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EXECUTIVE SUMMARY

It is clear that the Department of the Navy's (DON) research and development (R&D) budget will be under considerable stress for the foreseeable future, as the defense budget continues to experience reductions and re-prioritizations. In addition, there is a continuing requirement to increase the portion of the Navy's R&D work that is conducted by the private sector. The confluence of these forces dictates a change to the DON's in-house R&D infrastructure. To address these issues, the Assistant Secretary of the Navy (Research, Development and Acquisition) [ASN(RD&A] tasked the Naval Research Advisory Committee (NRAC) to conduct an assessment of the facilities, functions, processes and organizations of the Naval R&D infrastructure. The NRAC Panel on Naval R&D was formed to respond to the tasking.

The panel met in three formal sessions to receive extensive briefings from Department of Defense and DON sources; interspersed with sub-panel team visits to the four Naval Warfare Centers and their respective laboratories to collect pertinent information related to the panel's tasking. The emphasis in this data collection was on relevance to the Naval customer, critical technology interests, facilities, redundancy, organizational and personnel issues, interaction with industry and academia, critical problems, and ability to meet the needs of the DON in the 21st century.

The NRAC report is organized into four subject areas: historical perspective, critical R&D resources, R&D organization, and the R&D process.

Following an analysis of Naval Research and Development, weaknesses were identified in two areas: R&D organization, and the R&D process. Organizational weaknesses included deficiencies in structure, personnel policies, financial execution and planning. Process weaknesses included weak integration between R&D and Naval doctrine and a cumbersome requirements process that fails to address prioritization, or conduct performance, cost and risk assessments, and does not adequately address affordability issues.

The report recommends protection and retention of critical DON unique resources, such as one-of-a-kind facilities to test and evaluate unique Navy products; unique high value, irreplaceable facilities and unique geographical locations and ranges; unique capabilities that provide rapid responsiveness to threats; and personnel who represent a unique source of corporate knowledge. Further, the report recommends that the DON stand up a single Warfare Systems Command that reports directly to the ASN(RD&A) and Chief of Naval Operations, in lieu of the current individual systems commands, creating a central focal point and advocate to address the long-term R&D/Material needs of the Navy.

PANEL MEMBERSHIP

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RADM Marc Y. E. Pelaez, USN
Chief of Naval Research

EXECUTIVE SECRETARY
CAPT Michael J. Brinkac, USN
Military Director
Naval Research Advisory Committee

Terms of Reference

GENERAL OBJECTIVE:

Conduct an assessment of the missions, functions, processes, and core competencies of the Naval Research and Development infrastructure applying the following criteria:

- Relevance to the Naval customer
- Criticality to the Department of the Navy (DON) (Critical Technology Interests)
- Integration of R&D
- Interaction with industry/academia
- In-house cost and efficiency vs. out-of-house
- Ability to meet Naval needs of 21st century

BACKGROUND:

It is clear that the DON's R&D account will be under considerable stress for the foreseeable future. This stress will result from an overall reduction or reprioritization within the accounts themselves, and from continued requirements to increase the fraction of the Navy's R&D work conducted by the private sector. The confluence of these forces dictates a change to DON's in-house R&D infrastructure. DON cannot continue to conduct its R&D business as in the past without risking its entire in-house R&D program. Proportional reduction of the present infrastructure will not achieve the desired objectives.

SPECIFIC TASKING:

a. Review the evolution of Naval R&D. Derive a historical perspective and lessons learned of how and why the DON developed its current R&D infrastructure.

b. Examine the Naval R&D process. Address the entire process, from technical decision-making to program execution. Emphasize relevancy, integration, outsourcing, and efficiency.

c. Evaluate the current R&D headquarters and field activity relationship. Discuss advantages/disadvantages of future operations under Defense Base Operating Fund (DBOF).

d. Evaluate the technical contributions of Naval R&D infrastructure classes. Emphasize criticality, redundancy and ability to meet needs of DON in 21st century.

PRESENTATIONS

- APL — Dr. Smith
- ASN(RD&A) — RADM Oliver
- BSAT — Mr. Nemfakos
- DDR&E — Dr. Dorman
- MARCOR-SYSCOM — Mr. Vaughn
- N091 — RADM Houley
- N81 — Mr. Henry
- NAVAIR — VADM Bowes, RADM Lockard, Dr. Someroff
- NAVSEA — VADM Malley, RADM Hood
- NAWC — Mr. Lundberg
- NCCOSC — Mr. Wessel
- NLCCG — Dr. Blatstein
- NMRDC — CAPT Carter
- NØØK — Dr. Morrow
- NRAC — Dr. Colvard, MGEN Franklin, Mr. Rumpf
- NRL — Dr. Coffey
- NSWC — Dr. Blatstein, Mr. Reece
- NUWC — Mr. Messere
- ONR — RADM Pelaez, Dr. Saalfeld, Dr. Faulstich
- RAND — Dr. Bracken, Dr. Saunders
- SPAWAR — Mr. DeSalme

FIELD TRIPS

NSWC
- DAHLGREN
- INDIAN HEAD
- CARDEROCK
- WHITE OAK
- ANNAPOLIS
- PANAMA CITY

NAWC
- WARMINSTER
- CHINA LAKE
- LAKEHURST
- PAX RIVER

NUWC
- NEWPORT
- NEW LONDON

NCCOSC
- SAN DIEGO

NMRDC
- BETHESDA

NRL
- WASHINGTON

APL
- JOHNS HOPKINS UNIVERSITY

ARL
- UNIVERSITY OF TEXAS

HISTORICAL PERSPECTIVE OF NAVAL RESEARCH AND DEVELOPMENT

PRIOR TO WWI - THE EARLY YEARS

- **Tiny Budgets**
- **Late 19th and Early 20th Century Period of Technical Revolution**
  - **Steel Ships**
  - **Electricity**
  - **Rifled Guns**
  - **Steam Propulsion**
  - **Coal to Oil**
- **Navy's Technical Changes Came From Outside**
- **Emergence of Private Industrial Labs**
  - **Edison, General Electric, Dow Corning, Westinghouse, etc.**

Lessons of WWI:
- **Navy Not Served Well By R&D For WWI**

During the Civil War period, sweeping winds of changing technology engulfed the fleets of the world. The U. S. Navy was carried along on the tide, but participated largely in a copycat role. Wooden ships gave way to steel hulls and armor plate. Sails bowed to steam-powered paddle wheels and then screws; the wind no longer determined mobility and maneuverability. Cannon progressed from smooth bore muzzle loaders to rifling and breech blocks with corresponding increases in range, accuracy and rate of fire.

The U. S. Navy took its new technology from both the more modern European navies and from inventors. Early civilian commercial research laboratories, such as General Electric, Westinghouse, Bell, and Edison were reflections that private industry clearly recognized the need for an in-house research capability, but that relationship was yet to dawn on our Navy.

Prior to WWI, the U. S. Navy did not sponsor or conduct any basic research or technology exploitation. Naval facilities concentrated on design improvements and testing of relatively mature technologies. Numerous historians rated the U. S. Navy 12th among the world's naval powers during this period.

