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Department of Defense Field Activity Roles as Enablers for the Industrial Base: Naval Laboratory Analysis that Supports Key Acquisition Decisions

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Preface & Acknowledgements

During his internship with the Graduate School of Business & Public Policy in June 2010, U.S. Air Force Academy Cadet Chase Lane surveyed the activities of the Naval Postgraduate School's Acquisition Research Program in its first seven years. The sheer volume of research products—almost 600 published papers (e.g., technical reports, journal articles, theses)—indicates the extent to which the depth and breadth of acquisition research has increased during these years. Over 300 authors contributed to these works, which means that the pool of those who have had significant intellectual engagement with acquisition issues has increased substantially. The broad range of research topics includes acquisition reform, defense industry, fielding, contracting, interoperability, organizational behavior, risk management, cost estimating, and many others. Approaches range from conceptual and exploratory studies to develop propositions about various aspects of acquisition, to applied and statistical analyses to test specific hypotheses. Methodologies include case studies, modeling, surveys, and experiments. On the whole, such findings make us both grateful for the ARP's progress to date, and hopeful that this progress in research will lead to substantive improvements in the DoD's acquisition outcomes.

As pragmatists, we of course recognize that such change can only occur to the extent that the potential knowledge wrapped up in these products is put to use and tested to determine its value. We take seriously the pernicious effects of the so-called "theory–practice" gap, which would separate the acquisition scholar from the acquisition practitioner, and relegate the scholar's work to mere academic "shelfware." Some design features of our program that we believe help avoid these effects include the following: connecting researchers with practitioners on specific projects; requiring researchers to brief sponsors on project findings as a condition of funding award; "pushing" potentially high-impact research reports (e.g., via overnight shipping) to selected practitioners and policy-makers; and most notably, sponsoring this symposium, which we craft intentionally as an opportunity for fruitful, lasting connections between scholars and practitioners.

A former Defense Acquisition Executive, responding to a comment that academic research was not generally useful in acquisition practice, opined, "That's not their [the academics'] problem—it's ours [the practitioners']. They can only perform research; it's up to us to use it." While we certainly agree with this sentiment, we also recognize that any research, however theoretical, must point to some termination in action; academics have a responsibility to make their work intelligible to practitioners. Thus we continue to seek projects that both comport with solid standards of scholarship, and address relevant acquisition issues. These years of experience have shown us the difficulty in attempting to balance these two objectives, but we are convinced that the attempt is absolutely essential if any real improvement is to be realized.

We gratefully acknowledge the ongoing support and leadership of our sponsors, whose foresight and vision have assured the continuing success of the Acquisition Research Program:

- Office of the Under Secretary of Defense (Acquisition, Technology & Logistics)
- Program Executive Officer SHIPS
- Commander, Naval Sea Systems Command
- Army Contracting Command, U.S. Army Materiel Command
- Program Manager, Airborne, Maritime and Fixed Station Joint Tactical Radio System

- Program Executive Officer Integrated Warfare Systems
- Office of the Assistant Secretary of the Air Force (Acquisition)
- Office of the Assistant Secretary of the Army (Acquisition, Logistics, & Technology)
- Deputy Assistant Secretary of the Navy (Acquisition & Logistics Management)
- Director, Strategic Systems Programs Office
- Deputy Director, Acquisition Career Management, US Army
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- Office of Procurement and Assistance Management Headquarters, Department of Energy

We also thank the Naval Postgraduate School Foundation and acknowledge its generous contributions in support of this Symposium.

James B. Greene, Jr.
Rear Admiral, U.S. Navy (Ret.)

Keith F. Snider, PhD
Associate Professor

Panel 12 – DoD Field Activities as Enablers of the Defense Industrial Base: A Navy Example

Wednesday, May 11, 2011	
3:30 p.m. – 5:00 p.m.	**Chair: Dohn Burnett,** Head, Warfare Systems Department, Naval Surface Warfare Center Dahlgren Division ***Department of Defense Field Activities as Enablers of the Defense Industrial Base for the Acquisition of Surface Navy Combat Systems*** H. Glenn Woodard, Warren Lewis, Gilbert Goddin, and Wendy Schaeffer, Naval Surface Warfare Center Dahlgren Division ***Department of Defense Field Activity Roles as Enablers for the Industrial Base: Naval Laboratory Analysis that Supports Key Acquisition Decisions*** Steve Sovine, Lorilee Geisweidt, Nathan Miller, and Dave Clawson, Naval Surface Warfare Center Dahlgren Division ***In-Service Support of Surface Navy Combat Systems: Safety, Effectiveness, and Affordability Reviews: The Systems Engineering Process at NSWC PHD*** CDR Stephen Meade, Kris Hatakeyama, Juan Camacho, Karen Brower, and Dave Scheid, USN, Naval Surface Warfare Center Port Hueneme Division

Department of Defense Field Activity Roles as Enablers for the Industrial Base: Naval Laboratory Analysis that Supports Key Acquisition Decisions

Steve Sovine—Senior Force Analyst at the NSWCDD. Since 2001, Sovine has supported programs including LCS Functional Analysis, the Future Force Formulation Study, the Naval Sea Systems Command Alternative Future Fleet Study, and the Long-Range Shipbuilding Strategy. He has over 25 years experience conducting analysis of combat systems, warfare analysis, modeling and simulation, test and evaluation, project management, and force structure. Mr. Sovine served as an Air Force officer from 1984 through 1992 and holds an MS degree in Systems Management and a BS degree in Electrical Engineering.

