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The Voice of the Industrial Base

September 2, 2009

Office of the Secretary of the Navy
1000 Navy Pentagon
Washington, DC 20350-1000

SUBJECT: Report on the Undersea Warfare Industrial Base

Dear Secretary Mabus:

As prescribed by the bylaws and charter of the National Defense Industrial Association's Undersea Warfare Division (NDIA UWD), enclosed please find a report which summarizes the state of the undersea warfare industrial base, studies and other activities of the NDIA UWD.

Thank you for accepting the invitation to speak at the Undersea Warfare Conference during the week of September 21st. I wanted to provide you the opportunity to review this division's report prior to your address, since we expect nearly a thousand attendees from the Undersea Warfare community. The planning team for this conference is both excited and delighted that you accepted the invitation, which sends a strong message of support for a key mission of our Navy.

Also in context of this being a year of activity on the Quadrennial Defense Review (QDR), we stand ready and welcome the opportunity to provide a face-to-face briefing on this report to you, members of your staff and/or the Navy's QDR team.

Having personally sampled the meetings and conferences of the NDIA UWD, I am confident this organization will continue playing a strong liaison role between government and industry to enhance collaboration as we build and support the capability for our naval forces.

Very respectfully,

Lawrence P. Farrell, Jr.
Lieutenant General, USAF (Ret.)
President and CEO

Enclosure: The State of the Undersea Warfare Industrial Base

"Publishers of National Defense Magazine"



“The State of the Undersea Warfare Industrial Base”

**A Report by the National Defense Industrial Association
Under Sea Warfare Division**

Prepared for the Secretary of the Navy

AUGUST 2009

UNCLASSIFIED

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EXECUTIVE SUMMARY

In 2003 we identified the state of the USW industry as:

- **Fighting for Survival:** Consolidating; migrating to commercial and foreign opportunities; continuing to evolve legacy systems to maintain production; COTS reduces production; trying to survive on R&D, integration and support; depending on Congressional plus-ups.
- **Losing Skill Base and Intellectual Capital:** Designers for non-COTS components (transducers, telemetry, spatial/spectral signal conditioning, etc.) are scarce; USW industry losing the best and brightest to better opportunities.
- **Reacting to a Downsized Market:** Fewer platforms; fewer new systems; less R&D and focused investment.

In 2009 we have realized the effects of these issues and their continuing negative trends are consistent with the findings of the July 2008 Defense Science Board (DSB) Task Force Report on the National Security Industrial Base.

Industry capability in USW has struggled to sustain the necessary resources to support this warfare area; however it has not been investing in breakthrough technology. Instead of a "step-function" increase in capability to open a wide margin against diesel submarines and modern mines, we have utilized spiral/incremental development programs to insert only that technology which will fit the budget constrained programs with the highest demand signal from the immediate threats. Much of the recent capability enhancement of USW systems has been via the technology afforded from the telecommunication and computing industry. By using Open Architecture (OA) and Commercial-Off-The-Shelf (COTS) electronics, significant gains in signal and data processing have been achieved with only incremental investment. Although a major leverage at the national industry level, this business model has shifted the recurring production and sustainment of electronics from the USW industry to a generic industrial base which does not invest in USW domain expertise, sensors, or weapons. This has caused a migration of the industry away from some of the key enablers and into a modernization and sustainment role. Additionally, this trend has enabled the government agencies to encroach upon system engineering and integration work previously performed by industry. Spiral development became the antithesis of significant capability development. This incremental, often marginal improvement to legacy systems, does not address the challenges of the future. Combined with a flat or declining budget scenario, USW capability is asymptotically approaching mediocrity.

USW suffers from the perception that we lack an imminent and credible threat, causing resource sponsors and program managers to focus on sustainment and incremental capability insertion. This atrophy of focus also impacts the intellectual talent pool available to address USW technology and application. Without visible priorities and investments, key talent is drawn to the higher profile, better resourced programs. The concept of "pacing the threat" now has us "chasing the threat" and therefore lagging an acquisition cycle behind fielded and observed adversary capabilities.

Meanwhile the enemy and competitive international industries have been focused on developing submarine and mine technology at a pace ahead of our counter abilities.

This has been exacerbated by the consolidation of the industrial base and reduction in basic force structure, each dependent upon the other. Without significant government investment, industry's R&D follows the profile of sales and profit which decline with platform volume. In parallel, the government has organizationally shifted to "capabilities based resourcing" making it more difficult for industry to find decision makers or stakeholders able to commit to the future. As a result of the business environment, industry is losing the capability to provide significant improvements, or in some cases, even to maintain competency on existing programs.