NRAC

DT&E AS OF WWI - THE BUREAUS

- **Ordnance**
  - **Gun Factory - Washington DC**
  - **Torpedo Station - Newport**
  - **Firing Ranges - Annapolis → Indian Head → Dahlgren**
- **Construction and Repair**
  - **Model Basin - Washington Navy Yard → Carderock**
- **Steam Engineering**
  - **Engineering Experiment Station - Annapolis**
  - **Radio Test Shop - Washington Navy Yard**
  - **Fuel Oil Test Plant - Philadelphia Navy Yard**

Work Accomplished Primarily Development and Test Vice Advanced Research

With war clouds looming on the horizon, Secretary of the Navy Daniels convinced Thomas Edison to head the Naval Consulting Board. The board included Edison and two members each from the eleven largest engineering societies in the United States. These men were largely engineers and inventors. They evaluated 110,000 suggested inventions from all corners of society. One hundred ten were judged to be of sufficient merit to be reviewed by the executive group but only one went into production. Edison himself submitted such ideas as: a sonic device to detect submarines, anti-torpedo nets, ship decoys, smoke generators for ships, and many more. Edison later said, “I invented 45 things during the war, all were pigeon-holed; every one of them.” Science did little to influence U.S. Navy thinking during WWI. The board and Secretary Daniels did convince Congress to establish the Naval Experimental and Research Laboratory in 1916, although it was not opened and staffed until 1923.

The Bureau of Ordnance operated the gun factory in Washington, D.C. and the torpedo station at Newport as engineering, development, and testing facilities. As ranges of guns increased, their test facilities moved from Annapolis to Indian Head to Dahlgren to provide the required increase in space. The Bureau’s detailed engineering drawings and specifications enabled industry to respond to the demand for guns and ammunition during the “Great War.”

Yard, which moved to Carderock as model sizes grew. Under the Bureau of Steam Engineering; the Engineering Experiment Station, Annapolis; Radio Test Shop, Washington Navy Yard; and the Fuel Oil Test Plant, Philadelphia Navy Yard, all operated as small engineering sections aboard already established facilities. Though science and technology did little for the Navy in WWI, a cadre of officers was created who would be admirals before WWII, and would establish an in-house research and development capability within the Navy.

WWI THROUGH WWII - DISARMAMENT THEN BUILD-UP

- **Inadequacies of R&D for WWI Recognized by Military and Scientific Leaders**
- **Character of R&D Changed to Encompass Basic Scientific Research**
- **Navy Research Laboratory Established 1923**
- **Other Labs Expanded and New Ones Established Under the Bureaus**
- **R&D Funds Slim in 1920's - Increased Dramatically in Late 1930's**
- **Office of Scientific Research and Development Under Vannevar Bush Established by Congress in 1941 with Wide Authority and Funds**

After WWI, the scientists, engineers and inventors who had rallied to help the Navy returned to their campuses and private laboratories. Small but important seeds had been planted, both in the minds of the scientific community and some young naval officers. Though science had not greatly influenced the Navy in WWI, it would have to be embraced by the institution in order to progress into the 20th century. Private industrial laboratories increased from 300 at the end of WWI to over 2200 by the beginning of WWII. The age of "big science" was dawning. Survival in industry meant constantly pushing the frontiers in order to market new products. Survival of the Navy and the nation against technically advanced foes meant exploring new science, developing it into weapons and adopting new tactics and strategies to embrace the advances.

WWI THROUGH WWII - DISARMAMENT THEN BUILD-UP (Cont'd)

- **Lessons of WWII and Resultant Actions:**
  - **Bush Advocated Continued Strong Federal Support for Scientific Research**
  - **National Recognition of Value of R&D for Nation's Defense**
  - **Office of Naval Research and NRAC Created in 1946**
  - **Unique Facilities, Test Ranges and In-House Talent Retained**

The Naval Research Laboratory (NRL), the first basic research organization of the Navy, opened its doors in 1923 after seven years of bureaucratic bickering as to its mission, ownership and location. The slim R&D funding of the 1920's gave way to more substantial levels of investment as Europe moved inexorably toward conflict. The Bureau of Ordnance hired its first Ph.D. physicist, Dr. L. T. E. Thompson in 1923, to be the technical director at Naval Proving Ground, Dahlgren. In 1924, the first Norden bombsight was delivered to Dahlgren for five years of testing. A scientist named Goddard continued to hound the Navy for funding to advance the science of rocketry. Science and technology were elbowing their way into a reluctant Navy.

In 1941, Congress established the Office of Scientific Research and Development. The office, under Vannevar Bush, was given funds and broad authority to expand federally funded research for defense purposes. By the end of WWII, science and technology were full partners with the services. The Navy established the Office of Naval Research (ONR) and the Naval Research Advisory Committee (NRAC) in 1946. Vannevar Bush wrote, "Science: The Endless Frontier," and encouraged continued strong federal support for R&D. The Navy retained its key and unique facilities after the war and strove to maintain its in-house talent pool. Maintaining strong Federal support for unique Naval facilities and an in-house talent pool are key lessons learned for the future especially during the times of downswing.

POST WWII TO 1966-COLD WAR-
NUCLEAR WEAPONS, SPUTNIK AND BEYOND

- **Value of R&D Still Fresh in Nation's Mind from WWII**
- **Period Characterized By Intense Competition With Soviet Union**
- **For First Time Since 1812, National Borders Vulnerable**
- **Vigor of In-House Research Labs Continued**
- **Labs Reported to and Supported by Bureaus**
- **Civilian Scientists of High Caliber Continued to Serve After WWII**
- **In 1959 ASN(R&D) and DCNO(D) Established**
- **In 1966 Laboratories (Except NRL) Transferred to Chief of Naval Material Under Director of Navy Laboratories**

Throughout This Period Value of Research Recognized at Both Strategic and Tactical Level

The Nation emerged victorious from World War II, having fully mobilized and dedicated the scientific, engineering, and manufacturing capabilities of the United States to a single objective — winning the war. It was universally recognized that the power of technology had been a decisive factor in our struggle with advanced adversaries, especially Germany. The atomic bomb and radar are but two examples in which science had given us the edge.

Adding to this awareness of science was a realization that we were in a technological race with a powerful adversary. The Soviet's atomic and hydrogen bomb explosions of the late 1940's and early 1950's, followed by Sputnik in 1957, drove home the message that we had no corner on technology and that our survival was dependent upon continued investment in military R&D and weapons systems.

Navy R&D, in particular, benefited from this emphasis. In 1959, the Assistant Secretary of the Navy (Research and Development) [ASN(R&D)] position was established, eliminating the Assistant Secretary of the Navy (Air) [ASN(AIR)] position that previously had collateral duties for R&D, to administer the overall R&D program for the Navy. The laboratories and acquisition responsibilities remained under the bureaus.

In 1966, the Chief of Naval Material position was established, assuming responsibility for material functions, ending the bilateral Navy.

COLD WAR, 1966-PRESENT
VIETNAM - POST VIETNAM ERA

- **1966 - Chief NAVMAT Established and Weapons Systems Centers Formed 3 Months Later**
  - **15 R&D Laboratories Reorganized into 9 Centers Over Next 7 Years**
- **1966-77 - Period of Declining Basic Research Funding**
- **1973-84 - Common Threads of Many Commissions i.e. Grace, Packard, etc.**
  - **Layering of Staff**
  - **General Trend Toward Regulatory Performance Through Management Systems**
  - **Years of Constant Reorganization**
  - **Concern Over Retention of High Quality Technical Personnel**
- **1980 - Perry Report Strongly Supported In-House R&D Capability**
- **1985 - NAVMAT Disestablished - Labs Move to CNR, Then SPAWAR in 1986 - Central Leadership Lost**

The year 1966 marked a significant milestone in the evolution of the Navy's laboratories and material establishment. The Systems Commands, representing continuations of the older material bureaus, then reported to a Chief of Naval Material (CNM). The CNM reported to the CNO, rather than to the Secretary of Navy. The traditional bilinear organization where the material or producer side of the Navy reported to the Secretary and the user or operational side of the Navy reported to the CNO had now been replaced by a unilinear organization under the CNO. This substantially increased influence of the operational Navy over the procurement side of the Navy's activities. Laboratories also reported to CNM under a Director of Navy Laboratories (DNL). In a remaining vestige of the bilinear system the DNL reported also to the ASN(R&D).