Lorilee Geisweidt—Ms. Geisweidt has 25 years experience performing systems engineering analysis over all aspects of air and missile defense, both Joint and naval, including ship self defense, antiair warfare, ballistic missile defense, overland cruise missile defense, Marine Corps air defense, combat identification, and distributed weapons coordination. She currently supervises approximately 40 Naval Surface Warfare Center, Dahlgren Division (NSWCDD), analysts. Ms. Geisweidt has a BS in Civil Engineering Technology and an MBA with a concentration in Operations Research. She has also completed the Women Executive Leadership Program and the Naval War College 3-year course.

Dave Clawson—Senior Antiair Warfare Analyst. Clawson has over 30 years experience at NSWCDD. He has been a member of the multi-laboratory Requirements and Analysis Working Group since its inception over 15 years ago. Mr. Clawson has supported a number of major programs over the years, including the Surface Ship Theater Air and Missile Defense Assessment and the USS *Arleigh Burke* (DDG 51) Flight III Upgrade Study. He has also established a tutorial program for analysts at NSWCDD, is a member of the Warfare Systems Department New Employee Orientation and Training working group, and the NSWCDD Analysis Enduring Capability Working Group. Mr. Clawson holds an MS degree in Mathematics.

Nathan A. Miller—Operations Analyst and Systems Engineer, NSWCDD. Miller has held this position since 2003, supporting such programs as Navy Non-Lethal Effects, the Littoral Combat Ship Surface Warfare Mission Package, various other antisurface warfare programs, and the Tomahawk Weapons Control System. Mr. Miller served as a nuclear trained Navy officer from 1998 through 2003. He holds an MS degree in Electrical Engineering and an MA in National Security and Strategic Studies.

Abstract

Department of Defense (DoD) Field Activities scientists and engineers support the Joint Capabilities Integration and Development System and Defense Acquisition Management System processes, providing study leadership and technical analysis as part of the Pre-Milestone B activities. These technical analyses have direct bearing on formal documents and decision milestones, enabling senior leadership to effectively focus the efforts of the industrial base. Many technical analyses are required in this phase of the acquisition cycle. Each year, DoD Field Activities personnel are involved in a number of successful technical analysis efforts that directly support requirements and acquisition plans. Through analysis, scientists and engineers work to understand the capability needed to fill operational gaps and express that need in the form of requirements. They also have a direct link and responsibility to the operational community, routinely working alongside their military counterparts, which allows them insight into operational needs. Data and other information developed by the DoD Field Activities can be shared with all industry partners since it is government owned. Illustrated in this paper is the manner in

which the Naval Surface Warfare Center, Dahlgren Division, uses technical analysis to support acquisition decisions that focus the industrial base.

Introduction

As a smart buyer for its systems, the Department of Defense (DoD) relies heavily on its Field Activities to help manage that responsibility. Field Activities scientists and engineers have the technical expertise and knowledge to determine the capability needed to fill operational gaps and to express that need in the form of requirements. Because they routinely work alongside their military counterparts, these personnel have a direct link (and a responsibility) to the operational community. Analysis data and other information developed by the DoD Field Activities can be shared with all industry partners since it is government owned. For all these reasons, the DoD Field Activities organizations serve as enablers for the industrial base.

DoD Field Activities scientists and engineers currently support the Joint Capabilities Integration and Development System (JCIDS; CJCS, 2009) and Defense Acquisition Management System (USD[AT&L], 2008) processes, providing study leadership and technical analysis as part of the Pre-Milestone B activities. These technical analyses directly affect formal documents and decision milestones, enabling senior leadership to effectively focus the efforts of the industrial base. DoD Field Activities personnel also provide analysis to the Planning, Programming, Budgeting, and Execution (PPBE) process and the yearly Program Objective Memorandum (POM) submissions. Budget decisions affected include the number and type of ships to buy, as well as the systems to install. The objective of this paper is to examine the types of analyses DoD Field Activities perform and to explain how these analyses serve as enablers of the defense industrial base for the acquisition of surface Navy combat systems.

Analysis for Acquisition Decisions

Pre-Milestone B technical analysis by DoD Field Activities is critical since the concept and requirements for military systems are defined in this phase. Figure 1 depicts the main components of the JCIDS and Defense Acquisition Management process through Milestone B derived from CJCSI 3170.01G and DoDI 5000.2. There are many types of technical analyses that need to be conducted in this phase of the acquisition cycle, including Capabilities-Based Assessment (CBA) or other gap analysis, Analysis of Alternatives (AoA) or other trade studies, mission effectiveness, technology readiness, risk assessment, and cost analysis. Capability gaps identified by the operational and/or analysis community start the requirements development process. CBAs validate the gap and look at ways to close it, including Doctrine, Organization, Training, Material, Leadership and education, Personnel, and Facilities solutions. If a material solution is needed, an Initial Capabilities Document (ICD) is produced that reflects CBA results. After the Material Development Decision, an AoA or trade study is conducted in the Material Solution Analysis phase. The AoA focuses on identification and analysis of alternatives, measures of effectiveness, cost, schedule, concepts of operations, and overall risk as well as assessing the critical technology elements (USD[AT&L], 2008, Enclosure 2, p. 15). After Milestone A, the analysis focuses on life cycle cost estimates and risk assessment of technology solutions as well as on operational technical performance attributes of the system that will deliver the capability that fills the ICD-identified gaps. These performance attributes are specified in the Capability Development Document (CDD), one of the documents that supports the Milestone B decision. DoD Field Activities are involved in the CBA, AoA, and technology development

analysis and provide inputs to the ICDs and CDDs. These technical analyses and requirements documents enable senior leadership to effectively focus the efforts of the industrial base.