In order to meet its requirements for leading-edge USW capabilities, the Navy must provide industry better access to requirements and also develop programs which include an adequate mix of work and funding to sustain a capable workforce and physical infrastructure. Industry has the capability to provide leading-edge technologies, system design and integration, and long-term support for USW systems. Available funding needs to be applied to maximize the delivery of products in a restricted budget environment through cost reductions including increasing the efficiency of the business process. Achieving this change will require a revitalized effort by government and industry. Achieving a balance between the levels of industry, academia and government involvement in the development, production and support of military systems is the key to sustaining USW superiority. Our recommendations focus on the following objectives:

- Align and Prioritize Requirements with Projected Future Threats
- Integrate and Leverage Investment across Industry and Government
- Balance R&D Expenditures across New Development and Modernization
- Address the Critical Industrial and Human Capital Trends and Shortfalls

To survive and succeed as a Team Sport, USW needs a partnering approach to focus requirements, budgeting, research, development, and acquisition. The UWD could play a wider role to facilitate and coordinate industry input to form an enhanced, broadened Government/Industry collaboration toward a common goal. The conclusions and recommendations in this report have been reviewed and agreed by our Executive and Advisory Board who stand ready to engage in a forward-leaning partnership.

INTRODUCTION

From a 1954 Proceedings article by Samuel P. Huntington: “But A.S.W., although vitally important, can never become the primary mission of the Navy. For it is a defensive operation designed to protect the Navy’s base, i.e., its control and utilization of the sea, and this base is maintained so that the Navy can perform its important offensive operations against shore targets. Antisubmarine warfare has the same relation to the Navy as guarding of depots has for the Army or the protection of its airfields and plane factories has for the Air Force. It is a secondary mission, the effective performance of which, however, is essential to the performance of its primary mission. And, indeed, the successful accomplishment of the primary mission of the Navy – the maintenance of American power along the littoral – will in itself be the most important factor in protecting the Navy’s base.”

Although the business of USW has changed dramatically, the basic precepts make it a timeless priority. There are many drivers of this change: the threat, new and expanding traditional USW missions, the budget focus, the change in the business environment, reduced numbers of experienced professionals in the government and industry workforce, and rapid advances in technology. We address these areas and others in our State of the USW Industry assessment. The table below presents the trends which have impacted the industrial base over the past few decades:

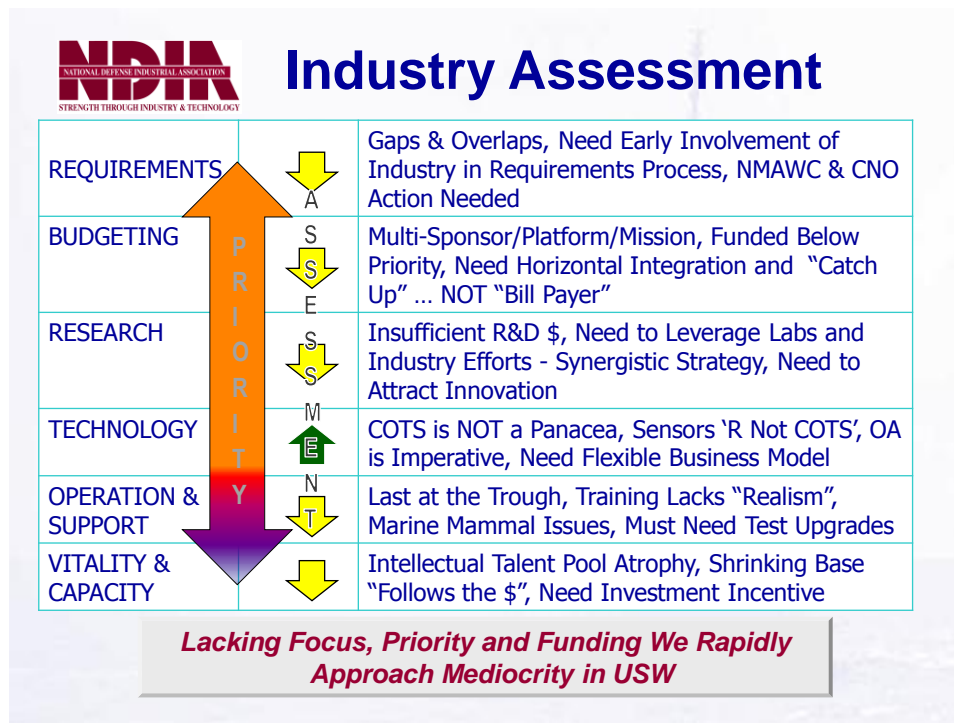
Past Focus on System Development & Acquisition	Present Focus on Modernization & Sustainment
<ul style="list-style-type: none"> • Develop to customer specified, threat-driven requirements • Customer funded research & development • Frequent sole source contracts to leverage continuity, mitigate risk, balance industrial base 	<ul style="list-style-type: none"> • Anticipate customer needs; adapt products, systems and services • Business invests strategically to intersect capability needs • Competitive bidding, varied selection criteria, follow-on competed
<ul style="list-style-type: none"> • Growth through DOD acquisition programs • Driven and dominated by specific USW system procurements • Business comprised of large programs with “tiered” participation • OEM contractors invested and sustained industrial base using production and O&S in a Homogeneous business model • Multiple large corporations with major development and integration facilities 	<ul style="list-style-type: none"> • Survival through FMS, Foreign direct and commercial sales • Vertically integrated platform procurements; system of system developments • Separate competitions for each program phase • Multiple business models – COTS, rapid tech insertion, continuous upgrades • Platform-centric large business developers; some facilities migrated to government labs

INDUSTRIAL BASE ASSESSMENT

As depicted in the table below, we organized the assessment around six pillars:

- Requirements
- Budgeting
- Research & Development
- Technology
- Operations & Support
- Vitality & Capacity

For each of these topics we solicited feedback from the UWD leadership, and then we articulated a consensus listing of the current situation, issues, and recommendations for each. Once we compiled this information, we assembled a team from within the UWD leadership to prepare the report. The team also made an assessment of the PRIORITY and TREND for each of the six pillars which are depicted by the order, color, orientation, and direction of the arrows in the table below. Each of these pillars is discussed in a subsequent paragraph.



