Defense Standardization Program

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Interoperability

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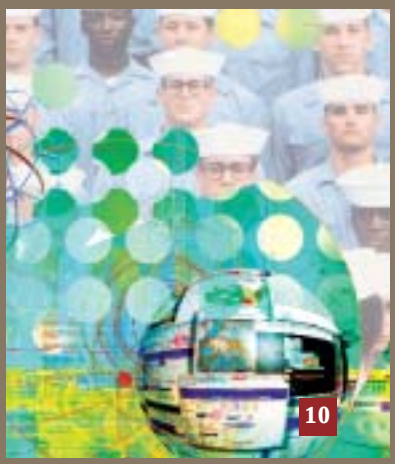

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Interoperability—More Than Just Making Things Fit

With apologies to Tina Turner—"What's Interoperability Got To Do With It?" Well, if "It" is the ability to go to war—the answer is "Everything." Imagine trying to operate in the high-tech field of battle with equipment that is incompatible with everyone else's equipment. Try hanging a missile on an airplane wing where the lugs are not carefully designed to mate and where the electrical connectors don't fit—or even worse, where they do fit but the mapping of the pins is incorrect so that the missile gets the wrong signal at the wrong time. Sound unlikely? Standardization Agreement 4007, "Electrical Connectors Between Prime Movers, Trailers and Towed Artillery," corrected a similar problem with a connector between a truck and a trailer. The connector fit, but when the driver switched on blackout lights every light on the trailer lit up. Not too good when you're trying not to be seen.

So interoperability is more than just making things fit, they must also operate together in the way they are supposed to operate and not cause harm to the overall system. Take a moment and look at the DSP seal—around the bottom it says, "Making Systems Work Together." There's not a much more succinct way of describing interoperability. Whether we're talking about one radio being able to talk to another within the same squadron, an F-16 IFF sending out the proper signal so that a plane is correctly identified, or a hitch on a U.S. trailer fitting the British truck that will be pulling it, interoperability is making sure that systems, large and small, fit together and work together.

Recognition of the importance of interoperability has grown dramatically since the early 1980s. Driven in part by both the successes and the failures of interoperability in Desert Storm and other coalition operations and exercises, interoperability has become the watchword of virtually all systems development and upgrade.

Gregory E. Saunders
Director, Defense Standardization Program Office

And what is it that makes interoperability possible? For the answer, let's look back at what is hailed to be the discovery that enabled the industrial revolution—standardization. In 1798, Eli Whitney secured a U.S. government contract (for $134,000) to produce 10,000 muskets. Whitney refined and successfully applied the "uniformity system" of production using interchangeable parts. However, Whitney met bureaucratic disbelief and delays in implementing his ideas. He overcame these obstacles by convincingly demonstrating to President John Adams the workability of the interchangeable parts concept. He showed Adams that randomly selected parts would fit together as a whole working musket. It was interchangeability that allowed for mass production, and that allowed for far greater productivity than the old "craft to fit" production methods. (Though it was later discovered that Whitney rigged the tests, the concept of interchangeability caught on and did, in fact, fuel the industrial revolution.) Further, this interchangeability of parts allowed for the development of a system of spare and repair parts that enabled faster and more reliable reparability.

That earliest interchangeability relied on the most fundamental form of standardization—commonality—pieces being made to the same dimensions from the same materials and usually with the same manufacturing methods. But commonality is not always the most appropriate solution. Interchangeability has evolved from that earliest concept to one that allows for tremendous flexibility and innovation, all while retaining form, fit, and function. Today's tires are far superior to those of even a few years ago, but thanks to interchangeability, you don't need a new car to take advantage of these developments. And in my earlier example of the truck and trailer, we had a third form of standardization—compatibility. In that case, after development of the standardization agreement, the electrical systems of the truck and the trailer were compatible.

NATO defines standardization in these terms: commonality, interchangeability, and compatibility. These all lead to interoperability—the ability for systems to work together. So it is appropriate for us to focus this issue on interoperability. It is what standardization is all about—our raison d'être.