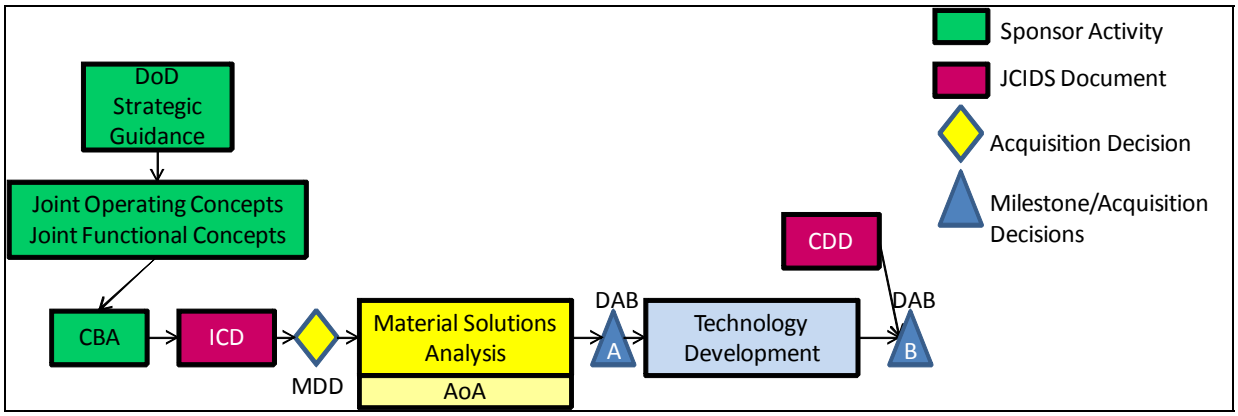

Figure 1. Acquisition Process Through Milestone B

In addition to the system development process, DoD Field Activities play a critical role in providing technical analysis to support budget decisions through acquisition trade-off studies. Combat system studies are used to point a way forward for the composition of the suite of combat systems to employ on a given platform type. These studies are typically carried out for each mission area and focus on the combination of the sensors, command and control system, and weapons on a particular ship to estimate value added, identify problem areas, and provide the insight needed to make an informed acquisition decision. Force structure studies also play an important role by examining numbers and types of ships coming in or going out of the fleet over time and by considering both peacetime and wartime Joint requirements as limited by budget realities. Naval Field Activities, by performing analyses to determine combat system composition on ships as well as the number and types of ships, directly influence what is needed in the industrial base.

The following five sections define in greater detail select analyses from the acquisition and budget process that the Naval Surface Warfare Center, Dahlgren Division (NSWCDD), is heavily involved in and identify linkages to the industrial base.

CBAs

NSWCDD has participated in CBAs that have provided input to ICDs. NSWCDD provided naval air defense mission effectiveness analysis for the Office of the Secretary of Defense (OSD)-sponsored Joint Integrated Air and Missile Defense (JIAMD) CBA. The analysis produced in this CBA by Navy, Army, and Air Force analysts formed the basis of the JIAMD ICD.

For the Office of the Chief of Naval Operations (OPNAV) N85-sponsored Amphibious Ship Recapitalization CBA, NSWCDD provided operational and force-level capacity analysis examining alternative amphibious ship concepts for recapitalizing the amphibious fleet. The analysis and decision alternatives produced had bearing on Resource, Requirements Review Board review, and POM 12 options.

ICDs, based on CBAs, provide the industrial base insight into capabilities needed by the DoD. Sharing of this information helps the industrial base shape its own technology investments to better prepare for emerging needs.

AoAs and Trade Studies

The AoAs and trade studies support both surface ship platform decisions as well as combat system decisions. These analyses combine mission effectiveness, cost, integration and technology risk, and schedule analysis for a variety of alternatives. All programs going through the JCIDS and acquisition management process are required to have an AoA, the scope of which is determined by the Milestone Decision Authority. For Major Defense Acquisition Programs Acquisition Category One (ACAT I), the AoA will most likely be extensive.

NSWCDD has been involved in many AoAs over the years. Currently, NSWCDD is leading the Navy Non Lethal Effects (NNLE) Family of Systems (FoS) AoA and participating in the Offensive Antisurface Warfare AoA. Examples of past AoAs include the following:

- Maritime Air and Missile Defense of Joint Forces AoA
- USS *San Antonio* (LPD 17) Cost and Operational Effectiveness Analysis (COEA)
- Ship Self-Defense System COEA
- Theater Ballistic Missile Defense (BMD) COEA

AoAs of smaller scope are usually thought of in terms of trade studies. These studies can be for smaller programs or for established programs looking to evolve to future capability. Examples of trade studies are the following:

- Littoral Combat Ship (LCS) Surface Warfare Module Trade Study for missile replacement
- DDG Future Upgrade Study
- CVN 79 Electronic Warfare Trade Study
- Precision Urban Mortar Attack Trade Study

The industry base provides input using a Request for Information (RFI) for the system alternatives being assessed. Normally, an RFI is published by the AoA Lead to ensure all alternative systems are considered. AoA and trade study analysts work closely with all industrial base partners to make sure the analysis uses the most accurate and up-to-date systems data available.