The period of the late 1960's, 70's and 80's can be characterized by a mass of commissions and reports on the administration and organization of research and development. By far the largest portion was focused on management. Many severely criticized the excessive centralization of decision-making in DOD and the Navy that resulted in overly large staffs, causing unwarranted paperwork, delay, and expense. A recurrent theme was that there had been a general trend toward regulatory performance through procedures and management systems, rather than reliance on competent individuals.

Reorganizations were rampant during this period. Examples include:

- David Taylor Model Basin, Carderock annexed the Navy Marine Engineering Laboratory, Annapolis to form the Naval Ship Research and Development Center

- In a series of sequential closings and consolidations, the Naval Ocean Systems Center (NOSC), San Diego, was formed from the Navy Electronics Laboratory, San Diego, the Pasadena Annex of Naval Ordnance Test Site (NOTS), China Lake, and the Naval Undersea Center (NUC), San Diego.

- The Naval Radiological Defense Laboratory, San Francisco was closed and functions transferred to Naval Ordnance Laboratory (NOL), White Oak and Naval Weapon Laboratory (NWL), Dahlgren.

- The Naval Applied Science Laboratory, Brooklyn was closed, with the functions moved to NWL, Dahlgren and Naval Ship Research and Development Center (NSRDC), Annapolis.

In a 1980 report issued by William J. Perry of Office of the Director of Defense Research and Engineering (DDR&E), Perry suggested that the in-house facilities “possess and demonstrate an institutional perspective toward their responsibilities,” unlike private sector organizations motivated by the profit factor. Perry regarded that perspective and “dedication to national purposes” as desirable and valuable. The Defense Department’s internal technical responsibility, he argued, provided “an institutional perspective and a continuity not available from any other source.”

Then, in 1985 Secretary of the Navy Lehman stated that he was shifting from centralization back to a system of vertical accountability and disestablished NAVMAT. The Navy’s Systems Commands and project managers would report directly to the CNO. The R&D Centers (laboratories) were assigned to the Chief of Naval Research who reported, in turn, to Assistant Secretary of the Navy (Research, Engineering and Systems) [ASN (RE&S)]. One year later, the labs were moved to the newly formed Space and Naval Warfare Systems Command, whose function it was to integrate weapon systems. These changes generally served to dilute and defocus the Naval R&D and material establishment.

COLD WAR, 1966-PRESENT
VIETNAM - POST VIETNAM ERA (Cont'd)

- **1986 - Goldwater Nichols Act**
- **1989 - Defense Management Report to President**
  - **ASN(RD&A) Established (1990)**
  - **PEOs Created - Report to ASN(RD&A) (1990)**
- **1992 - 34 Activities Merged Into Four Warfare Centers Under Systems Commands and ASN(RD&A)**
  - **10 Facilities to be Closed**
  - **16 Others Realigned**
- **Director of Navy Labs Disestablished**
- **RD&A Established Lab Oversight by Navy Laboratory/Center Coordinating Group (NLCCG) and Navy Laboratory/Center Oversight Council (NLCOC)**

Debilitating Period of Turmoil and Turbulence

The Defense Management Report of July 1989 laid out the actions DOD would take pursuant to implementing the Packard Commission's recommendations and the Goldwater-Nichols Act. Key provisions included:

- A single civilian official as the Service Acquisition Executive (SAE) [in Navy the ASN(RD&A)] with full-time responsibility for Service acquisition.

- The SAE to manage all major acquisition programs through Program Executive Officers (PEO's).

- Systems Commands to focus on roles of logistic support, managing programs other than those under PEO's, and support to PEO's.

Thus, the effect of Goldwater-Nichols has been the return to a bilinear system for major acquisitions in which the Secretariat has control of development and production. Two significant differences are noted from the pre-1966 bilinear system:

- Rather than 4 or 5 material bureaus reporting to the Secretary of the Navy (SECNAV), there are more than 12 acquisition officers reporting to the ASN(RD&A).

- The responsibility for depot maintenance support remains with the systems commands, and CNO.

With the disestablishment of the Director of Navy Laboratories, laboratory oversight and coordination is now exercised through two committees, established by the ASN(RD&A), the Navy Laboratory/Center Coordinating Group (NLCCG) and the Navy Laboratory/Center Oversight Group (NLCOC). The panel could find little evidence of the effectiveness of this arrangement; e.g. the NLCOC, which was to provide strategic oversight, has failed to meet in recent times.

HISTORICAL PERSPECTIVE - SUMMARY

- Little Research Contribution to Navy in WWI
- Basic Scientific Research (Much In-House) Pushed in '30s and Contributed Greatly in WWII
- Continued Technological Competition with Soviet Union in Post War Period
  - Infrastructure Grew in Keeping With Capability Needs
- Wide Availability of Sophisticated Weapons to Potential Adversaries
- Turbulence of Acquisition and Laboratory Reorganizations of 1970s-1980s - Presently Endangering Our Capability

Downsizing Must Not Destroy Capabilities That Are Irreplaceable and Needed

CRITICAL RESEARCH AND DEVELOPMENT RESOURCES

EVOLUTION OF CRITICAL FACILITIES

- **Development Sites In Early Years Tended To Be Located At Existing Facilities, Frequently Test Ranges**
- **Technical Expertise Grew At These Sites**
- **New Facilities Built To Support Emerging Needs**
  - **(Examples: Model Basin Tanks, Wind Tunnels, Machinery Test Beds)**
- **As Weapon Sophistication Grew Over Time, New Test Ranges Became Necessary**
  - **(Examples: China Lake, Dabob Bay, Pend Oreille, AUTEC)**
- **Geographically Unique and High Value Navy Facilities and Ranges - Many Not Replaceable**

Plan for Downsizing Must Consider the Necessary Infrastructure Capability Needed by Navy in the Future

During the era of the “Bureaus” the development, test and evaluation facilities and the associated expertise grew up amid existing yards, depots and test ranges. As the Bureaus embraced the full spectrum of science and technology development they began to build and operate extensive and often unique facilities. Research along the frontiers of aerodynamics, detection, deception and acoustics required the establishment of sophisticated ranges and environments where subtle differences in precise measurements could be detected and quantified.

Geographically and technically one-of-a-kind facilities sprang up in places like China Lake, Dabob Bay and Lake Pend Oreille. These expensive test and scientific measurement ranges, and the experts who operated them, became indispensable as the edges of our knowledge envelope were being probed.

In order to maintain our scientific edge into the 21st Century and beyond, it is imperative that we refresh the talent and preserve the one-of-a-kind ranges, test sites and facilities which have enabled us to become the world’s foremost naval power.

SUPPORT OF CRITICAL R&D RESOURCES

- **Must Retain:**
  - **Facilities to Test and Evaluate Unique Navy Products**
    - **e.g. Weapons and Acoustic Ranges**
  - **Support Capabilities For Unique Navy Requirements**
    - **e.g. Ordnance Development, Threat Analysis**
  - **High Value Unique Facilities**
    - **e.g. Tow Tank, Airframe Motion Simulator**
  - **Capabilities Providing Rapid Responsiveness**
    - **e.g. Threat Countermeasure Development/Deployment**
  - **Personnel Who Are a Unique Source of Corporate Knowledge**

Proper Stewardship Demands Certain R&D Capabilities Be Preserved

As the Navy looks to the future and the reality of a smaller infrastructure, it must insure that certain resources are maintained. A long-term Navy plan that identifies "must support" resource requirements should be developed. Those critical resources should include:

First, those facilities required to test and evaluate products that are unique to the Navy. Depending on private sector facilities for test and evaluation of products for which no commercial market exists, puts the Navy at an unacceptable level of risk in the long term. Examples of such facilities are test and evaluation ranges required to fully evaluate Navy weapons and weapons systems. These facilities typically represent an irreplaceable resource in land, sea, or air space.

