In Chief, Pacific Fleet

CLF - Combat Logistics Force/Commander, Landing Force

CLZ - Craft Landing Zone

CNR - Chief of Naval Research

COA - Course of Action

CONOPS - Concept of Operations

CONUS - Continental United States

COTS - Commercial Off-The-Shelf

CTI - Command Technology Issues

CVBG - Carrier Battle Group

CW/BW - Chemical/Biological Warfare

•D•

DAMPS - Denied Area Measurement and Processing System

DARO - Defense Airborne Reconnaissance Office

DARPA - Defense Advanced Research Project Agency

DBA - Dominant Battlespace Awareness

DBK - Dominant Battlespace Knowledge

DBM - Data Base Management

DEPTEMPO - Depot/Deployment Tempo

DIV - Division

DMA - Defense Mapping Agency

DOE - Department of Energy

DON - Department of the Navy

DSS - Decision Support System

DSWA - Defense Special Weapons Agency

•E•

ECCM - Electronic Counter-Countermeasures

ECM - Electronic Countermeasures

EFI - Electromagnetic Field Interference

EMP - Electro Magnetic Pulse

EO - Electro-Optic

EOD - Explosive Ordnance Disposal

ESM - Electronic Support Measures

EW - Electronic Warfare

•F•

FCS - Fire Control System

FDDI - Fiber optic Digital Data Interface

FFTS - Forward From The Sea

FLIR - Forward Looking InfraRed

FMS - Foreign Military Sales

FOTC - Force Over-the-horizon Track Coordinator

FOV - Field of View

•G•

G & C - Guidance and Control

GCCS - Global Command and Control System

GOB - Ground Order of Battle

GPD - Gallons Per Day

GPS - Global Positioning System

•H•

HARM - High-speed Anti-Radiation Missile

HAZMAT - Hazardous Materials

HF - High Frequency

HM & E - Hull Maintenance & Electrical

HMMWV - Highly Mobile Multi-purpose Wheeled Vehicle

•I•

I & W - Indications and Warnings

IADS - Integrated Air Defense Systems

ID - Identification

IDC - Independent Duty Corpsman

IFF - Identification Friend or Foe

IOC - Initial Operational Capability

IR - Infrared

IRAD - Internal Research and Development

IRST - Infrared Search and Track

ISAR - Inverse Synthetic Aperture Radar

ISR - Intelligence, Surveillance and Reconnaissance

ITV - In Transit Visibility

IW - Information Warfare

•J•

JLOTS - Joint Logistics Over-The-Shore

JMA/SA - Joint Mission Area/Support Area

JMCIS - Joint Maritime Command Information System

JMOCC - Joint Maritime Operations Command Center

JROC - Joint Requirements Oversight Council

JTF - Joint Task Force

JTG - Joint Task Group

JTIDS - Joint Tactical Information Distribution Systems

JTN - Joint Targeting Network

•K•

Kb - Kilobytes

•L•

LABS - Laser Airborne Bathymetry System

LAN - Local Area Network

LASER - Light Amplification by Stimulated Emission of Radiation

LCAC - Landing Craft, Air Cushioned

LCC - Amphibious Command Ship/Life Cycle Costs

LCU - Landing Craft, Utility

LF - Low Frequency

LFA - Low Frequency Active

LIDAR - Light Detecting And Ranging

LO - Low Observable

LOTS - Logistics Over-The-Shore

LPD - Low Probability of Detection

LPI - Low Probability of Intercept

LRC - Lesser Regional Conflicts

•M•

MAGTF - Marine Air/Ground Task Force

MARFORLANT -Marine Forces Atlantic

MARFORPAC -Marine Forces Pacific

MC & G - Mapping, Charting and Geodesy

MCCDC - Marine Corps Combat Development Command

MCM - Mine Countermeasures

MDU - Mission Data Update

MEF - Marine Expeditionary Force

METOC - Meteorological and Oceanographic

MEU - Marine Expeditionary Unit

MEW - Marine Expeditionary Warfare

MF - Medium Frequency

MHD - Magnetohydrodynamics

MIW - Mine Warfare

MOE - Measure of Effectiveness

MOPP - Military Operations Protective Posture

MOOTW - Military Operations Other Than War

MPA - Maritime Patrol Aircraft

MPF - Maritime Preposition Force

MPS - Maritime Preposition Ship

MRC - Major Regional Conflicts

MTBF - Mean Time Between Failures

•N•

NATO - North Atlantic Treaty Organization

NAVMETOCOM - Naval Meteorological Command

NAVOSH - Naval Occupational Safety and Health

NBC - Nuclear, Biological, Chemical

NCTR - Non-Cooperative Target Recognition

NEF - Naval Expeditionary Force

NL - Non-Lethal

NOX - Nitrous Oxide

NSF - National Science Foundation

NSFS - Naval Surface Fire Support

NVG - Night Vision Goggles

•O•

OBA - Oxygen Breathing Apparatus

OBOGS - Onboard Oxygen Generating system

OMFTS - Operational Maneuver From The Sea

ONR - Office of Naval Research

OOB - Order of Battle

OOTW - Operations Other Than War

OPAREA - Operations Area

OPDS - Offshore Petroleum Discharge System

OPTEMPO - Operational Tempo

OSHA - Occupational Safety and Health Agency

OTH - Over-The-Horizon

•P•

PERSTEMPO - Personnel Tempo

PGM - Precision Guided Munitions

PHID - Positive Hostile ID

PID - Positive ID

Pk - Probability of kill

PRK - Photo Refractive Keratectomy

PSM - Personnel Status Monitor

PTTI - Precise Time/Time-Interval

•Q•

QOL - Quality of Life

•R•

RAP - Rocket Assisted Projectile

RAST - Recovery, Assistance, Securing and Transversing

RCS - Radar Cross Section

RF - Radio Frequency

RLT - Regimental Landing Team

RMA - Revolution in Military Affairs

ROE - Rules of Engagement

RO/RO - Roll-On/Roll-Off

ROV - Remotely Operated Vehicle

RTEM - Real Time Environmental Measures

•S•

S & T - Science and Technology

SADARM - Surface to Air Defensive Anti Radiation Missile

SAL - Semi-Active Lasers

SAM - Surface to Air Missile

SAR - Synthetic Aperture Radar/Search And Rescue

SCI - Sensitive Compartmented Information

SDV - Swimmer Delivery Vehicle

SEAD - Suppression of Enemy Air Defenses

SEI - Specific Emitter Identification

SEW/I - Space and Electronic Warfare/Intelligence

SHF - Super High Frequency

SK - Soft Kill

SLOC - Sea Lines of Communication

S/N - Signal to Noise

SOC - Special Operations Capable

SOCRATES - Special Operation Command Research, Analysis & Threat Evaluation System