The AoA normally narrows options to one or a few promising alternatives. Between Milestone A and B, the industrial base is called upon to further develop the technology for promising solutions that are not at the required technology readiness level.

Combat System Mission Effectiveness Analysis

Combat system mission effectiveness efforts examine the detailed performance parameters of systems in multiple threat scenarios for different mission areas. Models used for these analyses have the ability to analyze the platform systems (e.g., sensors, command, weapons) as a whole operating singly or as part of a larger force. The system program offices use their own high-fidelity contractor-developed models to generate the element performance data that is provided to and used in the mission models. This analytical work provides the technical rigor required to determine the projected operational effectiveness of systems or platforms. This analysis is used to support CBAs, AoAs, and trade studies; for long- and short-range budget strategy decisions; and to answer operational performance questions. NSWCDD has expertise in the following mission areas: Antiair Warfare (AAW), BMD, Electronic Warfare (EW), Hard Kill (HK)/Soft Kill (SK)

integration, and Surface Warfare (SUW). Examples of combat system mission effectiveness analyses include the following:

- Naval Air and Missile Defense Command analysis to respond to quick turnaround operational questions
- Advanced Capability Build (ACB) 14 AAW and SUW analysis
- AAW/BMD/EW (HK/SK integration) analysis
- Naval Integrated Fire Control-Counter Air (NIFC-CA) federation development and analysis to support development and operational testing
- Surface Ship Theater Air Missile Defense Assessment (SSTAMDA)
- Air Warfare Destroyer (AWD) performance analysis
- Carrier Antiterrorism (AT)/force protection
- Amphibious Improvement Program
- AAW, SUW, and EW analysis for all ship classes
- Investment strategy: POMs and program reviews
- Missile load-out studies
- Cruiser conversion
- Bottom-up review

For these analyses, NSWCDD primarily works through the program offices and their technical leads to obtain the best available information on immature and "paper" systems. For more mature systems such as NIFC-CA and ACB, NSWCDD works closely with industry to ensure their systems are characterized correctly.

System and/or platform mission requirements are also developed in some of these analyses. For example, the SSTAMDA updated the Capstone AAW requirements set in the 1990s. These self-defense requirements are levied on the platform as a whole, and each system on the platform contributes to achieving that requirement. An understanding of these requirements by industrial base partners helps to ensure all are working to make their system support the whole. Requirements from these analyses are incorporated into DoD requirements documents the industrial base uses to design and build systems.

Cost Analysis

Cost estimating and analysis encompasses the entire programmatic life cycle cost of the system being studied. Cost analysis is leveraged for affordability comparisons, performance-based trade studies, and the development of program budgets. Historically, the focus for NSWCDD has been naval combat and mission systems. Cost analysts collect, normalize, and analyze data, ascertaining cost-estimating relationships, and conducting risk and sensitivity analyses. Cost estimating sometimes requires innovative and unique approaches and always entails collaboration with the engineering community as well as cost experts from Naval Sea Systems Command (NAVSEA), Naval Air Systems Command, the Missile Defense Agency, the Marine Corps, the Naval Center for Cost Analysis, and the OSD-level office of Cost Assessment and Program Evaluation. Cost analysis products and activities include the following:

- Program life cycle cost estimates
- Total ownership cost comparisons
- Analysis supporting the PPBE process
- Cost, schedule, and performance risk analysis
- Integrated baseline reviews
- Proposal evaluation and source selection

NSWCDD provides independent cost assessments for ship and submarine-based systems to ensure that adequate resources are budgeted. Cost analysts interface with government and industry partners as appropriate to understand both technical and programmatic attributes and to independently develop and validate cost estimates. These cost estimates determine the budget allocated for industrial base-built systems.

Force Structure Analysis

Force structure analysis continues to be important as the Navy determines long-range platform requirements and develops strategic shipbuilding plans. Navy's strategic shipbuilding plan not only sets near-term Future Year Defense Plan (FYDP) ship acquisitions but also sets long-range force structure levels and mix designed to implement the Navy vision and meet the strategic threat. Naval Warfare centers can better utilize their capabilities to continue to support all aspects of naval shipbuilding including analysis, methods, and tools that sustain the assessment of force structures. Naval scientists, engineers, and analysts are uniquely situated to reach across all the Field Activities to harness expertise in a wide range of disciplines to support Pre-Milestone B analysis efforts and Quadrennial Defense reviews. The Warfare Centers currently provide direct support to NAVSEA and OPNAV with force-level analysis and technical expertise. The NSWCDD commitment to continuous improvement of its analysis processes, models, and data management techniques also serves to provide a more consistent, repeatable analysis process and the tools needed to support force-level studies and capability analysis. Examples of these analyses include the following:

- OPNAV long-range shipbuilding strategy
- Force Acquisition and Inventory Model (FAIM) support
- Quadrennial Defense Review 10 fleet architecture assessments
- NAVSEA alternative future fleet study

Force-structure analysis provides the foundation for the shipbuilding strategy and prepares industry partners to respond to the Navy's vision of the future fleet.

NSWCDD Real-World Success Examples

Each year, NSWCDD is involved in technical analysis efforts that directly support requirements development and acquisition plans. In this section, we will take a deeper look at specific examples of AoAs and trade studies, combat system mission, and force structure analysis, and will highlight the industrial base interactions and/or influences.