Requirements: There exists a plethora of requirements from various stakeholders, sometimes more than can be addressed within a single organization. The issues arise with the priority and translation of requirements to R&D and acquisition programs. The fleet has made great advancements in driving their requirements into the R&D and acquisition communities. There is still a gap between conducting R&D and transitioning that work to acquisition programs. Early Industry collaboration in this area can assist in determining which requirements can be realistically and affordably transitioned to deployable systems and how long it will take to do this. Cost and schedule considerations should be included in all requirements setting efforts. The “detect to kill” chain in USW varies significantly across scenarios and often the sensors and weapons were derived from disparate resource sponsors in a platform constrained acquisition system. Even though USW is a “team sport” played by surface warriors, submariners, and aviators, there is not a systematic process to balance or leverage capability, particularly sensors and weapons, across the playing field. Several Navy leaders have characterized USW in terms and focus similar to those used in “strike or AAW or Missile defense” however there are not corresponding similarities in the organization which can pool and decide resources on USW as in these other key national security capabilities. Over the past few decades the coordination of USW resources has transitioned from a well resourced 3-star admiral to an O-6 whose only budget is that which can be influenced by a cross functional team or board. A strategy that enables the necessary government/industry partnerships needs to be developed, articulated and implemented across and within multiple organizations, since USW has multiple stakeholders with shared responsibility:

- OPNAV: Integrated Planning & Requirements
- ASN/RDA: Acquisition & Oversight
- NMAWC: Operations & Training
- Industry: Provide the Capability

We are allowing our enemies and competitors to close the gap on an advantage where we've held a significant margin because we have elected a policy to “pace the threat” instead of to continue along a superiority track. Today's threat is multiplex, diverse, asymmetric, agile, and extremely elusive. Clear requirements are harder to identify over such a broad threat spectrum, but there are some common and dominant components. For example, against an asymmetric threat traditional force-on-force approaches to capacity do not apply to the littoral battle space. Evolving diesel-electric, air independent and sixth-generation SSNs and asymmetric weapons are formidable and we could never produce the number of platforms necessary to match them force-on-force. We have special resources and technologies which could help us deny the threat space and time but these distributed, force-multiplying and asymmetric capabilities are not being vigorously pursued for USW. There appear to be many other risks which are neither understood nor acknowledged and cumulative potential losses could be cataclysmic. We need the capability and capacity to hold any player at risk. Although minimal analytic effort is expended to gain clarity on requirements, the evidence available indicates that multiple, advanced capabilities will be needed. We currently hold no advantage against threats who rapidly adapt ubiquitous military and commercial technology into ready capability.

Perhaps new, adaptive and autonomous technologies could be exploited to produce automated threat-matching capabilities, an area where industry could be an active partner to develop threat-matched requirements. Industrial resources and technology can enhance the assessment, analysis, simulation and other steps necessary to identify and fully articulate well-founded requirements for complex, threat-matched systems, speeding closure on the capability gap. This would enable incremental development programs driven by comprehensive requirements to achieve a “step function” increase which will be needed to defeat future threats.

To regain a position of dominance, we need force structure and cuing. These forces need improved connectivity and the ability to train in a robust interactive networked environment, since we cannot practice against actual threats on a routine basis. We need technology to help reduce the number of operators, capitalize on distributed sensors and autonomous processing, communications and networking. It is also critical that we utilize robust modeling and simulation tools to better exploit the environment and determine why our weapons do not have a consistent P-kill. This would improve the ability to match requirements to the threat and environment, which would then enable industry expertise to focus on technologies which address specific gaps.

Since the current SECNAVNOTE 5000 requires industry participation in the requirements, there is no need for policy or procedure changes. This approach would enable industry to gain a fuller understanding which would facilitate a more efficient and direct translation of technology and resources into threat-matched war fighting capability and capacity. Timing this activity with a reassessment of the threat to input and impact the next Quadrennial Defense Review (QDR) could have a significantly favorable outcome, with industry having a clear and direct translation of resources to capability and capacity to focus future investment.

Budgeting: The budget is the limiting factor and expected to become more of an issue. The focus on the Defense Department Budgeting has been and will continue to be in support of the war against terrorism and the ground wars in Iraq and Afghanistan. Over the past decade the fleet size was reduced by 60 ships, and the Navy will continue to adjust budgets to funding realities. Industry has already responded to some of these drivers through consolidation and international products diversification. The previously referenced DSB Task Force Report describes the effect of industry mergers and consolidation, and that impact is directly applicable to the USW industrial base.