SOF - Special Operations Forces

SOW - Statement of Work

SSBN - Nuclear Ballistic Missile Submarine

SSC - Surface/Subsurface Coordinator

SSG - Guided Missile Submarine

SSGN - Nuclear Guided Missile Submarine

SSN - Subsurface, Nuclear (submarine)

STOM - Ship To Objective Maneuver

STOVL - Short Take-Off/Vertical Landing

STRG - Science and Technology Requirements Guidance

•T•

TACAIR - Tactical Aircraft

TASM - Tactical Air-to-Surface Missile/Tomahawk Anti-Ship Missile

TAMPS - Tactical Air Mission Planning System

TBG - Technology Based Guidance

TBM - Theatre Ballistic Missile

TBMD - Theatre Ballistic Missile Defense

TDA - Tactical Decision Aid

TDD - Target Detection Device

TLAM - Tomahawk Land Attack Missile

TMD - Theater Missile Defense

TMIP - Theater Medical Information Program

TTP - Tactics, Techniques and Procedures

•U•

UAV - Unmanned Airborne Vehicle

UEP - Underwater Electric Potential

UHF - Ultra High Frequency

UNREP - Underway Replenishment

UTC/USNO - Universal Coordinated Time/U.S. Naval Observatory

UUV - Unmanned Underwater Vehicle

UV - Ultraviolet

•V•

VE - Virtual Environment

VOC - Volatile Organic Compounds

VLO - Very Low Observable

VLS - Vertical Launch System

•W•

WAN - Wide Area Network

WMD - Weapons of Mass Destruction

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Appendix 2

Deletions and Moves from *1996 STRG*

●The *1997 STRG* was developed as a refinement and enhancement of the *1996 STRG*. The goal was to provide stable guidance for the investment plan while clarifying requirements and accommodating changes necessitated by evolving concepts of operation. In order to make the 1997 document more useful to the user this appendix references all requirements from the *1996 STRG* that have been moved or deleted.

●Moves were made to more appropriately align requirements with functional areas or categories. Deletions were made to eliminate redundancy and to remove non-S&T requirements. Additional rewriting of requirements was done for the sake of clarity. These editorial changes are not listed.

●You can Scroll down or click once on the following chapters

CHAPTER 1. C4

Old Paragraph No. (from 96 STRG)	Comments
1.1.a	Deleted -- Not S & T
1.1.e	Deleted -- Moved to ISR 2.4.n (L)
1.1.j	Deleted -- Moved to 1.2.d (L)
1.1.k	Deleted
1.1.l	Deleted
1.1.n	Deleted -- Moved to 6.2.a (H)
1.1.p	Deleted
1.1.q	Deleted
1.1.r	Deleted -- Not S & T
1.1.s	Deleted
1.2.a	Deleted -- Moved to ISR 2.4.o (M)
1.2.b	Deleted -- Moved to ISR 2.4.g (M)
1.2.e	Deleted -- Moved to ISR 2.4.o.3 (M)
1.4.a	Deleted
1.4.b	Deleted
1.4.f	Deleted -- Moved to ISR 2.1.a (H)
1.5.d	Deleted
1.6.a	Deleted -- Moved to 1.4.i (M)
1.6.b	Deleted
1.6.d	Deleted
1.6.e	Deleted
1.6.f	Deleted -- Moved to 1.4.b.2 (H)
1.8.b	Deleted

CHAPTER 2. ISR

Old Paragraph No. (from 96 STRG)	Comments
2.3.c	Deleted
2.4.b	Deleted
2.4.h	Deleted
2.4.j	Deleted
2.4.l	Deleted

CHAPTER 3. AIR WARFARE

AIR WARFARE CHAPTER COMPLETELY RE-WRITTEN BY ROUNDTABLE

CHAPTER 4. SURFACE WARFARE

Old Paragraph No. (from 96 STRG)	Comments
4.3.b	Deleted
4.5.b	Deleted -- Contained in Chapter 8
4.5.c	Deleted -- Contained in Chapter 8
4.5.f	Deleted
4.5.h	Deleted
4.6.b	Deleted
4.8.f	Deleted

CHAPTER 5. MINE WARFARE

Old Paragraph No. (from 96 STRG)	Comments
5.1.a	Deleted
5.1.d	Deleted
5.1.e	Deleted -- combined with to 2.1.c
5.6.e	Deleted -- combined with 5.5.a

CHAPTER 6. UNDERSEA WARFARE

Old Paragraph No. (from 96 STRG)	Comments
6.1.g	Deleted -- contained in 6.1.a
6.1.h	Deleted -- contained in 6.1.c
6.2.d	Deleted -- contained in 6.1.c
6.2.f	Deleted -- contained in 6.2.a
6.6.a	Moved to 10.2.g
6.8.a	Deleted -- contained in 6.4.b

CHAPTER 7. AMPHIBIOUS WARFARE

AMPHIBIOUS WARFARE CHAPTER COMPLETELY RE-WRITTEN BY ROUNDTABLE

CHAPTER 8. LOGISTICS SUPPORT

Old Paragraph No. (from 96 STRG)	Comments
8.1.a.3	Moved to 9.3.a
8.4.c	Moved to 8.8.b.1
8.5.e	Deleted
8.5.f	Deleted
8.6.c	Deleted
8.6.h	Deleted -- contained in 8.1.a
8.6.j	Deleted -- contained in 8.1.f
8.10.a	Moved to 8.6.e

CHAPTER 9. MANPOWER/PERSONNEL

Old Paragraph No. (from 96 STRG)	Comments
9.1.	Deleted
9.1.	Deleted
9.2.	Deleted
9.2.	Deleted
9.2.	Deleted
9.2.	Deleted

CHAPTER 10. TRAINING

Old Paragraph No. (from 96 STRG)	Comments
10.1b	Deleted -- included in 10.1.a.3
10.2f	Deleted -- management issue
10.3a	Deleted
10.3b	Deleted

CHAPTER11. MEDICAL/PERSONNEL PROTECTION

Old Paragraph No. (from 96 STRG)	Comments
11.1.b	Deleted -- included in 11.5.g
11.1.j	Deleted -- included in 11.3.d.1
11.3.c	Deleted -- included in 11.1.h
10.5.h	Deleted

CHAPTER 12. BATTLESPACE ENVIRONMENT AND SUPPORT

Old Paragraph No. (from 96 STRG)	Comments
12.1.b	Deleted -- not S&T
12.1.c	Deleted
12.1.h	Deleted
12.1.i	Deleted
12.1.j	Deleted -- not S&T
12.1.k	Deleted -- COTS issue
12.1.n	Deleted

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Appendix 3

1997 STRG Requirements supporting the Joint Warfighting Capability Objectives

●This table lists the *1997 STRG* Functional Areas and requirements against the Joint Warfighting Capability Objectives which they support. In each box of the table the numbers or number/letter combinations designate the individual requirements in the *STRG* that apply to the Capability Objective. **'OA'** indicates an overarching relationship - which is to say that the implications of that functional area are pervasive for the particular objective. This derives from the discussions during Round Table I which identified such relationships for coordinated investment attention.