Destination: Interoperability

By Joseph Delorie

Introduction

Imagine, if you will, that you are embarking on a destination to a distant place you've never before visited and that your successful navigation and arrival at that destination was critical to our nation's security. Odds are that you'd want more help than just your intuition and a general sense of direction. After all, you wouldn't want to end up in "The Twilight Zone."

There might be alternative routes to get to your destination, but you probably would prefer to make an informed decision about which route to follow, rather than to leave the successful outcome of your journey to chance. If the territory has already been charted, no doubt you would opt to avail yourself of the use of a good map. Better still would be a map augmented with extra information about the routes, such as the presence of road construction that might hinder your progress or the availability of fueling stations or lodging along the route. If you could afford it, you'd probably want to have the latest technology, such as a vehicle equipped with Global Positioning System technology and one of those services that track your vehicle, providing up-to-the minute information on road conditions and turn-by-turn directions to your destination or to needed support services along the way.

The Joint Materiel Standards Roadmap fosters coalition interoperability in order to enhance warfighter performance.

What if your destination is in uncharted territory? In that case, you would want someone to blaze a trail and map the way for you, making your journey—and those of future travelers—less difficult. Alternatively, what if you had thousands of maps, but some of them gave conflicting directions? In that instance, you'd want someone to review the alternatives and resolve the discrepancies, eliminating the ones with dated or incorrect information, as well as those that would lead you astray from your desired destination. In both of those cases, what you really want is a clear map to follow.

Establishing such a map is what the Under Secretary of Defense for Acquisition, Technology and Logistics intended when he directed the Defense Standardization Executive, in a June 2001 memorandum, to "ensure our standardization efforts sup-

port implementation of approved warfighter unilateral and coalition interoperability requirements" by developing "a Joint Materiel Performance Standards Roadmap…consistent with our 'family of systems' strategy" and the implementation of the Future Logistics Enterprise (FLE). Working with representatives of the Departmental Standardization Offices of the Army, Navy, and Air Force, the Defense Standardization Program Office (DSPO) developed a draft Roadmap, and on October 10, 2002, the Defense Standardization Executive approved the document, now called the Joint Materiel Standards Roadmap (JMSR).

The JMSR establishes a filtering process to ensure that we develop and maintain standards needed to support the goals of the FLE and Quadrennial Defense Review. The operative word in the JMSR is "Roadmap" because the JMSR provides a coherent migration of the Defense Standardization Program consistent with the new National Defense Strategy. Those standards that make it through the filtering process will be included in a centralized database called the Program Manager's Tool (PMT). The PMT, which will be web based, will provide program offices, and the many organizations that support them, with a technical route for selecting standards (other than those for information technology) needed to meet interoperability, logistics readiness, safety, and other operational needs.

About the JMSR

Today, DoD relies on more than 30,000 different types of standards, including performance specifications, international standardization agreements (ISAs), non-government standards, commercial item descriptions, and military specifications and standards.[1] The JMSR defines the course of action to reduce the number of standards to those required to support joint service and coalition interoperability and logistics operations and to bring discipline to the ISA process. The JMSR will help DoD ensure that our standards efforts support the warfighters' operational requirements, while dramatically reducing the logistics footprint, as articulated in the FLE and the Quadrennial Defense Review. It also will provide the means to prioritize

DoD's efforts in supporting the development and maintenance of government and non-government standards.

What Criteria Must JMSR Candidate Standards Meet?

The JMSR vision is to have a focused body of standards that have been endorsed by the Office of the Secretary of Defense, the military departments, and defense agencies as required for meeting interoperability and logistics operations. A standard—whether active or new—can be considered for inclusion in the JMSR if it meets at least one of the following criteria:

- The standard is necessary to support DoD operational requirements for achieving the capability to accomplish approved military objectives, missions, or tasks.
- The standard is needed to ensure interoperability for a "family of systems," between systems, subsystems, or materiel within a service, among services, or with military treaty organization allies (excludes information interoperability as defined in the Joint Technical Architecture, or JTA).
- The standard is needed to meet the goals of the FLE for enhanced readiness, a reduced logistics footprint, complete supply chain visibility, improved transportation, or reduced and improved maintenance.
- The standard is needed to ensure safety.