AoAs and Trade Studies

LCS SUW Mission Package Trade Study

One of the most recent trade studies was led out of the Warfare Systems Department at NSWCDD. The study examined candidate replacements for the Precision Attack Missile (PAM) in the LCS SUW Mission Package. PAM was part of the Non-Line-Of-Sight Launch System (NLOS-LS), an Army-developed missile system the Navy was going to use for the surface mission module of LCS-class ships. In April 2010, the Army decided to cancel the NLOS program, causing the Navy to decide whether to take over NLOS development (and bear all the cost) or select another missile system. The Surface Warfare Directorate of OPNAV (N86), through the LCS Mission Modules Program Office (PMS 420) of Program Executive Office (PEO) Littoral and Mine Warfare (LMW), initiated this study.

The analysis process used was typical of an AoA or trade study. The study director formed a team consisting of system engineers, and mission and cost analysts. The study looked at alternative system concepts that included keeping PAM/NLOS-LS. Each candidate system was analyzed with respect to cost, schedule, performance, integration, and risk. The cost analysis was life cycle cost and the schedule analysis was based on the technology and program maturity. The performance was based on SUW combat system analysis of the LCS weapons systems with and without SUW mission module missiles in a variety of threat conditions. The integration analysis was based on the method in which the candidate systems could be integrated (also a cost factor) on the ship. The risk analysis considered technical maturity and risk along with cost, schedule, integration, and performance risk.

An industrial base RFI was published early in the process to ensure viable candidates were considered and to obtain manufacturer information for the analyses. Where information was unavailable, subject-matter experts provided estimates for system parameters.

The study was completed in July and the analysis provided to OPNAV N86 for a decision on the NLOS replacement. Since then, there have been follow-up questions and analysis to provide the most up-to-date information on all systems. At the Surface Navy Association Symposium in January 2011, OPNAV N86 announced the Griffin Missile was recommended to immediately replace PAM, with the caveat that the final solution would be competed. A final decision is expected soon.

Navy Non-Lethal Effects (NNLE) Family of Systems (FoS) AoA

The NNLE FoS AoA is sponsored by the OPNAV Naval Expeditionary Combat Command/Non-Lethal Weapons and Crew Directorate (OPNAV N857), and is supported by its designated third-party analysis study team, AVW Technologies, Inc. The NSWCDD Warfare Systems Department provided technical direction and coordination between subject-matter experts from across the center and worked closely with the analysis study team and AoA working groups. The NNLE program has been designated as an ACAT III program by Assistant Secretary of the Navy for Research, Development, and Acquisition (ASN[RDA]) with PEO LMW assigned as the Milestone Decision Authority.

The AoA pursues an FoS for NNLE materiel solutions. The primary customers are Navy surface forces (blue water) and include all Navy vessels and surfaced submarines. Secondary customers include Navy expeditionary forces (green and brown water and ashore) using the Joint Non-Lethal Effects CBA as the sole starting point. The AoA addresses naval expeditionary and surface force ability to immediately neutralize or incapacitate Level I and II asymmetric threat contacts of interest without causing personnel injury, death, or gross physical destruction. The scope includes pier-side AT, entry control point AT, anchored AT, maritime interdiction operations, restricted waters and harbor transit AT, high-value unit escort, maritime infrastructure protection, and counter-piracy missions.

This AoA is included because it is not typical in that the breadth of systems in this category is very large. The AoA is challenging because of the variety of Navy end users of non-lethal weapons and systems and the potential array of candidate alternatives that may achieve desired effects. Many scenarios have been developed to capture Navy end users, threat domain, unit and target types, and required non-lethal effects evaluated in the AoA. Non-lethal systems with a Technology Readiness Level of 4 or greater will be assessed against this case matrix to identify the most cost-effective means to cover NNLE capability requirements. Because of the very broad scope of the analysis, the AoA is not assessing

specific vendor systems but considering general types of non-lethal systems. Existing, in-progress, Joint- or service-specific acquisition efforts are represented in the AoA based on their requirements documents.

In February 2011, the Federal Business Opportunities published a "sources sought" to identify and collect data on potential NNLE systems for use in the analysis.

The war on terrorism is making non-lethal systems more desirable by the DoD. Although this AoA is not assessing specific vendor systems because of the broad scope of system types, follow-on system type trade studies will likely be conducted. Those systems that are rated high in all aspects (performance, technology, cost, schedule, and risk) have a strong likelihood of being procured by the DoD.

Combat System Mission Analysis

SSTAMDA

In 1996, the Chief of Naval Operations signed off on the Capstone Requirements Document. This document set forth self-defense requirements for the AAW capability of U.S. Navy ships then in service. Each ship class was assigned a threshold Probability of Raid Annihilation (PRA) requirement that had to be achieved against a specified raid density (expressed as "N threats arriving within T seconds"). As time went on, it became clear that these requirements needed to be revisited. The evolution of the threat might demand tougher self-defense requirements, but improvements in area-defense capability might call for relaxing the requirements. In addition, tools had improved significantly, affording the opportunity to perform a more comprehensive analysis of mission performance. Consequently, in 2006, OPNAV N86 directed that a new effort begin for the purpose of developing "21st century performance-based, ship self-defense requirements." This effort became known as SSTAMDA.

OPNAV appointed Systems Planning and Analysis as study lead. They in turn asked the Requirements and Analysis Working Group (RAWG) to conduct all ship-level and group-level analysis. The RAWG is a collection of government and quasi-government analysts under the direction of PEO IWS-7. The Naval Surface Warfare Center serves as the RAWG's technical lead. Other members include the Naval Research Lab, the Naval Air Warfare Center at China Lake, and The Johns Hopkins University Applied Physics Laboratory. The RAWG was established over 15 years ago for the purpose of providing assessments of surface ship AAW and SUW capabilities in support of the Navy's investment strategy.