JOINT WARFIGHTING CAPABILITY OBJECTIVES

DON STRG AREAS

	Information Superiority	Precision Force	Combat Identification	Joint Theater Missile Defense	Military Ops in Urban Terrain	Joint Readiness	Joint Command & Control	Electronic Warfare	Information Warfare	CB Agent Detection	Real-time Logistics Control	Counter-Proliferation
C4	1b, 1c, 1d, 1e, 1f, 2a, 2b, 2c, 2d, 3i, 4a, 4b, 4d, 5a, 6b, 6d, 7b	2a, 2b, 2c, 2d, 2e, 2f, 4c, 6c	2c	1a, 1c, 2b, 2c, 2d, 2f, 3a, 3b, 3c, 3e, 3h, 3k, 3l, 6b	1a, 1c, 1d, 1g, 1i, 2a, 2b, 2c, 2d, 2e, 2f, 3d, 3l, 4a, 4b, 4c, 4d, 5a, 6b, 6d, 7a	3d	3d, 6a	1c, 1f, 3b, 4a, 4d	1b, 1i, 2f, 4a, 4b, 4c, 4d, 5b	1c, 1e, 6b, 6d	OA	OA
ISR	1a, 1b, 1d, 1e, 1f, 2a, 2b, 2c, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3i, 3k, 3l, 3m, 3o, 4a, 4b, 4c	all	1b, 1d, 1e, 2b, 2c, 3i, 4b	1a, 1b, 1d, 1f, 2b, 2c, 3a, 4a, 4b, 4c	1a, 1b, 1d, 2b, 3a, 3f			1d, 3b		3m		1b, 6a, 6d, 6e, 6a, 8c
Air Warfare		all 1, 3						1f				
Surface Warfare	1a	all 1, 2, 3, 4, 5a, 5b, 5c, 5e	4e	4e, 4f, 5a, 5e, 5f			4a, 4c	1g, 5e		6e, 8a, 8c		1b, 6a, 6d, 6e, 8a, 8c
Mine Warfare	4a	all 2, 4, 6			5a		all 2, 3, 4, 5, 6, 7, 8					
Undersea Warfare	1f	all 1, 3, 5a					3a					
Amphibious Warfare	1d, 1f, 4d, all 6	1a, 1g, 1h, 1i, 1j, 3a, 3b, 3d, 3e, 3f, 3g			13c	1c, 2c, all 5	1a		4a	all 2		
Logistics Support	6b	OA	OA	OA	OA	OA	OA	OA	OA	OA	OA	all 3, 9c
Manpower/ Personnel	1a, 1c	OA	OA	OA	OA	OA	OA	OA	OA	OA	OA	OA
Training	OA	OA	OA	OA	OA	all 1, 2	OA	OA	OA		OA	x
Medical & Personnel Protection	OA	OA	OA	OA	OA	OA	OA	OA	OA	2b	OA	2b, 2h, 4a, 4b, 4e
Battlespace Environment & Support	OA	OA	OA	OA	OA	OA	all 1	OA	OA	1a, 1b, 1k, 2b	OA	1a, 1b, 1k, 1b

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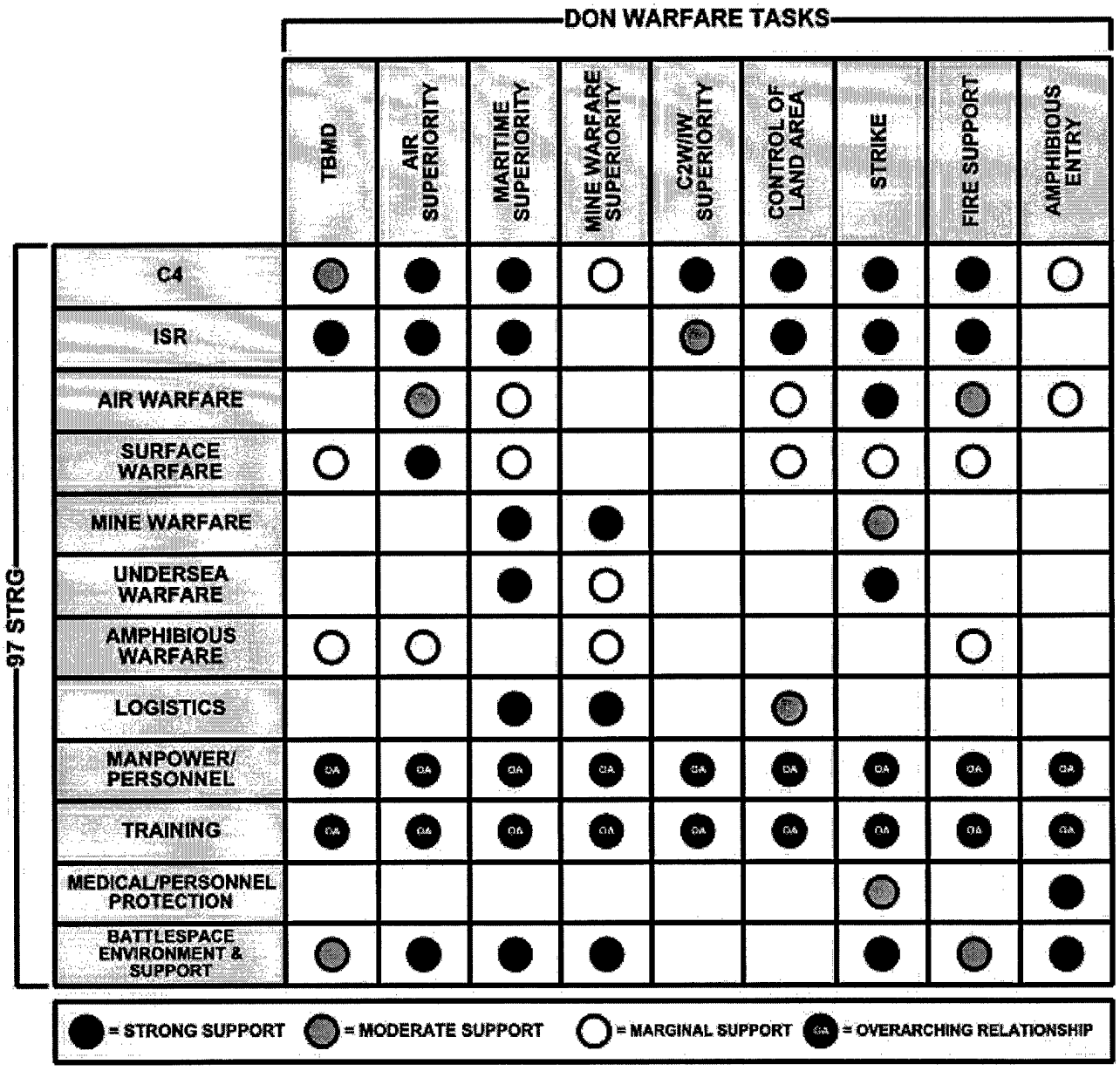
Appendix 4