Standards that do not support one of these criteria will be considered for cancellation.

What Is the JMSR Approval Process for Retaining Standards?

A military department's Standardization Executive may approve standards for retention if they meet the JMSR criteria and apply only to that one military department. An information copy of the approval must be sent to the other Standardization Executives and DSPO.

Standards that meet the JMSR criteria and apply to more than one military department or defense agency must be approved for retention by the Defense Standardization Council. A request for a standard's inclusion in the JMSR must be submitted to the Council through DSPO, and it may be submitted only by a Standardization Executive or Departmental Standardization Office.

Once standards have been approved for retention based on the JMSR criteria, they are considered for inclusion in the PMT.

Both the JMSR and the PMT will be featured topics at the **Defense Standardization Symposium**, to be held on **March 4–6, 2003**, in Washington, DC. For more information on the symposium, see the DSP website at **http://dsp.dla.mil**. The DSP website is also the best place to watch for future announcements about the availability of the Program Manager's Tool.

About the Program Manager's Tool

DSPO developed the PMT—a key component of the JMSR—to help program managers easily identify the specific standards that apply to their programs. For the most part, the standards are "preferred"—ones that program managers should consider using. But a small number of standards included in the PMT are mandated. A standard is designated as mandatory only if a public law or a policy-type document, such as a directive, instruction, regulation, or manual, requires its use.

Unlike the JTA, the PMT is not intended to be mandatory, nor does it include the standards from the JTA except, perhaps, in rare cases when a standard may address requirements such as human factors or safety, in addition to information technology requirements.

What Exactly Is the PMT?

The PMT categorizes standards by importance and by product category using a modified work breakdown structure (WBS). A WBS serves as a framework to define a program. It does so by breaking a defense materiel item into its component product parts, clarifying the relationships among those parts. In other words, a WBS defines a program in terms of hierarchically related, product-oriented elements.

The PMT has several modules. The Indexing module and the Update module are used by the "trailblazers"—analysts within DSPO and the military departments and defense agencies—that are reviewing standards and screening them for retention and inclusion in the JMSR.

Of primary concern to program managers is the Create WBS module, which allows users to build a WBS. That, in turn, gives them access to information and analyses provided by others to enable them to make informed decisions about the application of appropriate standards.

Currently, the PMT is available only on a developmental web server, which is being used to facilitate the review and analysis of standards for inclusion in the JMSR. As the Defense Standardization Council and the various Standardization Executives approve standards for retention, the information will be populated on a production website.

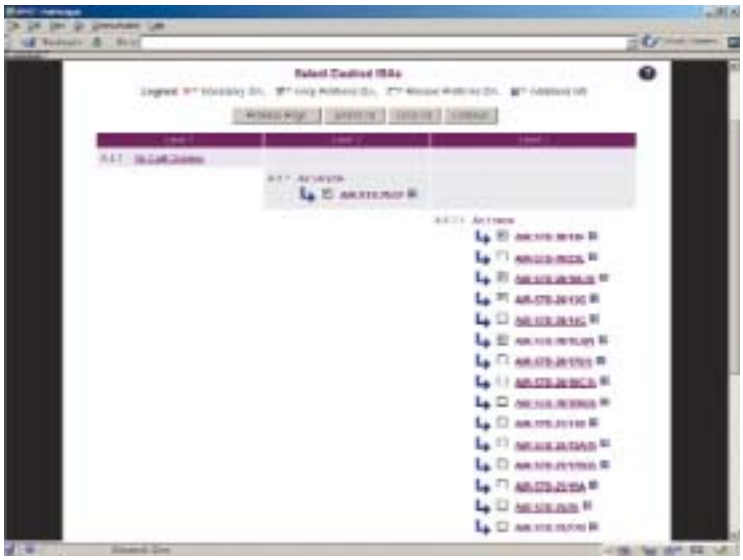
How Does the PMT Work?

Access to the PMT will be controlled through the ASSIST-Online[2] authentication process, so PMT users will require an

ASSIST-Online user registration and password. (Additional procedures for accessing the PMT will be issued by DSPO before the system is migrated to a production web server.)