Figure 2 is a simplified representation of the analysis process used for SSTAMDA. The process focused on examining mission-level performance in 17 different Tactical Situations (TACSITs). The TACSITs covered a wide range of operating areas, threat types, environmental conditions, force structures and timeframes. Of these 17, the RAWG was assigned eight high priority TACSITs to examine in detail. For each of these, the RAWG assessed weapon and sensor effectiveness, generated netted tracks, and input these data into mission-level models.

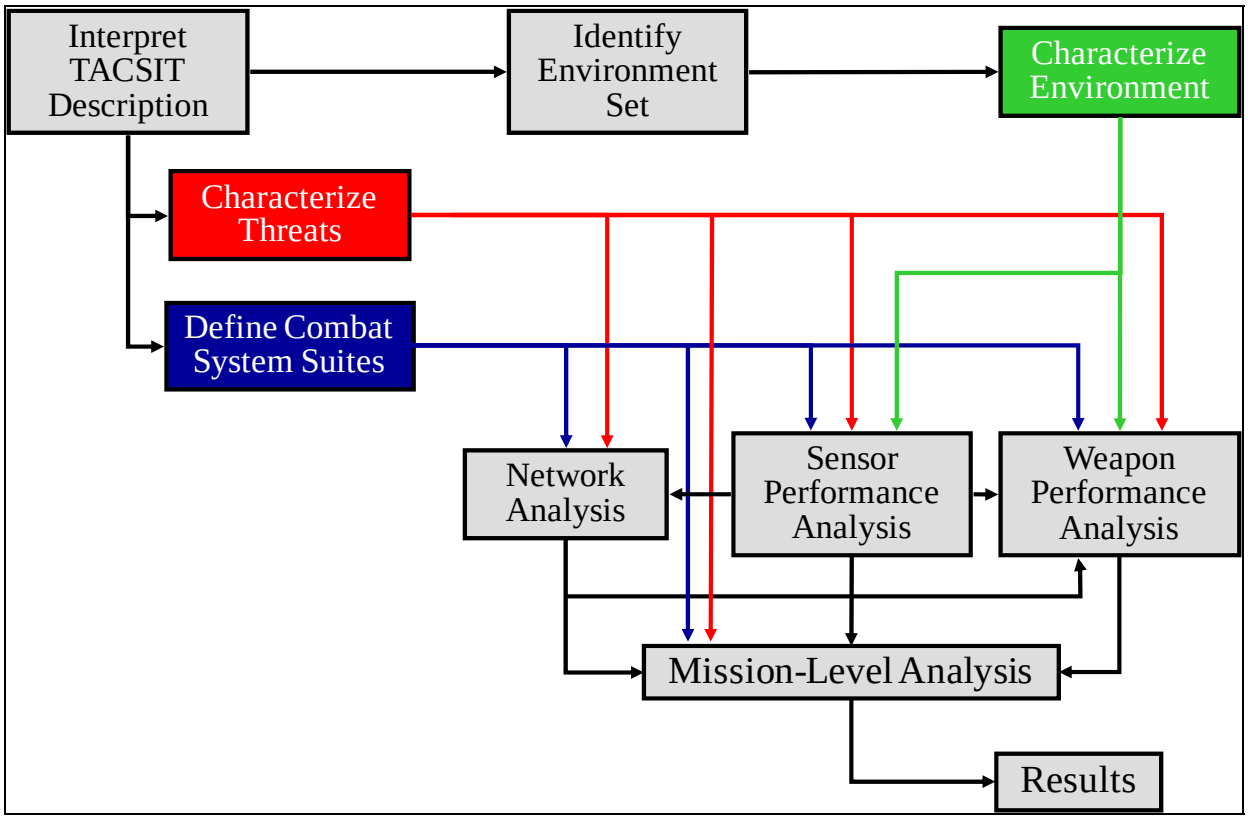

Figure 2. SSTAMDA Analysis Process

The mission-level models provide estimates of many single-ship and battle group-level metrics, such as weapon expenditure, probability of raid annihilation, and the number of threats killed as a function of ship, weapon system, and threat type. For this study, however, the results were used to determine the frequency with which a given ship (or ship class) in the force had to face a particular self-defense raid density.[1]

In 2008, N86 promulgated new requirements based on the SSTAMDA findings to "guide ship system design and resource allocation for designated new ship classes" and for consideration in major upgrades. These requirements will be incorporated in platform CDDs. Industrial base partners developing the platforms will need to ensure they can meet these requirements with the platform's combat system suite they are designing.

Force Structure Analysis

Long-Range Shipbuilding Plan and Force Structure Analysis

OPNAV N8FSCN is the program manager for the SCN budget and responsible for procurement of approximately 10 ships and $15 billion annually. NSWCDD provides direct

[1] The RAWG recognized the need to develop a consistent set of guidelines to address this rather simple-sounding task. For example, which threats in a raid are self-defense threats for a given ship? If only threats targeted on the ship are used, we omit threats the ship may engage if they pass nearby. On the other hand, if an area-defense ship kills a threat that is targeted on the other unit, should that threat be considered a self-defense threat even if the targeted ship never engaged it?

support in two principal areas—developing balanced shipbuilding plans and conducting force structure analysis.