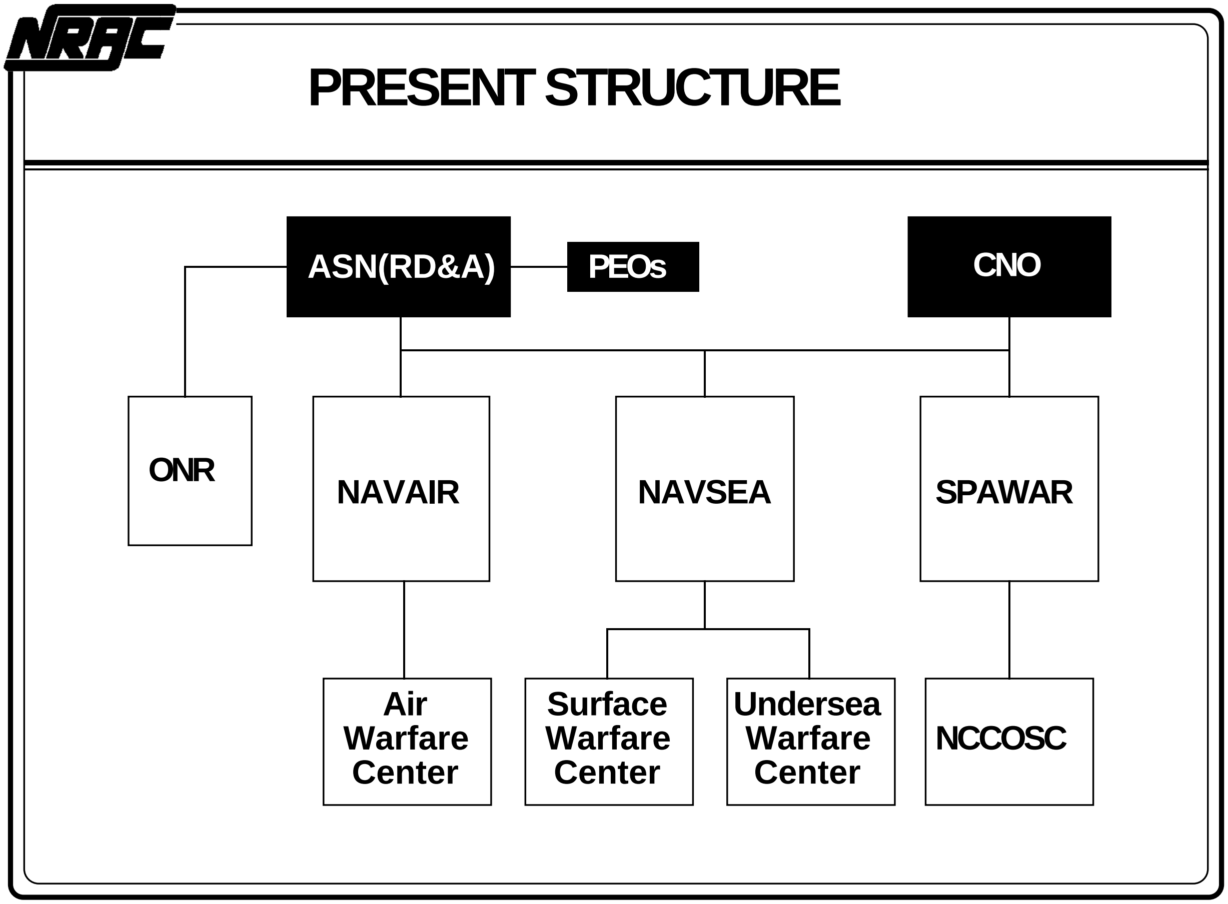
Second, those support capabilities used for analysis, development and prototyping of unique Navy products and requirements. Examples of these capabilities include: the system and applications knowledge required for analysis of warfare area threats and countermeasures, and the development capabilities for ordnance.

Third, very high value fixed facilities that are unique and critical to Navy needs. Examples of such facilities include the tow tank facility at Carderock used for hull/shape analysis, and the airframe motion simulator centrifuge facility at Warminster used for training and medical research.

Fourth, capabilities that can provide rapid response to emergency requirements. These would include analysis, development, and limited production or prototyping capabilities. Examples include: the rapid development and low volume production of new infrared countermeasures during the Gulf War, and new threat electronic countermeasure development and deployment, also during that conflict.

Fifth, and perhaps the most vital resource that we have is our people, and the knowledge and corporate memory that reside in them. We must retain an adequate, high quality core of these personnel. They must be used, not only to perform their technical functions and provide leadership for our private industry partners, but, also to be the “pilot light” that guides and passes on corporate knowledge to new talent entering the organization. It is also imperative to continue the infusion of this new talent into the naval infrastructure in order to maintain their knowledge of emerging technologies and new ideas from our universities.

RESEARCH AND DEVELOPMENT ORGANIZATION



The present R&D/Material Command structure is keyed to three systems commands reporting in trilateral fashion to the CNO as second echelon commanders and to the ASN(RD&A) for matters of development and acquisition. Thus, the structure is only integrated at the very highest levels (e.g. CNO, ASN). The engineering, development and test facilities are combined into four warfare centers which, in turn, are assigned to appropriate systems commands.

IDENTIFIED ORGANIZATIONAL WEAKNESSES

- **Structure**
  - **R&D Execution and Material Organization Not Integrated Below Policy Level [(ASN(RD&A)]**
  - **R&D/Material Organization Lacks Uniform Long-term Vision, Constancy of Purpose, and Continuity of Policy**
  - **Warfare Centers and Systems Commands Represent Unnecessary Management Layering**
  - **Similar, But Independent Efforts Performed Across Warfare Centers at Component, Material and Process Levels**
  - **R&D/Material Organization Policy Unrelated to PEO Workload Demand**
  - **Headquarters Management Diluted by Engineering and Other Functions Appropriately Performed in Warfare Centers**
  - **Insufficient Emphasis On Manufacturing Technology (MANTECH)**

Separation of the primary Navy technical material resources into three systems commands and then further into the four warfare centers leads to the following weaknesses:

- Material program execution and technical resources across the Navy material organization are not integrated until reaching the ASN(RD&A) level. This Navy acquisition policy and oversight level and has many internal and external demands beyond insuring proper integration of its vast technical resources.

- The leadership of the systems commands is vested in senior military professionals with considerable, but varied experience. Each of these leaders creates his own organizational purpose and policy. Differing policies in each systems command are the result. Particularly as the Navy grapples with downsizing, preservation of its technical resources requires well thought out, long-term, uniform personnel and facility strategies, policies and procedures. These objectives are practicably unobtainable within the present organizational structure.

- The individual field commands or divisions located in the individual warfare centers are managed by the warfare centers and, in turn, by the systems commands. This structure represents excess layering, with many redundancies and inconsistencies.

- Similar technical efforts exist in several of the field activities. These efforts do not necessarily represent redundancies, as they are usually performed for different purposes or on different products. An example is research into corrosion, its effects, and control on aircraft and ship systems that is being conducted at several different facilities. There are opportunities to increase effectiveness and efficiency of resource integration like establishing centers of excellence in such areas.

The separation of the acquisition managers (PEOs & Program Managers) from the executing organization leads to conflicting demands at the warfare center or field activity level. In particular, the workload demands placed on the technical resources by the acquisition managers is not consistent with personnel downsizing policies placed on the warfare centers by their chain of command. This situation leads to high levels of frustration at field activities.

The systems commands' headquarters are performing a myriad of functions including: acquisition contracting and accounting support; acquisition and program management; integrated logistics support functions; and engineering. These support functions tend to divert attention from important management and policy level functions.