1997 STRG Requirements supporting the Navy Warfare Task

●This table lists the *1997 STRG* Functional Areas and requirements against the Navy Warfare Tasks which they support. In each box of the table the symbols indicate the level of support from requirements in that functional area. **'OA'** indicates an overarching relationship - which is to say that the implications of that functional area are pervasive for the particular warfare task. This derives from the discussions during Round Table I which identified such relationships for coordinated investment attention.



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Appendix 5

FLEET CINC CONSOLIDATED COMMAND TECHNOLOGY ISSUES (CTIs)

- This appendix reprints the Command Technology Issues (CTI) table from the 1996 *STRG*. These issues remained constant from 1995 through 1996. This year they are undergoing revision and redefinition. Because of this process the 1997 CTIs are not available for inclusion in the *STRG*. No attempt has been made to realign CTIs with the revised JMA structure until the entire CTI process is concluded.

- This table is, therefore, for reference purposes only, and will be updated as soon as practicable. The update will be applied to the database version of the *STRG*.

COORDINATED FLEET CINC

CONSOLIDATED COMMAND TECHNOLOGY ISSUES

OCT 1996

SUMMARY

JMA COMMAND TECHNOLOGY ISSUE (95 PRIORITY)	1996 PRIORITY
JOINT STRIKE WARFARE	
COMMON/CONSISTENT TACTICAL PICTURE (HIGH)	HIGH
TARGETING/BATTLE DAMAGE ASSESSMENT/COMBAT IDENTIFICATION (HIGH)	HIGH
ADV STANDOFF WEAPONS (HIGH)	HIGH
ENHANCED AIRCRAFT/AIR CREW SURVIVABILITY (HIGH)	HIGH
JOINT LITTORAL WARFARE	
MINE WARFARE/MINE COUNTER MEASURES (HIGH)	HIGH
SHALLOW WATER ASW (HIGH)	HIGH
SHIP SELF DEFENSE (HIGH)	HIGH
THEATER MISSILE DEFENSE-TMD (HIGH)	HIGH
NON-LETHAL (NL) WEAPONS (MED)	HIGH
NAVAL SPECIAL WARFARE (MED)	MEDIUM
NAVAL SURFACE FIRE SUPPORT (MED)	MEDIUM
LANDING FORCES (MED)	MEDIUM
MARITIME INTERDICTION FORCE SURVEILLANCE (LOW)	LOW
JOINT SURVEILLANCE	
RECONNAISSANCE (HIGH)	HIGH
OFFBOARD SENSORS (HIGH)	HIGH

SPECIFIC EMITTER IDENTIFICATION (SEI) PLATFORM TRACKING (MED)	HIGH
IMPROVED EM/EO SENSOR PREDICTION SYSTEM (MED)	MEDIUM
JOINT SEW / INTELLIGENCE	
COMMON/CONSISTENT TACTICAL PICTURE (HIGH)	HIGH
JOINT/MULTI-NATIONAL/COALITION C4I2 SYSTEM (HIGH)	HIGH
COMMUNICATION RELIABILITY (HIGH)	HIGH
BATTLEGROUP COOPERATIVE ENGAGEMENT EW (HIGH)	HIGH
SECURE SUBMARINE COMMUNICATIONS (MED)	HIGH
INFORMATION WARFARE (N/A)	HIGH
JOINT BATTLEFIELD SIMULATION/STIMULATION (MED)	HIGH
SHIP-TO-SHORE COMMS OTH (MED)	MEDIUM
MAPPING CHARTING AND GEODESY (MC&G) DATA DISTRIBUTION & TRANSMISSION (MED)	MEDIUM
COVERT TRACKING (HIGH)	MEDIUM
STRATEGIC DETERRENCE	
THEATER MISSILE DEFENSE (HIGH)	HIGH
COOPERATIVE ENGAGEMENT CAPABILITY-CEC (HIGH)	HIGH
MARITIME SUPPORT OF LAND FORCES	
SEALIFT CAPABILITY (MED)	MEDIUM
VISIBILITY OF EQUIPMENT, MATERIALS, & SUPPLIES (MED)	MEDIUM
TRAINING	
SIMULATION/STIMULATION EMBEDDED IN EXERCISES (HIGH)	HIGH
SHALLOW WATER TRAINING RANGE/CAPABILITY (MED)	MEDIUM
TARGETS (MED)	MEDIUM
READINESS	
CONDITION BASED MAINTENANCE (HIGH)	HIGH
SHIP AND AIRCRAFT CORROSION REDUCTION AND CONTROL (HIGH)	HIGH
COMPOSITE and LOW OBSERVABLE MATERIAL REPAIR (MED)	MEDIUM
IMPROVED RELIABILITY OF ELECTRICAL & MECHANICAL SYS (HIGH)	MEDIUM
SUPPORT & INFRASTRUCTURE	
ENVIRONMENTALLY SAFE ALTERNATE MATERIALS (HIGH)	HIGH
ENVIRONMENTALLY SAFE REMOVAL & DISPOSAL FOR HAZMAT COATINGS (HIGH)	HIGH
GARBAGE REDUCTION AND DISPOSAL (HIGH)	HIGH
HAZARDOUS MATERIAL MANAGEMENT (MED)	MEDIUM
OBA CANISTER (MED)	LOW
FORWARD PRESENCE	
ENVIRONMENTAL COMPLIANCE (HIGH)	HIGH
MEDICAL	
BG/BATTLEFIELD MEDICAL AIDS (N/A)	MEDIUM
BW/CW VACCINES (N/A)	HIGH
MANPOWER & PERSONNEL	
N/A	