Working closely with OPNAV, NSWCDD analysts maintain ship data, in-house force structure models, and conduct analysis to develop shipbuilding plans that balance the force levels and procurements within OPNAV guidance. Three constraints must be managed to achieve a balanced, long-range shipbuilding plan: capability, cost, and industrial base. Capability is met by procuring enough ships to maintain force levels required by the operational fleet. Cost is met by maintaining an affordable, stable annual budget, given the mix of ships to be procured. Industrial base is met by maintaining sufficient levels of workload to sustain the shipyards' ability to efficiently build ships. These constraints, known as the "iron triangle," are difficult to manage, especially in these lean times where ship cost is persistently the driving factor in shipbuilding. The balance is to recapitalize in such a way as to stay in budget, meet force levels, and stabilize the shipyards over time.

The shipbuilding plan analysis process is shown in Figure 3. The process examines the legacy fleet, plans for the retirement of existing ships, constructs an acquisition plan to procure ships by class by year, examines the resulting battle force inventory, and examines the resulting annual SCN budget. This process is iterative, adjusting each factor by ship class and then across the force to balance the force levels and mix along with the SCN budget. The analyst iterates to shape the shipbuilding case under development to the desired overall vision of the force structure.

The FAIM is employed to manage the development of shipbuilding plans and the factors that shape the resulting inventory and SCN cost. For all cases, the legacy fleet is determined from the FAIM database reflecting the current operational fleet and characterized by ship class, hull number, and Expected Service Life (ESL).

The acquisition plan details ship procurements annually by ship class resulting in a future fleet composition. The acquisition plan identifies by ship class the procurement year(s), a delivery shift, and a ship cost profile. The acquisition plan table depicts ship class "B" procurement in FYs 2011 and 2015 with a delivery shift of two years. Ship classes "C" and "D" are similar with procurements in FYs 2013 and 2012, respectively, and delivery shifts of three and five years, respectively. Delivery shift accounts for programmatic variances and construction time. Ship cost, not detailed here, can be expressed very specifically with budget quality (as in the FYDP) or projected as a nominal profile detailing the procurement costs by year including any advanced procurement and multiple year funding. The "projection" method allows the analyst to quickly examine the effects of varied ship procurement strategies. These multiple factors are adjusted consistent with force-level guidance provided to balance capability, cost, and the industrial base. These analyses, detailing multiple and evolving guidance, are nearly continuously conducted to support the Navy long-range shipbuilding plans.