MANTECH offers significant opportunities to save critical Navy resources during downsizing. The Navy's MANTECH strategic plan addressing the needs of the PEOs and PMs has not been funded or supported in the budget process. The MANTECH office appears to be buried at an inappropriately low level in the organization. This area has significant promise and requires serious attention.

IDENTIFIED ORGANIZATIONAL WEAKNESSES (Cont'd)

- **Personnel**
  - Personnel Policies Are Eroding Capability By Distorting Work Force Skill Mix During Downsizing (e.g. Hiring Freeze, Promotion Freeze, Transfer/Replacement Limitations, Early Outs)
- **Financial System**
  - DBOF Concept OK, but:
  - Large Rate Swings Due To 2 Year Cycle
  - Does Not Provide Adequate Funding For Low Use Critical Capabilities
  - No Standard Accounting System
- **Downsizing**
  - No Long Term Plan Exists Defining the Future R&D/Material Establishment to Guide BRAC Process
  - No Actionary Exists For Such A Plan

PERSONNEL

The material organization's technical personnel resources suffer from a variety of constraints including: reduced personnel budgets; personnel hiring freezes; high grade controls; and priority placement programs, both at the systems command (in some cases) and at the Department of Defense (DOD) levels. These constraints, coupled with the relatively inflexible civilian personnel system and early out and separation incentive programs, make effective personnel downsizing an enormously difficult task for the warfare center field activities. As downsizing continues, without infusion of new talent, and with separations based more on length of service than function or skill, there is a real likelihood that serious skill imbalances will result and that vital knowledge bases will unnecessarily erode.

THE DEFENSE BASE OPERATING FUND

DBOF, in concept, generally is a good operating system for the material organization's field activities. Costs are well identified and emphasis is placed on efficiency of operation. Some difficulty in DBOF implementation is caused by setting rates on a two-year cycle during periods of rapid change, particularly downsizing, leading to large rate swings which complicate field activity management and sponsor program budgeting. Under DBOF some **critical facilities** may not be used sufficiently to provide the business base to defray the cost of operation. This could result in closure of critical facilities.

Many different automated accounting systems are used by the field activities for DBOF implementation. This complicates cost comparisons between activities, makes consolidations more complex, and results in wasted resources by maintaining many different systems.

DOWNSIZING

While each field activity has some sort of downsizing plan that primarily addresses personnel, no high level “corporate” plan exists to address the future requirements of the material organization and guide field activity plans. Such a plan would be invaluable in providing guidance to the BRAC process. No readily identifiable material organization entity exists with the responsibility for creating such a strategic plan.

RECOMMENDED ORGANIZATIONAL ADJUSTMENTS

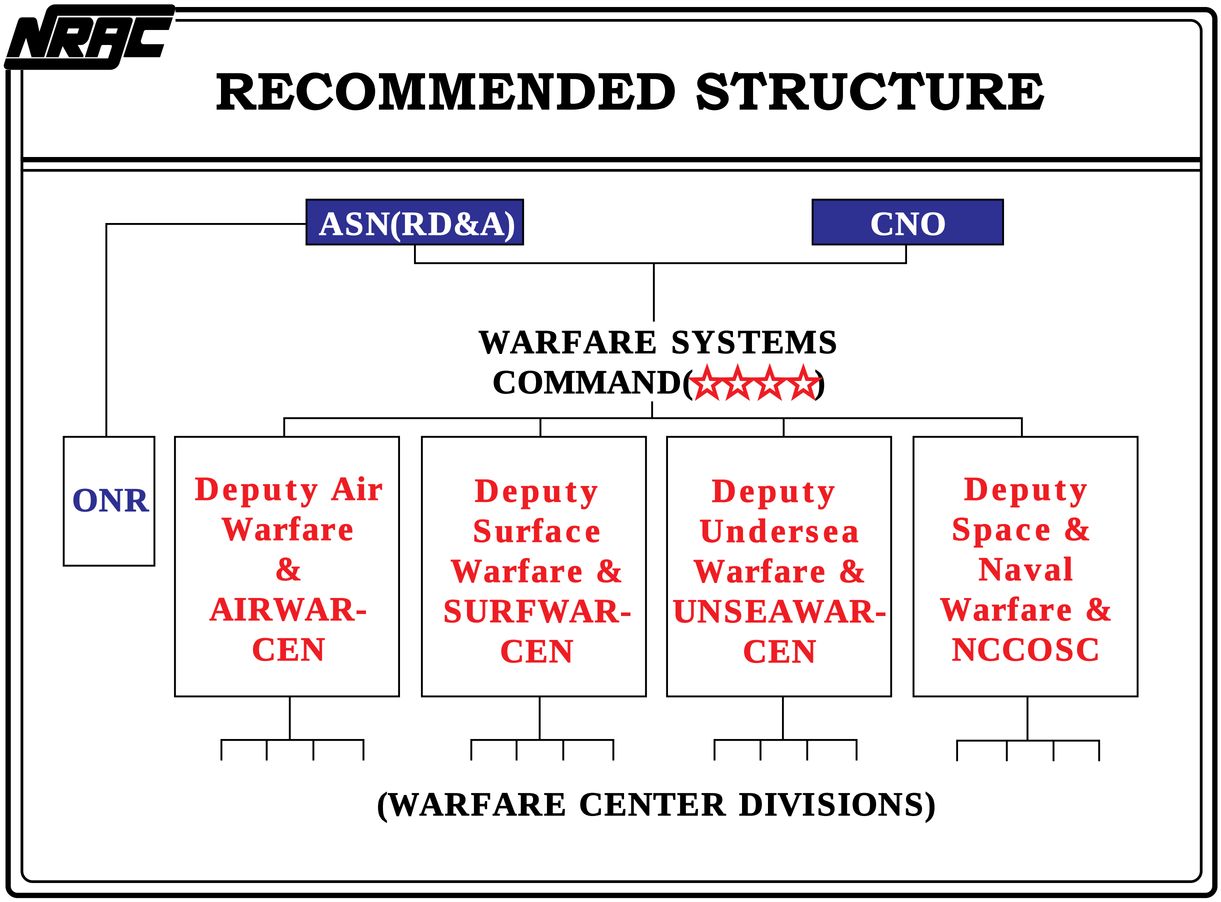
- **Structure**
  - **Unify R&D/Material Command Structure**
  - **Provide Senior R&D/Material Command Leader/Advocate**
  - **Reduce Layering**
  - **Decentralize Engineering and Support Functions from Headquarters to Warfare Centers**
  - **Combine Common Functions Into Centers of Excellence Where Appropriate (e.g. Materials Research, Arithmetic Processing, Energetics)**
  - **Place MANTECH In Unified Organization**

Fundamental to the panel's recommendations is the consolidation of the current trilateral headquarters structure into a unified headquarters under the command of a senior naval officer. This new command should report to the CNO for administration and for logistics matters and to the ASN(RD&A) for matters involving research, development and acquisition. The principle headquarters responsibilities should focus on general policy, integration of material resources needed to respond to the warfighting requirements set forth by the Office of the CNO and the Fleet Commanders and the oversight and review of the ongoing effectiveness of the R&D/Material organization in support of the ASN (RD&A).

The recommended Warfare System Command would provide support to the ASN(RD&A) in order to assist that office in the execution of its broad spectrum of development and acquisition responsibilities. The Commander would ensure that command policies are consistent, supportive and responsive to the changing needs of the designated acquisition managers and would review program support to ensure ongoing effectiveness. The Commander would be in a position to make changes in the organizational structure which could result in significant efficiencies. Headquarters staffs could be further reduced through reassignment of many routine support functions to the warfare center activities. Common functions which are currently performed at more than one activity could be combined into Centers of Excellence, either real or virtual, in order to optimize output effectiveness as well as reduce duplication.