•The COMMAND TECHNOLOGY ISSUES presented here are from the *1996 STRG.* They are being reviewed and revised at this time and will be up dated in next year's *STRG.*

1. JOINT STRIKE WARFARE

A. COMMON/CONSISTENT TACTICAL PICTURE (HIGH Priority)

Current systems cannot collect and fuse all-source tactical information from Navy, Joint, Allied and Coalition sources. This results in a foggy overall tactical picture. All elements of this picture including primary collection, fusion and dissemination architecture, de-confliction, classification, broadcast, and display technologies are critical. The architecture for pulling this picture together is a major system engineering challenge, and should include all sensor platforms (air, surface, submarine and space) and two-way information sharing. Any such system must be reliable, robust, and secure for effective command and control. Naval forces cannot play in the joint arena without it. The requirement is for improved reliability for all communication channels, including those connecting Navy, Joint, NATO and other coalition partners. In addition, this capability must be supported by databases, models and decision aids for METOC issues, Mapping Charting and Geodesy (MC&G) overlays and electro-magnetic propagation prediction.

B. TARGETING/BATTLE DAMAGE ASSESSMENT/COMBAT IDENTIFICATION (ID) (HIGH Priority)

Recent conflicts have required threat identification beyond visual range. In many cases, air crews are forced to use visual or TV sightings to confirm an aircraft is not friendly or is a non-combatant, thus limiting long range anti-air missile use to daytime with clear skies. Improved combat ID is needed to prevent fratricide and identify non-cooperative targets. Without improved combat ID air crews cannot use their long range missiles effectively. Targeting decisions require BDA as requisite input. BDA in the tactical time frame is required for mission planning, attack and re-attack assessments. The unmanned airborne vehicle (UAV) provides an essential tool for tactical reconnaissance, targeting and BDA. Improvements in technologies such as digital imagery and transmission are required. Target bearing and range accuracy must be improved to increase standoff ranges and intercept probability.

C. ADVANCED STANDOFF WEAPONS (HIGH Priority)

Smarter weapons are essential to improved mission capability and aircraft survivability. They must be released outside the range of point defense envelopes and attain "one weapon released equals one target destroyed" criteria. Incorporating precision navigation, new/improved sensors and onboard sensor data fusion will improve weapon lethality and shooter survivability. Smart air-to-ground munitions, improved TLAMs, and improved long and short range air-air missiles are examples. Such weapons should include the ability to reconfigure and retarget post-launch. Ships also need new weapons for this environment. For instance, platforms like AEGIS or SSNs require more flexible weapons than Harpoon anti-ship missiles and MK-48 torpedoes when dealing with small combatants or recalcitrant merchants.

D. ENHANCED AIRCRAFT/AIR CREW SURVIVABILITY (HIGH Priority)

Battlespace dominance in the littoral requires air superiority. Dazzling/damaging lasers pose a threat to the required air superiority. Protection against fixed-line and frequency-agile lasers, short/long pulse or continuous wave, is a requirement. Protection is required for ground and air forces, and for sensitive equipment. Additionally, protection for air crews from NBC attack requires significant improvements in the protective equipment provided to aircrew and maintenance personnel. Finally, improved aircraft design and introduction of new materials have allowed aircraft performance capabilities to outpace that of human ability to withstand flight stresses. Improved flight suits and flight control aids are required to maintain aircrew safety during maximum aircraft performance.

2. JOINT LITTORAL WARFARE

A. MINE WARFARE/MINE COUNTER MEASURES (HIGH Priority)

Mines present a major littoral warfare threat. MCM capabilities are required for surface, submarines, air and Naval Special Warfare forces. Landing forces need the capability to land without suffering major casualties and equipment losses by mine warfare. These forces must either avoid, neutralize or remove the mine threats. Deep moored mines and very shallow surf zone mines pose extremely difficult threat. MCM C^4I capabilities are required. This C^4I requirement needs to be in a cooperative engagement format so ALL forces provide/share MCM collected information. MCM improvements include, but are not limited to: new sweeps and neutralization techniques, ship and small craft tracking system, avoidance/detection sonars and other sensors, reduced ship signature and vulnerability, methods to land without triggering mines, improved EOD mine clearance technology, trainers and simulators.

B. SHALLOW WATER ASW (HIGH Priority)

Littoral operations require mission performance in shallow water inside enemy threat envelopes of surface, submarine and air forces. The mission requirement is to detect, classify, localize, attack and destroy diesel submarines in this complex environment. Improved acoustic and non- acoustic sensors, processors, displays and tactical decision aids are needed. A capability to quickly identify threat submarines f3om neutrals and friendlies in the littorals is required. There

is a need to reduce submarine signatures to maintain a U.S. acoustic advantage. Surface and air forces require a better periscope detection capability. This is especially critical against diesel submarines which spend a great deal of time at periscope depth. An improved ASW weapon tailored for this environment is required. Submarines must have weapons which operate in the shallow water environment. Minisub defense and methods to deter covertly deployed enemy SOFs (i.e., sapper teams) are required. Improved submarine navigation and depth control are required for shallow water operations.

C. SHIP SELF DEFENSE (HIGH Priority)

All ships (especially surface ships, but including submarines) need improved self-defense capabilities against diesel submarines (periscope detection), torpedoes, small boats, cruise missiles, and floating mines. In the event damage does occur, expert ship damage control could saves lives and ships. Ship systems and personnel protective clothing/equipment are needed for protection during NBC attack. Also required is a soft kill capability for incoming anti-ship cruise missiles. Current ASCM-capable systems have not been optimized for BG operations with ships close in company. Synergism between hard kill and soft kill is assumed, but inappropriate use of either can result when target information is inadequate, unclear or misjudged. Attack helicopters are required to provide surveillance and kill in littoral waters for surface ship defense. Systems that provide enhanced EO/IR/Visual detection capabilities (i.e., Smart Mast Mounted Sight) and multi-spectral decoys are needed. Detection systems (sensors) for littoral waters need to be fused and provide high probability of detection and validation.