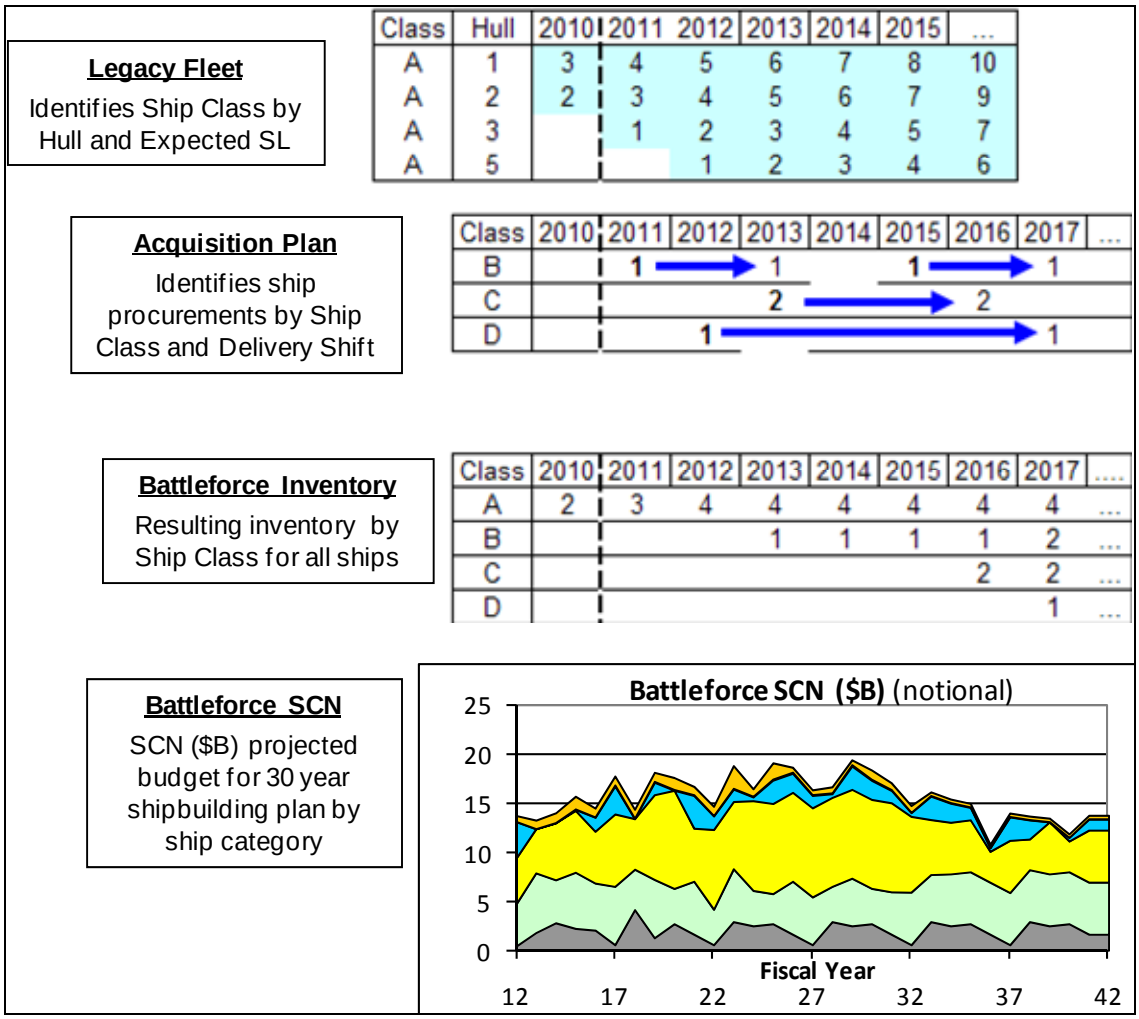

Figure 3. Shipbuilding Plan Analysis Process

The current ship Navy strategy defines an overarching capability and capacity for the 2020 timeframe. An evolving shipbuilding plan must prepare the composition of the fleet architecture beyond 2040. NSWCDD conducts force analysis to examine alternative fleet designs to gain insight into the principle capability drivers and to conduct performance, cost, and technical risk assessments (see Figure 4). The timeframe for examining alternative fleet architectures is the far term, 15-to-30-plus years out. Principle drivers of an evolving architecture are roles and missions in a changing world, cost and affordability assumptions, ship concepts, key technologies, force architectures, retirement profiles, and integrated acquisition strategies. Force structure analysts integrate needs and strategies from the operational community, with realities and insights gained from NAVSEA warfare capability analysis.

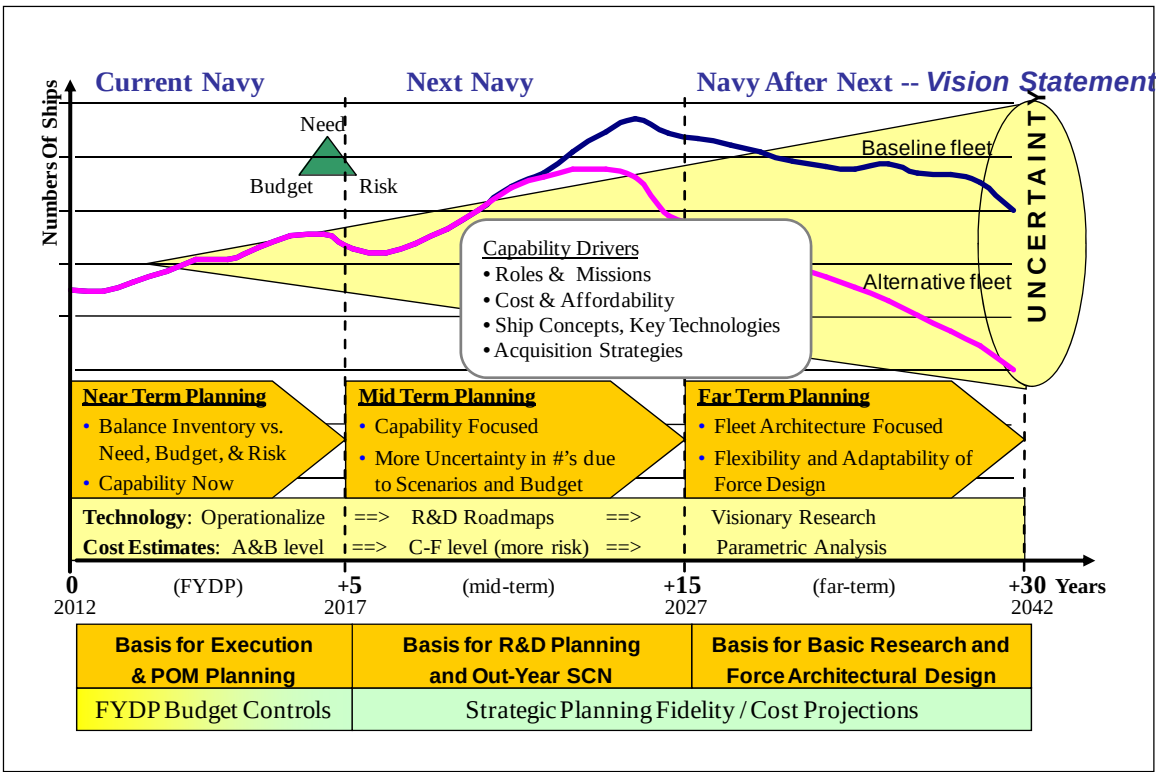

Figure 4. Force Analysis Planning Context

Force structure analyses provide senior leadership insight into decision trade space, provide a foundation for many CBAs and AoAs, and determine near-term (within FYDP) annual ship procurement strategy. Force structure analysts take the industrial base into consideration in the analysis, along with capability needs and cost constraints. Output from the force analyses influence the ship buys in and beyond the FYDP, which provides industrial base insight into the future direction of Navy procurement strategies.

Takeaway

NSWCDD, like other DoD Field Activities, will continue to provide technical analysis to support Pre-Milestone B acquisition and FYDP budget decisions that focus the industrial base. DoD Field Activities are key to the understanding of technical system knowledge for the DoD operational and acquisition communities, and translating that knowledge into achievable capabilities through requirements documents. These documents guide industrial base partners to build the platforms and systems needed by the warfighter. Working together, government, industry, and academia can produce a capable and affordable future for our military.

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