The Create WBS module, accessible from the Create WBS menu option in the left navigation frame of the PMT, lets a user prepare a customized WBS. The user tailors a WBS by selecting applicable levels from the desired three-tiered levels formally documented in the Joint Materiel Architecture, as explained in MIL-HDBK-881. The initial screen lists all Level 1 categories, with a check box to the left of each category. The user selects each applicable category by clicking the check box.

After selecting all applicable categories, the user clicks Continue, located at both top and bottom of the screen. A new screen will appear listing the JMSR standards associated with the chosen WBS levels. Each standard listed is a hyperlink to the document analysis data in the ASSIST database for that standard.



Standards can be either mandatory or preferred. A red asterisk will be displayed next to each mandatory standard, indicating that it must be included as part of the WBS. A check box will be displayed next to each preferred standard, and the box will be checked by default. The user has the option to deselect, or uncheck, preferred standards to exclude them from the WBS they are creating.

Each JMSR standard on the list also has an icon with a question mark. Clicking this icon opens a window that explains why the standard is preferred (or mandated) and what the implications are of not using the standard. Reviewing the analysis and the associated information from ASSIST (which could include reviewing all or portions of the standard itself or, for an ISA, the implementing documents) can help the user decide whether or not to include a preferred standard in the WBS.

A user may save a WBS to the database by clicking the Save to Server button at the top of the screen. The user will be asked to assign a name to the WBS during the save process. The WBS can be recalled by using the Retrieve WBS menu option in the left navigation frame of the PMT. Once a user has completed his or her review, the WBS may be exported either as a Microsoft Excel spreadsheet or a Microsoft Word document. The exported file includes all selected WBS levels, the JMSR documents associated with each level that the user did not deselect, and—for any identified ISA documents—the associated implementing documents.

A user also will be able to request a copy of the WBS, along with the associated image files for all selected JMSR documents (including all ASSIST implementing documents for selected ISAs), directly from the DoD Single Stock Point by clicking the Order CD button at the top of the screen (a feature still under development at the writing of this article). Other planned enhancements include a user feedback module and a service to alert users when mandatory or preferred documents (or their associated implementing documents) have been canceled or revised.

The PMT itself has not yet been implemented on a production database. To date, the analysis effort has been focused on materiel-related ISAs and their associated implementing documents in the ASSIST database. The results of these reviews are released, in batches, to the cognizant military department and defense agency Standardization Executives for their review and comments, as needed. It is also up to the cognizant Standardization Executives to review any organization-specific, non-ASSIST implementing document. Once the review period is completed, and any needed corrections have been made to the initial analyses, the approved data will be moved from the developmental database to a production database.

As additional standards are reviewed and added to the JMSR, the PMT should prove to be an increasingly valuable resource to help program managers achieve the goal of materiel interoperability in coalition warfare.

About the Author

Joe Delorie is a member of the Defense Standardization Program Office staff.

[1]The term "standard" is used generically to represent any type of standardization document developed, approved, or adopted under the auspices of the Defense Standardization Program, including ISAs, non-government standards, and defense and federal specifications and standards. For a description of the types of standardization documents, refer to DoD 4120.24-M, "DSP Policies and Procedures" (available online at http://dsp.dla.mil).

[2]Acquisition Steamlining and Standardization Information System (ASSIST).