D. THEATER MISSILE DEFENSE-TMD (HIGH Priority)

Littoral warfare exposes CVBGs and forces deployed ashore to the TMD threat. Regional powers already possess TMD capability, including conventional warheads and Weapons Of Mass Destruction (WMD). An organic capability to defeat all facets of this threat is needed, shortly after launch or before apogee. TMD should also include protection against the Anti-Ship Cruise Missile (ASCM). Long range detection and CEC is needed, not only against the TBM, but also against long range, stealthy ASCM's.

E. NON-LETHAL (NL) WEAPONS (HIGH Priority)

A NL capability is required to immobilize opposition personnel and equipment in order to neutralize and contain during initial mission phases. NL weapons are also needed during occupation to ensure minimal injury to personnel. NL weapons should have the capability to vary duration and intensity of incapacitation and to select targets.

F. NAVAL SPECIAL WARFARE (MEDIUM Priority)

Naval Special Warfare operations are an essential part of Littoral Warfare. Special Warfare forces require new covert means to interdict enemy territories. Requirements for interdiction center around: high energy density propulsion systems, stealthy platforms and advanced life support systems. These systems must have small rugged sensor fusion and C^4I capable hardware. Special Warfare forces must be able to covertly transmit collected intelligence in a timely manner. Shallow Water MCM capabilities are required. Other important requirements include: non-lethal tunable weapons, advanced sensors, target location and marking, advanced weapons and munitions, and overall weight reduction and miniaturization of equipment.

G. NAVAL SURFACE FIRE SUPPORT (MEDIUM Priority)

Current NSFS systems are limited in range and types of munitions delivered. Longer ranges with increased accuracy using advanced munitions are required to support Littoral Warfare.

H. LANDING FORCES (MEDIUM Priority)

Need improved night operations capabilities, medium range man portable anti-tank weapons, covert/stealthy reconnaissance, signature reduction (including special operations equipment), and improved expeditionary airfield capabilities (light weight matting, night-ops capability and modular aircraft revetments). Improved NBC protection is required for ground personnel including protective clothing and detection systems.

I. MARITIME INTERDICTION FORCE SURVEILLANCE (LOW Priority)

Recent experience in regional conflicts shows maritime interdiction is a required mission. The maritime force must possess the capability to detect, track, and monitor potential embargo violators. Boarding parties also must possess the capability to search a vessel rapidly and thoroughly, without damaging non-embargo cargoes.

3. JOINT SURVEILLANCE

A. RECONNAISSANCE (HIGH Priority)

A system which facilitates integration of Joint, Multi-National or Coalition reconnaissance data is required. It should be compatible with the concepts embodied in the "Common Tactical Picture" described under Joint Strike. Real-time processing and transmission of tactical reconnaissance data from manned and unmanned aircraft is required. Littoral Warfare requires organic real-time Ground Order of Battle (G0B) definition. Improved organic surveillance capabilities are needed, including better EO sensor suites and better ISAR. Sensors are primarily intended for aircraft, but could also be placed aboard surface ships or submarines .

B. OFFBOARD SENSORS (HIGH Priority)

(Also applies to Joint Littoral) Offboard sensors are required to increase the capability for conducting covert surveillance in a littoral warfare scenario. Sensors are needed for mine detection, identification and avoidance; wide area search and covert surveillance of diesel submarines; oceanographic surveys; and undersea BDA/BDI. Improved cost effective UUV's are required. Platforms require offboard sensors that can be vectored on short notice to provide critical surveillance and targeting information. Low cost UAV's that can be controlled by local commanders ashore or afloat are required to provide joint surveillance data. For interdiction missions, improved over-the-horizon radar is required for detection and tracking of vessels and aircraft.

C. SPECIFIC EMITTER IDENTIFICATION (SEI) PLATFORM TRACKING (HIGH Priority)

SEI is a promising concept for tracking all air and ship traffic in the BG AOR and contributes to the Common Tactical Picture without requiring a large investment in additional aircraft or other surveillance systems. The technical feasibility of making the SEI measurement has been demonstrated. Improved equipment, standardized databases, and better matching algorithms are needed to reduce the procedure to an operationally useful tactic. This concept also includes small craft with low profiles used in drug trafficking. Surface Search Coordination (SSC) and Force OTH Track Coordination (FOTC) can be enhanced by developing a similar tactic using HF transmissions. The tactic should be fully automated to search, detect, parametrically classify and correlate to platform.

D. IMPROVED EM/EO SENSOR PREDICTION SYSTEM (MEDIUM Priority)

(Applies to Joint Strike also). The EM/EO spectrum provides important information about enemy deployments, OOB, etc. EM energy propagates in the wave guide of the atmosphere over the irregular boundary of the earth's surface. The combination of variable atmospheric conditions and variable terrain creates a highly range-dependent environment that makes propagation prediction difficult, but essential. Current EM and EO prediction systems use a single atmospheric profile, obtained from a ship at sea; this is inadequate. Operations require "volume/synoptic" sampling across the battlespace, vice "point" sampling; and a model capable of predicting EM/EO behavior across the transition from sea to land. A Tactical Decision Aid is needed that displays the geo-referenced result.

4. JOINT SEW / INTELLIGENCE

A. COMMON/CONSISTENT TACTICAL PICTURE (HIGH Priority)

A system which provides a common/consistent joint, multi-national, or coalition tactical picture is required. It should possess the ability to fuse all-source data, have multi-level security (including the ability to selectively pass information to different operational partners), and allow two-way transfer of information (e.g. from Navy units to JTF units). Above all, it should respond in tactical time frames. Shear volume of message traffic requires improved communication and processing equipment. Increased capability provided by BG/Theater-wide WAN (interconnection of high reliability LANs to the unit level), is needed for high volume reliable communication. Building the Common Tactical Picture is enhanced by maximum usage of standard software and databases.

B. JOINT/MULTI-NATIONAL/COALITION C4I2 SYSTEM (HIGH Priority)

(See also "Common Tactical Picture"). This is a Roll On/Roll Off capability for use by hurriedly-assembled coalition partners, which also would address the needs of JTFs assembled from widely dispersed units. Today's battlefield will most likely contain not only other services but other nations serving in coalition efforts, neutrals, civilians, and hostiles. The ability to adequately separate the various entities and maintain tracks and their separate identifying parameters is essential. A second facet of this capability could be a Joint Maritime Operations Command Center (JMOCC).