Most significantly, the Commander would constantly provide the leadership, consistency of policy, long-term perspective and overall advocacy needed to ensure the viability of the Navy's R&D/Material infrastructure into the future. This role takes on added importance in the face of future decisions to downsize the Navy's infrastructure, or to consolidate with the other service R&D/material organizations. The Commander must formulate policies which are responsive to the intent of the decisions of the Congress, the DOD and Office of the Secretary, and must do so with a view to the long-term effectiveness of the R&D/Material structure and its personnel. To assist in this responsibility he/she would institute a long-term planning process which would set forth future resource requirements for the R&D/Material establishment. This strategic plan, approved by the CNO and SECNAV, would be important in the near term to assist BRAC process decisions.

The Navy's MANTECH effort offers the opportunity to achieve lower cost systems through reduced cost of manufacturing. Reassigning this program to the R&D/Material organization allows for improved integration of MANTECH with the Navy's development and follow-on production programs, providing significant cost savings in a budget down environment.



The recommended R&D/Material organization institutes a senior (four star) Warfare Systems Command. Four deputies, oriented to the separate warfare areas, are assigned to the Commander. These deputies are "dual hatted" as Commanders of the four warfare centers. The present systems commands are disestablished. The Deputies would be co-located with the Warfare Systems Commander.

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RECOMMENDED STRUCTURE ATTRIBUTES

- **Headquarters: Small, Policy Level Staff**
- **Integrates R&D/Material Resources**
- **Integrates Technical Capabilities Into Broad Warfighting Systems/Support (Example: Littoral Warfare)**
- **Enhances Capability Through Center of Excellence Concept**
- **Manages Technical Resources (Warfare Centers)**
- **Develops Organization's Strategic Plan For Future Resource Requirements**
- **Simplifies Lines of Responsibilities**

Creates Focal Point and Advocate for the Long-term R&D/Material Needs of the Navy

The institution of a single senior uniformed commander providing the leadership and management of the Navy's R&D/Material infrastructure takes on particular significance during the planning and execution of the downsizing of that infrastructure. In addition to simplifying the current trilateral lines of responsibility into a single integrated one, the command serves as the needed focal point for the future needs of the R&D/Material organization. With the support of the Deputies, the Commander would be responsible for the development of the strategic resource plan for the future R&D/material infrastructure and would act as its principal advocate, to the ASN(RD&A) and the CNO.

The consolidation of the system commands into one Warfare Systems Command provides the opportunity to decentralize many of the current systems command engineering and support functions into the warfare centers, thus significantly reducing the size of the headquarters staff. This would enable the Commander to better focus on integrated management functions in the areas of policy, planning, review and audit. In addition, he or she would provide direct assistance to the ASN(RD&A) in discharging the responsibilities of that office to direct the Navy's development and acquisition program.

The consolidated Warfare Systems Command structure will better provide for the integration of the needed technical resources across all of the separate warfare areas to develop broad warfighting capabilities such as in the Joint Strike and Littoral Warfare Joint Mission Areas.

RECOMMENDED ORGANIZATIONAL ADJUSTMENTS

- **Personnel**
  - **Delegate Personnel Management to the Lowest Appropriate Level - Emphasize Work Force Quality**
- **Financial System**
  - **Use Actual Instead of Stabilized Rates**
  - **Fund Critical Low Use Facilities Outside DBOF**
  - **Invoke Standard Financial Accounting System for All DBOF Activities**
- **Downsizing**
  - **Embed Responsibility for Long-term R&D/Material Establishment Plan at Highest Level in Organization**

PERSONNEL

Each activity should concentrate on the retention of the proper mix of personnel necessary to ensure the future effectiveness of that activity in meeting assigned mission requirements. This mix must consider current technical expertise as well as level of experience within each area. The management of this process takes on added significance in the period of downsizing. Personnel policy needs to provide general guidance at the highest levels, but each activity should be delegated the capability to tailor policy, consistent with the law, to the unique aspects of its mission.

FINANCIAL SYSTEM

While, in concept, DBOF provides a generally good operating system for the material organization, a few adjustments would improve its effectiveness. In order to react to the rapidly changing business base caused by downsizing, actual rates or more frequently changed stabilized rates should be used, rather than the two-year stabilized rates currently mandated. Certain low use, high operating cost facilities should be funded by special funding accounts similar to range funding. A firm plan to acquire and implement a standard accounting system for DBOF activities should be put in place.

DOWNSIZING

The responsibility for the formulation and periodic update of the R&D/ Material Establishment Strategic Plan should rest with the Commander, Warfare Systems Command. The proper assessment of the future needs of the organization must be conducted and the results set forth in the Strategic Plan. The plan should provide valuable input to the ongoing BRAC process and insure the long-term effectiveness of the Navy's R&D/Material infrastructure.

ORGANIZATION SUMMARY

- **The Immediacy of Downsizing Requires Near Term Solutions**
- **Identified Weaknesses Should Be Addressed and Corrected**
- **Recommended Adjustments Are Intended To Address Each Identified Weakness**

The Recommended Organizational Structure Forms the Basis for a Unified and Strengthened R&D/Material Organization

As the Naval R&D/material organization follows the downsizing path, its R&D capability becomes increasingly vulnerable. In order to minimize disruption and the loss of vital resources, the weaknesses in structure, personnel, operating systems, and plans for downsizing identified by this NRAC panel should be addressed and corrected methodically and rapidly.

The adjustments recommended herein address all identified weaknesses. Several adjustments can be made simply and quickly, such as delegation of personnel management to the lowest practical level. Other adjustments, such as the recommended significant reorganization, require detailed planning and thoughtful implementation.

The panel feels strongly that the recommended organization concept offers the potential for significant improvements in almost all aspects of the Naval R&D/ material organization's effectiveness.

RESEARCH AND DEVELOPMENT PROCESS

NOTIONAL R&D PROCESS

- Establish Capability Requirements
- Translate Into Technology Requirements
- Assess Existing Technology Base
- Develop High Level Investment Strategy
- Plan and Execute
- Evaluate Performance and Adjust Strategy

In order to effectively plan a research and development effort, it is first necessary to clearly establish what new or enhanced capabilities are required. Ideally, these capability requirements should come from the ultimate users, the warfighters. Once these desired capabilities are established, they must be "translated" into the technologies required to achieve them. This requires the combined efforts of the customers, or end users, and experts in existing and emerging technologies (the technology base). In the course of this capabilities-to-requirements translation, it is essential to continually assess the technology base to identify existing technologies capable of meeting the capability requirements before committing to develop new technologies. It is also important to make cost versus risk assessments for proposed technology development efforts.

When available resources (money, manpower, and facilities) are not adequate to pursue all technology development options, prioritization of both capability requirements and technology requirements is essential to make the most efficient use of limited resources. The combination of capability requirements, technology requirements, cost and risk assessments and institutional priorities can then be used to develop an investment strategy. Although all factors are important, the level at which priorities are set ultimately determines the value of the R&D process to the parent organization.

Planning and execution are the heart of any research and development process. Given a valid investment strategy from which to develop an execution plan, the skill and vigilance of the program staff are vital to creating and maintaining a responsive research and development process. Since corporate strategy is not invariant with time, and in view of the long-term nature of the R&D process, it is essential to regularly evaluate the execution of the R&D plan against the investment strategy in order to ensure their continued alignment.