Industry follows the money and that is likely to continue in future budgets, so programs which have a history of serving as bill payers will not draw consistent investment and commitment of resources. Although many flag officers and senior executive service leaders have made public statements about the priority and need for increased investment in USW, they have not materialized in the budget, where the procurement accounts are projecting further declines. This is not a new phenomenon, since the Navy has a long history of stretching and/or canceling major USW programs before the delivery of the first article.

Some examples include:

- There is not an active torpedo production line, rather we are kitting existing ones.
- Lightweight torpedo war-shot test firings have been deferred due to cost.
- SUBROC and ASROC were terminated because they were to be replaced by SEALANCE, which was subsequently terminated prior to production.
- VLA ASROC (VLA) went out of production in 2008.
- Multiple surveillance systems were terminated prior to deployment (ADS, MSS, RDSS, FDS, ARIADNE) and the DNS program is in a state of flux.
- SURTASS force structure was reduced from over twenty to less than five ships.
- Multiple UUV programs (NMRS, LMRS, MRUUV) were demonstrated using submarines, however the 21" UUV capability has been put on the shelf.
- Production of training targets has been suspended and the inventory does not represent the contemporary threat.
- CAPTOR, MK-56 and Submarine Launched Mobil Mines (SLMM) have or will be retired without replacement.
- All 12 coastal mine hunting ships (MHC) were retired without replacement, and the MCS was canceled with a plan to use "vessels of opportunity."
- The plan to use RMS as an organic mine hunting capability was deleted from the DDG-51 requirements with no alternative capability available.
- LCS mission modules for USW have not matured at a pace needed to meet ship deployment needs.
- SSN force levels may dip below 40, S-3's were retired without replacement, P-3's will be taken out of service faster than P-8 production will deliver their replacements, and not all DDG's have a full USW capability.

With many competing issues, USW has taken a secondary or tertiary position in the priority list, despite frequent public and symposia comments that it is the #1 priority. Changing the perception and trend will require several POM cycles of evidence that the priority requirements also draw the requisite funding.

In FY 09 the 6.1, 6.2, and 6.3 programs received only 9.5% of the total Navy RDT&E budget. The Basic Research (6.1) budget is spent primarily at in-house Navy Laboratories and at Academic Institutions and only a small portion of this can be related to USW development, so private industry receives very little funding in the Basic Research area.

Within Applied Research (6.2), the budget contains a separate Program Element (PE) specifically for USW Applied Research and at least five other Program Elements that support USW, Ocean War fighting Applied Research, Force Protection Applied Research (torpedo defense, signature reduction), Common Picture Applied Research (navigation and underwater communications), War fighter Sustainment Applied Research, and Mine and Expeditionary Warfare Applied Research (Mine Warfare) and others to a smaller extent. If we assume that some portions of the non-USW PE's apply to USW Applied research then approximately 10%-12% of the funding for the 6.2 budget supports USW

Applied Research. Although the budget in this area is predicted to slowly increase over the FYDP, the USW Applied Research PE has experienced reduced funding of over \$33M from 2007 to 2009.

Within Advanced Technology (6.3), four PE's apply to USW: USW Advanced Technology, Force Protection Advanced Technology, (torpedo defense, signature reduction), Common Picture Advanced Technology (navigation, communications), and Mine and Expeditionary Warfare Advanced Technology. If we make the same assumptions as with 6.2 funding, then 15%-17% of the 6.3 budget supports USW development. In the remaining areas of the RDT&E budget, industry does receive a significant amount of funding; however this funding is aimed primarily at development, test and evaluation and not at research and it is difficult to determine how much funding specifically supports USW. Additionally, multiple sponsors can fund development and maintenance of duplicative capabilities across multiple platforms; stovepipes begin with R&D and sustain through SCN and OPN.

The unintended consequence of continuing at low or declining R&D levels is the declining intellectual capital, since there is a "critical mass" necessary to sustain a robust engineering capability and capacity in a company, especially in major system or platform developers. We have already seen the combined effect of the economic recession and forecasted reductions to defense budgets as companies begin taking preemptive measures with their workforces. It is often difficult to map "USW Capabilities" to the PPBS process. So there may be a need to determine those critical and unique USW resources which might be "fenced" (e.g., like nuclear & submarine technology); these must also be traceable to requirements (i.e., S&T through Procurement). There is a similar need for programming and budgeting stability within USW as with shipbuilding, where the current and recent CNOs have placed emphasis (albeit now under debate within the new administration). There are some positive trends, especially from recent CNO Executive Boards (CEB), e.g., the ASW Roadmap will be refreshed, the UUV Plan is being updated, and a MIW Roadmap is in place (however it doesn't address offensive mining). The upcoming QDR and budget cycle should be viewed as an "opportunity" instead of a "challenge."