C. COMMUNICATION RELIABILITY (HIGH Priority)

Reliable and secure communications are fundamental to effective command and control. Naval forces rely on advanced, emerging communication technology to participate in joint operations. The need exists for improved reliability of all communication channels as well as multi-level secure computer networks, including those connecting Navy, Joint, NATO, and other coalition partners. Battle Group and fleet-wide automated frequency and bandwidth management, electronic mail and automated data base management capabilities are needed.

D. BATTLEGROUP COOPERATIVE ENGAGEMENT EW (HIGH Priority)

(See ship self defense in the Joint Littoral also). Optimized soft kill measures against Anti-Ship Cruise Missiles (ASCM) are needed. We need to know the effects of using EW measures on other ships at close ranges. We also need to know the effects of using multiple ECM systems simultaneously in a constrained battlespace. Optimum deployment of chaff, SLQ-32 units, unit positioning, etc. need to be known in advance for expected threat axes.

E. SECURE SUBMARINE COMMUNICATIONS (HIGH Priority)

Two-way communications with submarines at speed and depth is not optimum for all offensive and defensive missions. We need the capability to process bi-static active signals to support SSN/SSBN security and operate effectively while the submarine is at speed and depth. While a one-way (receive) capability is adequate for some missions, two-way communications is required. In both cases, security demands high data rate transmissions to reduce ship vulnerability and exploit the ship's stealthiness.

F. INFORMATION WARFARE (HIGH Priority)

There is a need for comprehensive coordinated multi-platform capability to plan and conduct C2 warfare for crisis and combat operations. There is the need for C^2 protection improvements in the areas of: unauthorized access prevention; data base exploitation; software/data base corruption from organized threats and hackers; and, LAN/WAN multi-level security and firewalls.

G. JOINT BATTLEFIELD SIMULATION/STIMULATION (HIGH Priority)

Distributed network. Should provide stimulation of embedded capabilities in addition to simulation ashore (at training centers, etc.). This will allow enroute training on actual equipment, tailored to the situation at hand. Many technological issues are included in the requirement and it must be Joint and Interoperable.

H. SHIP TO SHORE COMMS OTH (MEDIUM Priority)

Amphibious operations envision launching assaults from OTH stand-off distances. Sensors for OTH use and communications for Beyond-Line Of Sight forces are limited. Means of collecting sensor data for OTH targets and for communicating with forces that are beyond line of sight are needed. Communications must be secure, jam-resistant, voice and data capable and interoperable with joint, multi-national and coalition forces.

I. MAPPING CHARTING AND GEODESY (MC&G) DATA DISTRIBUTION & TRANSMISSION (MEDIUM Priority)

Littoral operations may take place in unanticipated and unsurveyed areas of the world. The ability to collect and process Mapping, Charting and Geodesy (MC&G) data as quickly as possible is critical. After processing, immediate distribution to all units is required for mission planning and execution (e.g., amphibious, mine warfare, submarine operations, etc.) Such collection, processing and distribution must be digital for transmission to units afloat.

J. COVERT TRACKING (MEDIUM Priority)

(Also see Joint Surveillance, SEI Platform Tracking) Many Navy missions require covert tracking. The capability to detect, track and monitor small craft with low profiles and small or semi-submerged craft utilizing conventional or non-conventional sensors is required. This includes the use of unmanned air vehicles, Specific Emitter Identification (SEI), night vision devices, laser radars, and command level networks which can also collect and relay tactical real-time video. These capabilities are also required for other larger craft that might be involved in evading embargoes. The problem includes separating suspect craft from friendlies and neutrals; marking and tagging such craft; and, enhanced detection of drugs in the cluttered littoral environment.

A. THEATER MISSILE DEFENSE (HIGH Priority)

Littoral warfare exposes BGs and forces deployed ashore to the TMD threat. Regional powers already possess TMD capability, including conventional warheads and WMD (see Joint Littoral description). This problem statement extends the need to include the strategic threat within the larger AOR (vice strictly the littoral during localized operations). As before, an organic TMD capability to defeat this threat is needed, shortly after launch or before apogee.

B. COOPERATIVE ENGAGEMENT CAPABILITY-CEC (HIGH Priority)

Today's battlespace is compressed in time and stretched in space. When coupled with stealthy, high-speed threats, this changed battlespace demands a quicker, more effective way to engage incoming weapons. With sensors and engagement capabilities spread over multiple platforms, an integrated system is needed to optimize search, detection, tracking, and engagement options.

6. MARITIME SUPPORT OF LAND FORCES

A. SEALIFT CAPABILITY(MEDIUM Priority)

Advanced/improved air or surface craft are needed to include a strategic lift vehicle and surge sealift capability.

B. VISIBILITY OF EQUIPMENT, MATERIALS, & SUPPLIES (MEDIUM Priority)

Naval Expeditionary Forces (NEF's) must transit from CONUS or prepositioned sites to the Amphibious Objective Area (AOA). These forces must provide the right equipment and supplies, in the correct amounts, to ensure ready combat forces can be inserted into and sustained in a hostile environment. In any large operation, the supplies and equipment will depart from several ports on many different ships. When they all arrive in the AOA, it is difficult to locate any individual piece of equipment or supply item. This makes sustainment difficult and jeopardizes landing forces. NEFs need the capability to identify, locate and track equipment, materials and supplies during transit. They also need the ability to access the needed supplies and move them to the combat element.

7. TRAINING

A. SIMULATION/STIMULATION EMBEDDED IN EXERCISES (HIGH Priority)

Funding for steaming to participate in exercises and travel to training ranges is becoming scarcer. Also, current training does not stress the operators like a real combat situation, resulting in unrealistic training. Training can be more cost effective if exercises can be augmented with realistic simulation or stimulation (preferred). There is also a need to advance technologies like virtual reality, making simulation more realistic. Improvements in embedded training, especially those tied to stimulation, are required. Realistic training also requires BG level and JTF level simulation and/or stimulation. Training should be based on the common/consistent tactical picture (see text under Joint Strike, Common/Consistent Tactical Picture).

B. SHALLOW WATER TRAINING RANGE/CAPABILITY (MEDIUM Priority)

Proficiency and readiness depend on accurate and realistic training. Littoral warfare demands an improved shallow water training capability. One facet of such training is a shallow water training range, used by air, surface and submarine assets for training coordinated operations in mining, shallow water ASW, SOF, etc.

C. TARGETS (MEDIUM Priority)

Low cost realistic surface, aerial and submerged targets are required for crew training and maintaining warfighting proficiency. Surface and submerged targets should be ship deployable.