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DON R&D PROCESS

- **Scientific Research Process (6.1)**
  - **Well Established and Regulated**
  - **Crucial to "Smart Buyer" Function**
  - **Vital to Long-term Health of Navy**
- **Technology Process (6.2-6.3)**
  - **Too Cumbersome**
  - **Poor Connectivity to Development Process**
  - **Suffers From Lack of Prioritization of Capability Requirements**
  - **Most Impacted By Changes**
- **Development Process (6.4-6.5)**
  - **Best Reflects DON Strategy Today**
  - **Does Not Directly Benefit From S&T Investment**

The Department of the Navy's research and development process is divided into three distinct areas: scientific research, technology base and development. Scientific research (6.1) and technology base (6.2-6.3) efforts comprise the research component, while the development efforts (6.4-6.5) are separate. The scientific research process managed by the Office of Naval Research has been in place for almost 50 years. It is mature and well respected. Participation of ONR, NRL and warfare center personnel in this basic research function ensures that naval interests are represented in the research community at large and that DON personnel will have access to and cognizance of emerging technologies. Since our National warfighting strategy relies on technological advantage to avoid placing our warfighters in harm's way, this connectivity with the basic research community is vital to the long-term health of the Navy.

The 6.2 and 6.3 funding categories draw upon 6.1 results to develop technologies and components necessary for future capabilities. This process is presently quite cumbersome and is not well connected to the development process. In particular, a lack of prioritization of capability requirements makes it practically impossible to preserve and maintain the most crucial technology development efforts in a period of declining budgets. The long-term focus of scientific research and the near-term focus of the development effort mean that the technology development base is the most appropriate area in which to respond to rapidly changing requirements.

The near-term focus of the development process with emphasis on prototype performance, manufacturing costs and milestones means that this area best reflects DON strategy today. The development programs interviewed by this panel did not appear to make use of the research efforts. Undoubtedly, this is at least partially due to the difference in time scales between research and development. However, the lack of connectivity was apparent in all cases. Improved awareness of technology needs in development programs is a crucial element for developing a useful R&D strategy.

REQUIREMENTS TRANSLATION

- **Capability Requirements Should Reflect DON Doctrine and Strategy**
  - **JMA/SA**
  - **New Doctrine Command**
- **Joint Effort of Users/Developers Required for Translation to Technology Requirements**
  - **Present Process Is Cumbersome**
  - **Should Be Institutionalized in Time of Rapid Change**
  - **Important to Include All Players**
  - **S&T Roundtables**

Identification of required capabilities is the starting point for any research and development process. DON requirements are presently derived from des criptions of Joint Mission Areas and Support Areas (JMA/SA). The new Naval Doctrine Command and the JMA/SA Integrated Priority List (IPL) planned by the OPNAV staff (N81D) should provide essential guidance for prioritizing capability requirements and resulting technology requirements, but their impact has yet to be seen.

Translation of capability requirements into technology requirements requires the participation of both warfighters who are knowledgeable about the needed capabilities, and R&D specialists with expertise in the technology base and the R&D process. In a time of rapid change, in terms of corporate priorities, budgets, and personnel, it is important that the process of translating capability requirements into technology requirements be institutionalized, lest it be lost. It is of course important that all parties with interest in, or a responsibility for, the effort be included in the translation process, which in the DON today is not necessarily the case.

The present ad hoc process for translating capability requirements into technology requirements is through use of Science and Technology Roundtables. The process is presently cumbersome and demanding of manpower and time.

Neither attendance nor acceptance are uniform across the sixteen roundtables. This reflects the embryonic nature of the process which is viewed as an important step toward an institutionalized requirements process. This translation process requires a thorough review and validation.[1]

[1] Planned roundtable process improvements scheduled for FY95 include a closer alignment and integration with the JMA/SA process which will reduce the number of roundtables from sixteen to ten (one roundtable per JMA/SA) and increase participation in the S&T requirements process.

USE OF TECHNOLOGY BASE

- **In-House S&T Involvement Necessary to Facilitate DON Acquisition and Provide Technology Push**
  - **Maintain NRL as S&T Center of Excellence**
  - **Some S&T Should Be Performed at Warfare Centers**
- **Declining DOD Budget and Increasing Pace of Commercial Development Leads to Increased Importance of Non DON/DOD Developed Technology**

DON Must Increase Emphasis on Monitoring/Acquiring Outside Technology

As new threats to our national security and interests emerge and DON doctrine and strategy shift in response, new demands will be placed on the DON R&D infrastructure. Reduced R&D budgets make it increasingly important to maintain an awareness of the existing and emerging technology base from all sources. This awareness can only be achieved through interactive involvement of DON personnel in the S&T research community at large. In order to derive maximum benefit from the resulting expertise, it is important that this expertise be distributed throughout a wide spectrum of DON activities. This promotes awareness of DON needs and problems on the part of the researcher and ensures that the technology base expertise is widely accessible within DON.

The DON will be forced to use an increasing percentage of technology developed outside the Navy and Marine Corps structure. A prime example is the rapidly increasing acceptance of commercial computer technology within weapons systems. As budget reductions continue, externally developed technology will continue to increase in importance to the Navy. Other U. S. government agencies, foreign and domestic industry and academia are all potential sources for usable technology.

Tracking external technology developments and assessing their utility requires technical competence by those involved. To this end, it is necessary that the Navy continue to perform technology development across a wide spectrum of areas so that competence is maintained.

Maintaining a technology clearinghouse and assessing utility of non-DON developed technology requires a shifting of priorities within the Naval R&D structure. The current structure is oriented primarily toward developing rather than acquiring technology. In general, the resources devoted to technology acquisition from all sources must be expanded, if necessary, at the expense of the development function. Systems and procedures to accomplish this goal are required.

R&D INVESTMENT STRATEGY

- **Must Reflect DON Doctrine and Strategy**
- **Needs More Direct Involvement of DON Warfighters to Set Goals, Objectives and Priorities**
- **Requires Prioritization Increasingly as Resources Decline**
- **Must:**
  - **Address Affordability at 6.2-6.3 Level (MANSCIENCE)**
  - **Utilize All Resources (Other Government, Industry, Academia, Foreign)**
- **Provides Basis For Planning and Evaluation of R&D Process**
- **Necessary to Ensure Integration of S&T With Development Process**

One critical overarching function that is essentially missing from the DON R&D process is the articulation of an overall R&D investment strategy. Such a strategy should be a concise statement of objectives and goals with sufficient prioritization so that it will be used as the major guidance for R&D planning and execution. The strategy must have the concurrence of DON corporate leadership. The current lack of connectivity of the R&D process with the DON warfighters is one of the key issues identified by this study. If this panel's recommendation for the establishment of a Warfare Systems Command is adopted, this command would be the appropriate entity to represent the Navy's corporate warfighting perspective in the development of Navy R&D investment strategy.

The prioritization of R&D resources must directly reflect the DON doctrine to emphasize critical areas and minimize non-relevant investment. Several relatively recent initiatives will assist in the development of the top level R&D investment strategy. In particular, the outcome of the JMA/SA process does provide some guidance and with the "integrated priority list" should have more influence in the future. It is important to address affordability of new and emerging technologies as early in the R&D process as possible. This will aid in performing cost/risk tradeoffs between competing technologies and help ensure that emerging technologies chosen for further development will not suffer from excessive manufacturing costs. As resources decline, it is important not only to rely solely on the DON budget to meet the Navy's R&D needs. In addition to acquiring non-DON developed technology, opportunities should be sought to share R&D costs and benefits among interested partners. Potential partners include other government agencies and industry as well as foreign governments.

The existence of a current, high level R&D investment strategy, in addition to aiding, planning and execution, would provide a basis for regular, periodic evaluation of the R&D process. Such a strategy is also necessary to ensure the integration of the science and technology research processes with the development process which is not currently well done.