Research & Development: This is the bridge between requirements setting and acquisition programs and there have been attempts over the past few years to enhance and streamline this process. The focus on R&D should be toward affordable capability which can transition to feasible, producible, operable and deployable systems. Efforts to rapidly demonstrate new capability through fleet experimentation drew attention, priority, focus, and investment from industry but only achieved a few successful rapid transitions. While there is a feeling of need to quickly respond to requirements there is also a need to be realistic about what can be done. Some R&D projects can transition quickly while others, especially those that are based on interdependent technologies can take a long time to transition. There will always be a need to fund disruptive technologies to insure that we are working on responses to unknown future advanced capability threats.

Much of S&T does not have a clear transition path and it either does not transition or stays in the S&T environment longer than it should eating up more precious USW funding. There isn't a clear path to show the linkage in funded programs to take leading edge thinking into investment tied to a program and schedule to deliver capability. The diesel-electric and littoral threats are not drawing top priority, so our allies' R&D efforts follow the US Navy's (lack of) investment strategy.

The concept of embracing the merchant fleets and a wide number of our allies' ships to create a virtual "1000 Ship Navy" is a widely accepted valid concept which has no funding or programming directed to bring the capability to reality; meager R&D demonstrations have relied upon industry investment to build confidence in the approach. Research for foundational or transformational work on ASW, mines, vehicles and weapons is marginal and incremental, and Navy sponsored fundamental research on performance limiting components like sensors, transducers, fuses, etc. is not widely accessible.

Industry can help by providing an early input to R&D program decisions by performing a sanity check on what can transition to production with acceptable risk based on the requirements and the results of the R&D phase. Although the DOD Acquisition Guidance, e.g., 5000 series procedures, has recently been amended, there may be additional demands on R&D for programs which must adapt to extended demonstration phases and parallel path efforts. When these policy revisions are taken as "mandates" across all programs the impact will be a significant demand signal on government and industry funded R&D with no change in the expected business case and therefore a net reduced "return on investment" or a lengthened "negative cash period" which may dissuade rather than stimulate wider competition.

Simultaneously, many R&D programs which have been distributed across Navy laboratories are being further diluted when these agencies further break the funding into small pieces and distribute it over multiple, potentially disconnected or conflicting efforts within industry. These overlaps and conflicts are not discovered until the funds have been committed or spent. The ONR led effort to develop a thread using FNC's has not resulted in a strategy around which industry can rally and focus, although the concept seemed like a valid approach to address the issue.

Collaboration and synergy are operative and imperative measures to help improve in this area, especially within an overly constrained budgeting environment. In addition to the near term industrial base effect, we risk our future intellectual capital through a generational "draw down" as the baby boomers retire. We need exciting programs which will incentivize and excite the GenerationY brainpower to work on USW solutions!

Technology: The wide availability of technology which can be applied to military applications poses an equal threat as do specific countries, e.g., China. We should be leading the threat as defined by technology, not just defending against what an adversary or competitor is building today. The rapid evolution of technology especially in the area of computers and networks has led to a revolution in combat system design and

implementation. The availability of Commercial-Off-The-Shelf hardware and software has changed the way we do business. Tech insertion and modernization programs have made significant performance improvements to legacy systems. The initial cost to provide these performance improvements has resulted in system procurement costs that are significantly lower than the cost of the legacy systems which are being replaced. While we are able to provide this improved performance at lower cost we must not become complacent. These COTS technology advances are available to any country intent on improving their war fighting capability and we must continually improve our own performance in order to stay ahead of any threats. Staying even, “pacing the threat” is no longer acceptable as these threats can quickly catch up and out-pace us if we let them. We cannot proceed with “business as usual” where we are taking advantage of emerging technology in small pieces to lower the budget without applying some of the leverage to future investment.

It is easy to confuse the contribution of COTS to improving capability with the real key to performance which is the processing algorithms and system designs that come from scientists and engineers with experience and knowledge in USW. This latter capability is what allows us to “stay ahead of the threat” rather than pacing it.

Information assurance (IA) has become a more significant technology as systems migrate to open architectures and commercial products. As this requirement becomes a higher priority, there are also cultural issues which will either impede or accelerate the adoption of techniques which protect vital information and information systems:

- IA carries a cost in design, production, operation, and sustainment and therefore competes with the acquisition community goals directed toward more affordable and open systems. Achieving a balance between requirements and implementation is a key area for government and industry collaboration.
- Transparency objectives of government policy makers form a natural tension against those actions which cannot be done in an open environment, yet critical IA capabilities must be as protected as the systems they ensure. Clear and articulate requirements and cultural acceptance of this imperative will be a leadership challenge within government and industry.
- The newest and brightest employees in government and industry have grown and been educated in an environment where unlimited connectivity is a “birthright” and will perceive IA as a limitation if they don’t appreciate the need.

Most significant is that several critical USW technologies do not derive from commercial products; e.g., transducers, telemetry, spatial/spectral signal conditioning, underwater sensors, weapons, and special communications have limited consumer or industrial application. In many of today’s USW systems, contemporary electronics are connected to geriatric sensors and weapons. If the industrial base for these components is not self-sustaining at a critical mass through government funded programs then it will atrophy rapidly and perhaps be unable to reconstitute without years of gapped capability.