8. READINESS

MAINTENANCE

A. CONDITION BASED MAINTENANCE (High Priority)

Scheduled maintenance for many ship and aircraft systems consume scarce manpower and equipment resources, impacting availability of maintenance capability and ultimately ship readiness. Unnecessary maintenance often adds the costs of handling and disposing of hazardous waste also. Processes and systems are needed for determining the physical condition of systems (especially electro-mechanical systems), either on-line or off-line that signal when preventive maintenance is required. Sensors, neural networks, vibration monitors/analysis and fluid quality test equipment or monitors are examples of technologies that may be applied.

B. SHIP AND AIRCRAFT CORROSION REDUCTION AND CONTROL (HIGH Priority)

Corrosion of ship and airframe internal spaces, bulkheads at deck bulkhead seams, electrical surfaces (i.e., grounding points), seawater piping systems, tanks, voids and bilges require frequent maintenance. Stripping, surface preparation and repainting are costly, occupy scarce resources, impact readiness and add to the hazardous waste problem. New or alternate materials that are more resistant to corrosion and fouling are needed for new/replacement systems. New protective coatings are needed plus new, faster and less expensive stripping and surface preparation techniques for maintenance. New coating materials should be: anti-fouling hull coatings; environmentally safe; applied using equipment/techniques that are not hazardous to personnel or the environment.

C. COMPOSITE AND LOW OBSERVABLE MATERIAL REPAIR (MEDIUM Priority)

Low observable materials are becoming more common throughout fleet aviation. We need the capability to repair them at shipboard intermediate maintenance activities with environmentally safe materials and processes. Repairing composite materials is difficult and costly. Repair is impossible at some levels of maintenance thus causing repairs to be performed at higher maintenance levels which further adds to cost. Composite materials repair equipment, techniques or materials are needed that make repair possible at low (operational) maintenance levels. A new capability is required to repair the composite to original specifications with simple equipment, and be safe for the user and the environment.

D. IMPROVED RELIABILITY OF ELECTRICAL AND MECHANICAL SYSTEMS(MEDIUM Priority)

Frequent repair of leaky seals, gaskets and other common components is very time consuming and impacts availability of maintenance personnel and ship readiness. Improved reliability of common ship and aircraft mechanical and fluid components will reduce overall maintenance workload and costs. A new family of reliable, low maintenance electrical connectors is needed with low corrosion characteristics.

9. SUPPORT & INFRASTRUCTURE

ENVIRONMENTAL

A. ENVIRONMENTALLY SAFE ALTERNATE MATERIALS (HIGH Priority)

The Navy uses many materials/chemicals that are environmentally unsafe and/or hazardous to personnel who work with them. The most pressing problem is the replacement of ozone depleting substances such as HALON (used in fire fighting systems), which is no longer being manufactured. ChloroFluoroCarbons (CFCs) should be eliminated by 1995 and shipboard use of plastics should be reduced or eliminated by 1998 or sooner. A new fire fighting system/material is needed that is effective, safe to use and environmentally friendly. New refrigerants and chemicals for spray cans are needed to replace CFC's. Alternatives for plastic packaging materials and a non-toxic, environmentally safe lube oil replacement are needed. Use of heavy metals such as lead and zinc chromate should be eliminated. An improved flight deck non-skid material is needed, one with less silica.

B. ENVIRONMENTALLY SAFE REMOVAL AND DISPOSAL FOR HAZMAT COATINGS (HIGH Priority)

When HAZMAT is present in coatings, removal techniques must comply with federal, state, and local environmental regulations. Techniques must also comply with all personnel safety regulations (e.g., OSHA). Removal processes are time consuming and costly. Environmentally safe techniques and equipment for removing and disposing of HAZMAT coatings are needed. A rapid and reliable portable test method is needed to determine if lead is present in paint on existing surfaces. Equally important are environmentally safe techniques and equipment for removing and disposing of lead-based paints.

C. GARBAGE REDUCTION AND DISPOSAL (HIGH Priority)

Pending laws will require eliminating discharging many types of wastes from ships by 1998. This same law allows no discharging in special areas which will probably grow in number in this same time frame.

Accumulating garbage consumes valuable storage and working spaces. Transferring garbage to support ships will become an unworkable alternative as the fleet is reduced with dramatic impact on tenders. Several thermal destruction technologies have been investigated. Plasma arc pyrolysis has been assessed as one of the most promising for success in ship installations. However, it is estimated to take 8-10 years before production equipment may be available. Garbage disposal, or volume reducing, systems must be developed and deployed before the legislation is effective and negatively impacts on the Navy's ability to operate. Garbage treatment systems must comply with emerging regulations and be usable onboard ships of all classes.

D. HAZARDOUS MATERIAL MANAGEMENT (MEDIUM Priority)

A wide-area hazardous materials inventory information-sharing system is needed. Activities needing hazardous materials can obtain them from another activity who has materials near shelf life expiration. Automated inventory, tracking and disposal documentation capability for hazardous materials is also needed to support this HAZMAT sharing capability.

E. OBA CANISTER (LOW Priority)

Current OBA canisters are used frequently for fire fighting and training and are a hazardous waste after use. A new NAVOSH approved OBA canister is needed that does not create a hazardous waste problem after it is used.

10. FORWARD PRESENCE

A. ENVIRONMENTAL COMPLIANCE (HIGH Priority)

The reality of doing business overseas involves complying with foreign environmental regulations and host country sensitivities (i.e., restrictions associated with night landing practice in Japan, limited opportunity for overseas low level training areas, environmental concerns associated with amphibious training areas, environmental compliance associated with port visits, etc.). US ships and aircraft must comply with international regulations in order for the Navy to have a viable Forward Presence. See previous Environmental CTI's.

B. CAPABILITY TO MOVE NAVAL FORCES ANYWHERE IN A TIMELY MANNER

See comments associated with Strategic Sealift and Protection.

C. OPTIMIZED JOINT AND COMBINED FORCE INTEROPERABILITY

See comments associated with Joint SEW/INTELLIGENCE.

D. ENABLE FORCE DEFENSE

See comments associated with Joint Strike Warfare.

11. MEDICAL

A. BG/BATTLEFIELD MEDICAL AIDS (MEDIUM Priority)

Remote medical presence aids are required and have great potential for improving patient care and reducing cost associated with medical evacuation. A WAN with the ability to transmit and receive data and imagery (i.e., digital x-ray, video, ...) is needed to improve diagnosis and treatment of BG and battlefield patients.

B. BW/CW VACCINES (HIGH Priority)

More effective vaccines are needed to counter the biological and chemical agent threat.

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