PLANNING AND EXECUTION

- **Presently Most Mature and Successful Segment of R&D Process**
- **Needs Improved Linkage to DON Strategy**
- **Division of R&D Execution Between In-House and Out-of-House Sources Must Reflect DON Planning and Strategy Rather Than Quotas**

R&D program development and execution, particularly for the S&T portion, is presently the most mature and successful segment of the R&D process. Program plans are generated and execution progress is regularly and formally measured against those plans. The process would clearly benefit from improved linkage to DON strategy and several recently implemented changes already mentioned should partially address this weakness.

One aspect of S&T execution that appears to require attention is the issue of in-house vs. out-of-house execution. This is presently mandated across labs and centers as a 60%/40% ratio without regard to criticality of task. As the R&D investment strategy is developed, it will become clear which technologies the DON should take primary responsibility for and which it will rely on outside sources for. This strategy should be used to develop a rational plan for in-house/out-of-house division of the various R&D tasks at center, rather than arbitrary quotas.

R&D EVALUATION

- **Presently Done Against:**
  - **Plan for S&T**
  - **Milestones for Development**
- **Scientific Research Evaluation Requires Long-term Perspective**
- **Technology and Development Would Benefit From Evaluation Against the Overall R&D Goals and Objectives**
- **Results Should Be Used to Modify R&D Investment Strategy**

Individual programs are regularly evaluated against program plans and appear to be generally well managed. There is, however, little evidence of overall evaluation of the R&D program against a DON corporate investment strategy. Such an evaluation is necessary to eliminate efforts that are no longer relevant, and to shift investment strategy to support newly identified critical technologies or capabilities.

Extreme care must be exercised in evaluating scientific research. The fundamental and long-term nature of this work makes it difficult to evaluate against (relatively) shorter term strategy. The traditional approach to evaluating scientific research is quality oriented; relying upon referred journal articles, citations, and patents. This approach is still relevant, but the overall science and technology research program would benefit from closer connectivity with DON doctrine, strategy and capability requirements. The technology and development efforts would benefit from evaluation against overall R&D goals and objectives which are derived from the R&D investment strategy.

It is important that the results of these evaluations be used to modify the R&D investment strategy on a regular basis. If technology developments critical to DON needs lag, either alternatives must be found, or more resources must be directed toward these critical efforts. As corporate strategies are changed, this must also be reflected in the R&D investment strategy. The more closely these two are linked, the fewer resources will be wasted as changes occur.

R&D PROCESS FINDINGS

- R&D Process Needs Stronger Linkage to DON Doctrine and Strategy
- S&T Process Needs Stronger Linkage With Development Process
- Proposed Organizational Structure, in Conjunction With ONR, Would Facilitate Stronger Linkages

RECOMMENDATIONS

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RECOMMENDATIONS

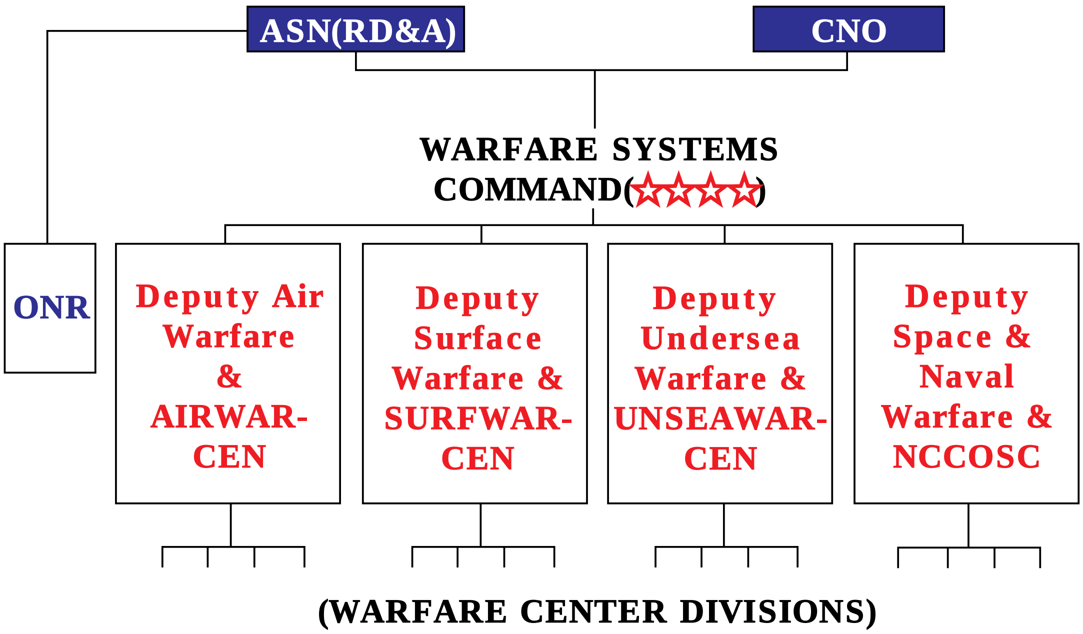
- **Some Capabilities and Facilities (Including Geographical Locations) are Singularly Unique and Critical to DON and DOD. They Should Be Protected and Maintained.**
- **Provide Senior Military Commander To Create Focal Point and Advocate for the Long-term R&D/Material Needs of the Navy**

Although the panel's recommendations deal with the R&D organization and with preserving critical R&D capabilities and facilities, a number of other significant aspects addressing the DON R&D infrastructure and processes have been covered and should be dealt with. These include important recommendations in the following areas:

- Personnel Policies
- Technological centers of excellence
- R&D requirements and planning processes
- DBOF issues
- MANTECH
- Outsourcing rationale
- Accessing external technologies

The panel wishes to thank all DON representatives for their cooperation and appreciates this opportunity to be of service to the Navy.

RECOMMENDED STRUCTURE



LIST OF ACRONYMS

AIRWARCEN	Air Warfare Center
ASN(AIR)	Assistant Secretary of the Navy (Air)
ASN(R&D)	Assistant Secretary of the Navy (Research and Development)
ASN(RD&A)	Assistant Secretary of the Navy (Research,Develop ment and Acquisition)
ASN(RE&S)	Assistant Secretary of the Navy (Research,Engineering and Systems)
AUTEC	Atlantic Undersea Test and Evaluation Center
BRAC	Base Closure and Realignment Commission
CNM	Chief of Naval Material
CNO	Chief of Naval Operations
CNR	Chief of Naval Research
DBOF	Defense Base Operating Fund
DCNO(D)	Deputy Chief of Naval Operations (Development)
DDR&E	Director of Defense Research and Engineering
DNL	Director of Navy Laboratories
DOD	Department of Defense
DON	Department of the Navy
IPL	Integrated Priority List
JMA/SA	Joint Mission Areas and Support Areas
MANSCIENCE	Manufacturing Science
MANTECH	Manufacturing Technology
NAVAIR	Naval Air Systems Command
NAVMAT	Naval Material Command
NAVSEA	Naval Sea Systems Command

NCCOSC	Naval Command, Control and Ocean Surveillance Center
NLCCG	Navy Laboratory/Center Coordinating Group
NLCOC	Navy Laboratory/Center Oversight Council
NOL	Naval Ordnance Laboratory
NOSC	Naval Ocean Systems Center
NOTS	Naval Ordnance Test Site
NRAC	Naval Research Advisory Committee
NRL	Naval Research Laboratory
NSRDC	Naval Ship Research and Development Center
NUC	Naval Undersea Center
NWL	Naval Weapons Laboratory
ONR	Office of Naval Research
PEO	Program Executive Officer
PM	Program Manager
R&D	Research and Development
SAE	Service Acquisition Executive
SECNAV	Secretary of the Navy
SPAWAR	Space and Naval Warfare Systems Command
SURFWARCEN	Surface Warfare Center
SYSCOM	Systems Command
S&T	Science and Technology
T&E	Test and Evaluation
UNSEAWARCEN	Undersea Warfare Center