Operation & Support: The implementation of COTS based systems is having a major impact on the way we operate and support these systems. The ability to upgrade system capabilities and performance places a greater need on our ability to train our operators to make maximum use of these new system attributes. The training systems and their curricula must be constantly updated and the operators must be allowed time to expand their skills and ability to operate the new system functions. We need to conduct a parallel effort in developing training systems as we upgrade our operational systems.

Maintenance of COTS based systems is also much different than the maintenance approach used on legacy systems. The COTS hardware is not supported by commercial industry for more than a few years as it is constantly being replaced by more powerful and smaller footprint hardware. This requires that we must plan to replace the hardware in our combat systems on a regular basis. Purchasing a large number of spare parts is no longer a valid maintenance approach as many of these parts will not be used before they become obsolete. With regard to non-COTS system elements, support costs are borne by a relatively small industrial base and government infrastructure, perhaps giving the appearance that these systems are costly to support. This is a direct effect of the limited market space accessible to industries providing these critical technologies. In some cases the support infrastructure is a loosely knitted set of organizations which do not implicitly have critical mass, yet rely on each other to sustain the food chain. Instances where the cost of obsolescence exceeds the cost of a new design, or where the diminishing manufacturing source puts a program at schedule and cost risk, may become more prevalent if the current trend continues.

The recent trend and focus of the NMAWC has been helpful in re-aligning, training and certification processes with the requirement for USW dominance, however this command plays only an influence role in the budget for systems which contribute to their mission. Industry can and should play a greater role, especially if the gaps in capability are timely and widely known.

Headline news has been more distracting than supporting of the USW mission, especially in the area of “marine mammals vs. active sonar.” This critical issue played against the Navy’s key training requirements and although recently settled, the lost training needs to be recovered. The same applies to the time and priority lost on active sonar solutions due to a perceived preference for social correctness over USW capability and proficiency.

Industry is capable of helping with the training and support challenges faced by the Navy; however the business models should be reviewed for relevance in order to better focus and align resources and investments. We must implement a balanced model which stimulates collaboration while sustaining a vital and competitive field.

Vitality & Capacity: As a result of the force structure reductions, fewer platforms mean fewer systems, and reduced R&D drives modernization over acquisition of newer systems. With less acquisition investment comes less money invested in industry funded R&D, industrial infrastructure and personnel. In addition the personnel who are retained are less experienced than those retiring or leaving for more lucrative jobs.

With the decrease in funding for USW, companies merged and reduced infrastructure, and others exited the defense industry. From the DSB Task Force Report we find that almost sixty defense sector companies have been consolidated under five large prime contractors; only a handful of the original sixty were not directly involved in USW!

The primary new business roles for companies (not building platforms) relying on U.S. defense revenues are Research & Development (R&D), System Integration and System Life Cycle Support. The nature of the R&D work (small sized jobs spread over broad-based technology areas) is short cycle projects which do not enable sufficient long term revenue to sustain significant up-front investment. Instead of a business model where companies can stimulate products through strategic investment, government R&D is distributed over a large number of programs which are focused on incremental or near-term improvement. In addition, a shift in electronics production has significantly reduced the USW industry revenue which would have absorbed the R&D and capital depreciation. Although the system integrator role preserves a robust prime contractor industrial base, this model does not produce recurring income unless there is continual funding for new capability insertion.

The OA/COTS model also impacts the industrial base for sustainment. The approach of buying large numbers of spare parts is no longer viable because many of the electronic assemblies become obsolete before the spare is needed. When these logistic support roles are distributed across an industry wider than the USW base, the net effect is a further dilution of resource and investment available for sensor and weapon technology. Sensor and weapon technology is tightly coupled to platforms and only loosely linked to the electronics systems. Although the Navy is fielding new ships, aircraft, submarines, and autonomous vehicles, there has been little research and development to take advantage of the efficiencies from the gains in power reduction and miniaturization of the electronics. For example, instead of conceiving a torpedo which would benefit from a wide range of industrial development, an incremental improvement effort is focused almost exclusively on the electronics in the sensing package. Similarly, we are embarking on a high altitude aviation USW capability without an equivalent investment in the sensors and weapons to conduct the mission in a new paradigm.

The USW industry's intellectual capital is provided by a shrinking number of personnel who developed their capability over many years of specialized study and hands-on experience. While there is extensive educational opportunity (public and private universities and colleges) in the areas of computers, digital processing, and network hardware and software, there are no specialized courses in USW except for at the Naval Postgraduate School and Woods Hole Oceanographic Institute. Since the overall national defense industrial base suffers from the drought of undergraduate engineers, the USW talent pool suffers an amplified negative trend. If an industrial base capable of developing, fielding, and supporting USW systems is to be realized, a collaborative government/industry/academia program to train future scientists and engineers in the practical application of a college-level science and engineering education to the development of USW systems is required. This creates a challenge for industry to sustain

a critical mass in facility and intellectual capital, and has resulted in several actions which are overall dilutive to the USW base:

- Industries have consolidated, and many have pursued diversification through non-USW opportunities and/or foreign military sales. Some of these actions create a net favorable efficiency or synergy of using “other people’s money” toward US Navy needs, however the international markets will not sustain the same vitality and competitiveness as that from US Navy focused investment.
- The prevalent use of COTS shifted some workload to non-USW industries, which provides a net favorable affordability gain. However, it reduces the business case for USW industries to reinvest in their core businesses. This is exacerbated when US Navy customers challenge the “value added” by a prime contractor who has a large recurring system content derived from COTS based product integration. A near term gain is achieved at the potential loss of future investment base.
- The facility and human capital skills for sustaining and modernizing legacy systems to maintain a business base does not regenerate the same level of innovative thinkers as when designing and developing leading edge systems.
- Financial models of industry are challenged when the net effect is a lower expected ROS/ROI on a declining sales base. Unless “strategic” to a larger company benefit, some “no bid” decisions will have a long term impact on the overall capability and competitiveness.
- Although the use of congressional earmarks is being challenged and subdued by the current administration, there may be programs which were enabled by such actions which would not be considered “best value” today.

Both industry and government are supporting programs to increase the number of students in Science, Technology, Engineering and Mathematics (STEM) curricula. The NDIA has a separate division dedicated to STEM participation. The NDIA is also a member of the Tapping America’s Potential (TAP) coalition of business organizations. TAP has a goal of doubling the number of U.S. citizen and permanent resident STEM graduates from 200,000 in 2001 to 400,000 in 2015. The DOD is also engaged in increasing STEM graduates as part of the Science, Mathematics, and Research for Transformation (SMART) program which provides grants to students in STEM programs. These programs do not necessarily provide employees who can obtain the necessary security clearances or have an interest in working in the defense industry. In addition the number of STEM graduates is 20% less that at its peak level in 1985 and is falling far below the demand for these employees. There are also a number of organizations within the Navy that are supporting STEM programs; for example NAVSEA has the 21st Century Engagement, Education, and Technology Program (21CEETPP) which captures various strategic thrusts of STEM outreach to youth, nurturing college students via scholarships and research projects, and producing a STEM workforce for the future with recruiting and career development efforts.

In the awarding of advanced degrees, 50% of the PHD graduates are ineligible to obtain a security clearance. The long term effect on the overall industrial base will be similar for USW as for the rest of the defense industry.

Industry is also suffering from a diminished USW career path and experience in an area which is both art and science. In recent history when we had significant forces in air, surface, and ashore infrastructure dedicated to USW and therefore offered a career path for significant numbers of career officers, some of whom reached significant levels where they had influence and where the seriousness of the threat was understood. Industry relies on some percentage of former government and military professionals to finish their careers with companies which have similar values where they can apply previously learned skills. The “intellectual” industrial base thus spans wider than the industry sector.

A new administration in the executive and legislative branches may afford the opportunity to bring “new issues” to the surface and provide resolution. Just as MIW has been able to connect and focus the government leaders and legislators on that mission, perhaps a widened or new caucus could place USW in the context of a national imperative. As we consider the impacts of a diminishing industrial base, perishable skills, and volatile budgets, these are issues which are common for government and industry where both can benefit from an enhanced collaboration.

CONCLUSIONS & RECOMMENDATIONS

The USW industry faced the same reduction that the defense industry experienced over the past few decades. Without a perceived and compelling threat, there has been insufficient rationale to support major acquisition programs; rather, the trend has been to fix, modernize, sustain, and pace the threat. In addition, both the realization that domestic programs require large insertions of funding to remain viable and the diversion of funds to the ongoing war on terror leaves a reduced funding line for USW programs.

Early collaboration between the Navy and Industry on USW programs: requirements, R&D, acquisition, and support can provide a more streamlined, and cost effective process and higher quality products in support of Navy USW requirements. Global technology availability allows any country to improve their capability quickly and at a reasonable cost, so we can only rely on the incremental and sustainment approach as a bridge to a funding issue. Long term viability for USW dominance requires a consistent technology investment to rebuild the competitive advantage.

As the government proceeds with growing its acquisition workforce, the infusion of new people (management and technical) who will need to be trained in the government operations and processes will offer both a challenge and opportunity for a strengthened partnership with industry. Use of the more flexible National Security Personnel System could help to recruit and create a USW career path for the best and brightest personnel. At the same time, Industry must find ways to recruit and train employees who can develop and build USW systems. Programs, such as STEM, SMART and others need to

be aggressively pursued by Government and Industry to develop the next generation USW workforce. Industry-to-Government and Government-to-Industry personnel rotations should be implemented.

The following recommended actions are specifically focused on those areas where industry can play a major role as contributor and/or facilitator in parallel with the US Navy's forward plan:

- Assign the NDIA UWD Navy Liaison Officer to the Navy USW Cross Functional Board to enhance the industrial base perspective of this team. Also empower and authorize this representative to share relevant information with the UWD leadership. UWD roundtable events could be used as a forum to ensure compliance with government regulations.
- Formalize the UWD relationship with NMAWC to enable first hand dialogue, information sharing, and access to capability assessments of both the operational tools and industrial base.
- Consider expanding the UWD role to include relationships with principal allied stakeholders and complementary non-US based USW technology providers; this would require processes and procedures which might be similar to those used in current industry dealings with the export of technical data (e.g., data licenses or technical assist agreements).
- Promote scholarships & incentives for students in technical college degrees to broaden the seeds of interest in USW studies.
- Utilize the flexibility incorporated in the National Security Personnel System to recruit/retain USW expertise (e.g. form a "Community of Interest or Practice" or make strategic decisions in government technical or acquisition positions to raise the visibility and enhance the talent pool).

The NDIA UWD is in a unique position to support building a Navy/Industry team approach to ensuring superiority in Undersea Warfare. This team should have as its goal the creation of a 21st Century USW Industrial Base structure and government/industry interfaces. Both the government and industry must work together, and be structured to preserve and grow critical USW skill sets and capacity in the long term. The NDIA UWD leadership team is committed to this objective and stands ready to ensure the US Navy maintains and grows the advantage of USW superiority.

APPENDIX A: NDIA UWD

The Undersea Warfare Division (UWD) of the National Defense Industrial Association (NDIA) operates as an independent organization (no government contracts and not representing any individual or company) with the following mission:

- Promote the exchange of technical information between Government and Industry and expansion of Undersea Warfare (USW) related R&D
- Serve as an open communications conduit between Government and Industry
- Advise Government and Industry on Policy, Acquisition and Planning
- Conduct Navy Sponsored “pro bono” studies using voluntary resources and participation by members

The UWD draws upon the membership and resources of more than 1,500 companies and almost 68,000 individual NDIA members representing a wide cross section of the National Security Industrial Base. The UWD leadership includes about fifty industry executives who serve as members of its Executive Board, Advisory Council, and/or Committee Chairs. Members of the UWD are afforded the opportunity to participate in two significant SECRET level conferences each year, along with receiving a periodic newsletter and access to current and completed studies on USW. On average, about 1500 members participate actively in the UWD conferences and committees. The conferences, studies and technical committees are organized around key technologies and capabilities for USW:

- Sensors
- C4 and Combat Systems
- Aviation
- Mine Warfare
- Undersea Vehicles

In order to focus the UWD activities on relevant topics and issues, the leadership team holds periodic Roundtable Sessions at the SECRET level with uniformed and civilian key Navy leaders. Additionally, the UWD has an established practice of rewarding key leaders and technical icons, as well as funding three graduate student stipends annually.

As part of the UWD charter and bylaws under the NDIA, the UWD is required to provide a biennial report to the Secretary of the Navy, which is the purpose of this document and the appended briefing.

- Open Architecture, Dual Commercial/Military Use of Large Displacement Unmanned Undersea Vehicles
 - Sponsor: PMS403 Status: Compete Final Brief: Feb 05
 - Impact: The study found that use of commercial UUV's without extensive modification would not meet unique military requirements
- Sonobuoy Receiver Digital Output Interface Study
 - Sponsor: PMA264 Status: Complete Final Brief: Apr 03
 - Impact: STANAG 4283 Annex C Revision 5 in January 2006
 - Impact: Interface adopted by P-8A, P-3C, and MH-60R Programs; Navy and NATO adopted a COTS digital architecture common across Maritime Patrol Aircraft and Helicopters with an estimated \$160M cost avoidance

Studies which were completed from 2004-2007:

- Aviation: Sonobuoy Receiver Digital Output Interface Study for PMA-264 (2002-2004) - Navy and NATO adopted a COTS digital architecture common across Maritime Patrol Aircraft and Helicopters with an estimated \$160M cost avoidance
- Undersea Vehicles: UUV Open Architecture Study for PMS 403 (2005) - Determined that there was no viable business case for UUV dual-use; use of commercial UUV's without extensive modification would not meet unique military requirements
- Undersea Sensors: Distributed Netted Sensor Study for Director, ASW Cross Function Board, OPNAV N87 (2005-2007) - Concepts Briefed at '07 Clambake, Acoustical Society Conference and Included in NUWC/NWC DNS Workshop and Fleet Wargame
- FORCEnet Study – Comments provided to the Navy on industry perspective of proposed FORCEnet standards

Studies which are in process:

- C4I and Combat Systems: Communications Management in Support of an Anti-Submarine Warfare Common Tactical Picture for Director, Cross Function Board, OPNAV N87 (2007-2009) - Developed and recommended a combined line-of-sight/non-satellite COMMS system with adequate bandwidth, security and timeliness for coordinated ASW OPS
- Mine Warfare: Underwater IED Study for NMAWC (2007-2009) - Investigated and recommended application of military systems for use in ship channels and harbors to counter terrorist use of underwater IED's
- Undersea Vehicles: State of the Practice in Unmanned Systems Technology for Capt. Paul Siegrist, USN, Program Manager for Unmanned Maritime Vehicle Systems (PMS-403) (Nov. 2008-June 2009) - Reviewed emerging technologies for merit in application to UMVs and established a list of attributes by which candidate technologies could be evaluated for UMVS application.