OPEN ARCHITECTURE

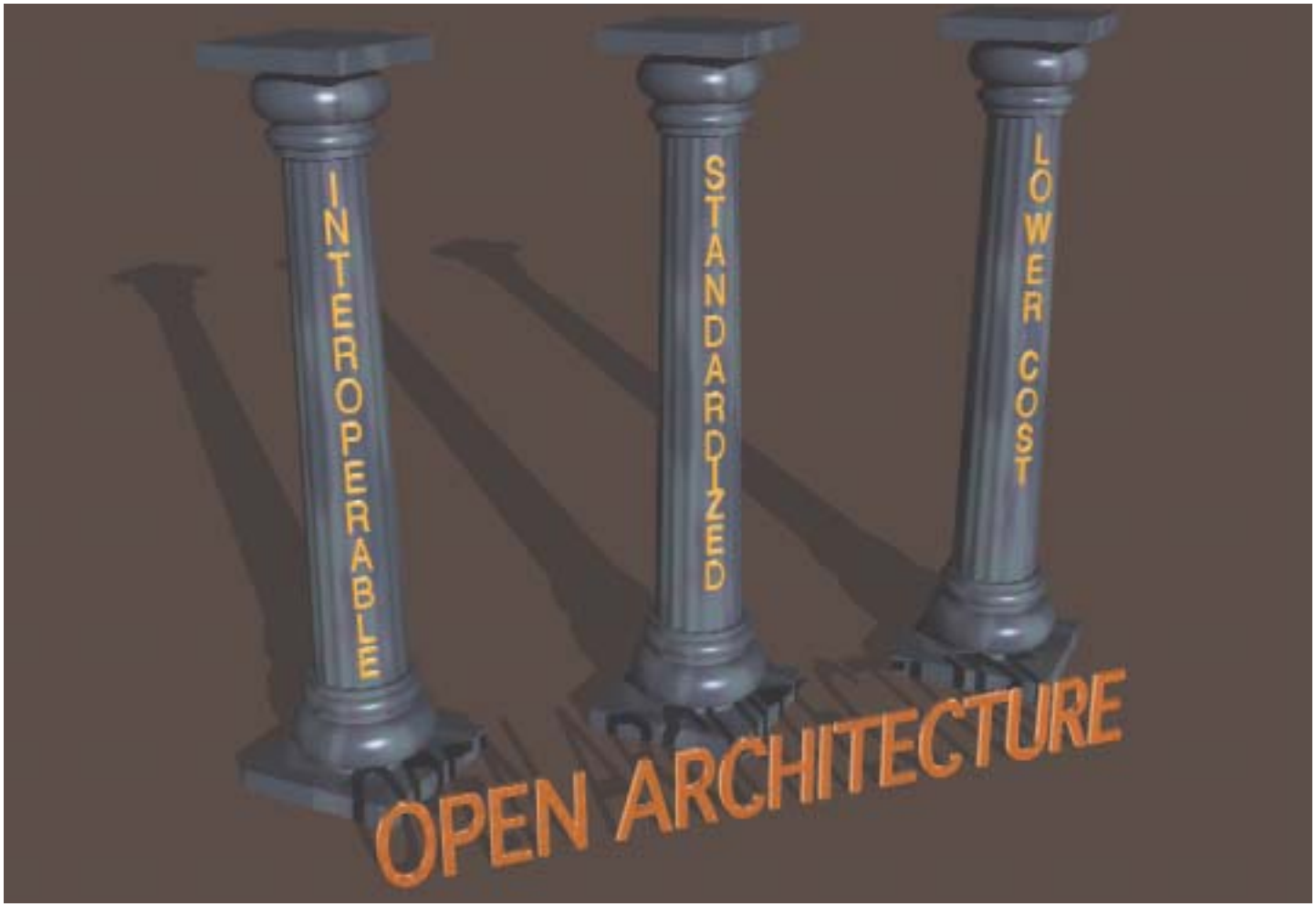
A Standards Approach to Navy Joint Force Effectiveness

By Rear Admiral C. T. Bush, USN, and Captain T. Strei, USN

Open architecture (OA) is a concept that speaks to the very core of the Defense Standardization Program (DSP). Rooted in the Defense Acquisition Reform and Revolution in Business Affairs developments of the 1990s, OA advances the use of commercial computing products, processes, and standards in weapons systems and platforms where it makes good military and business sense to do so. OA is thus key to DSP's continued success in achieving the goals of operational effectiveness, reduced costs, improved logistics support, and increased reliability.[1] Instead of a "Tower of Babel" of proprietary, stovepiped computing systems, with a jumble of incompatible interfaces, hardware, software, and middleware, OA promises to enhance service interoperability and warfighting capabilities at the lowest total ownership cost.

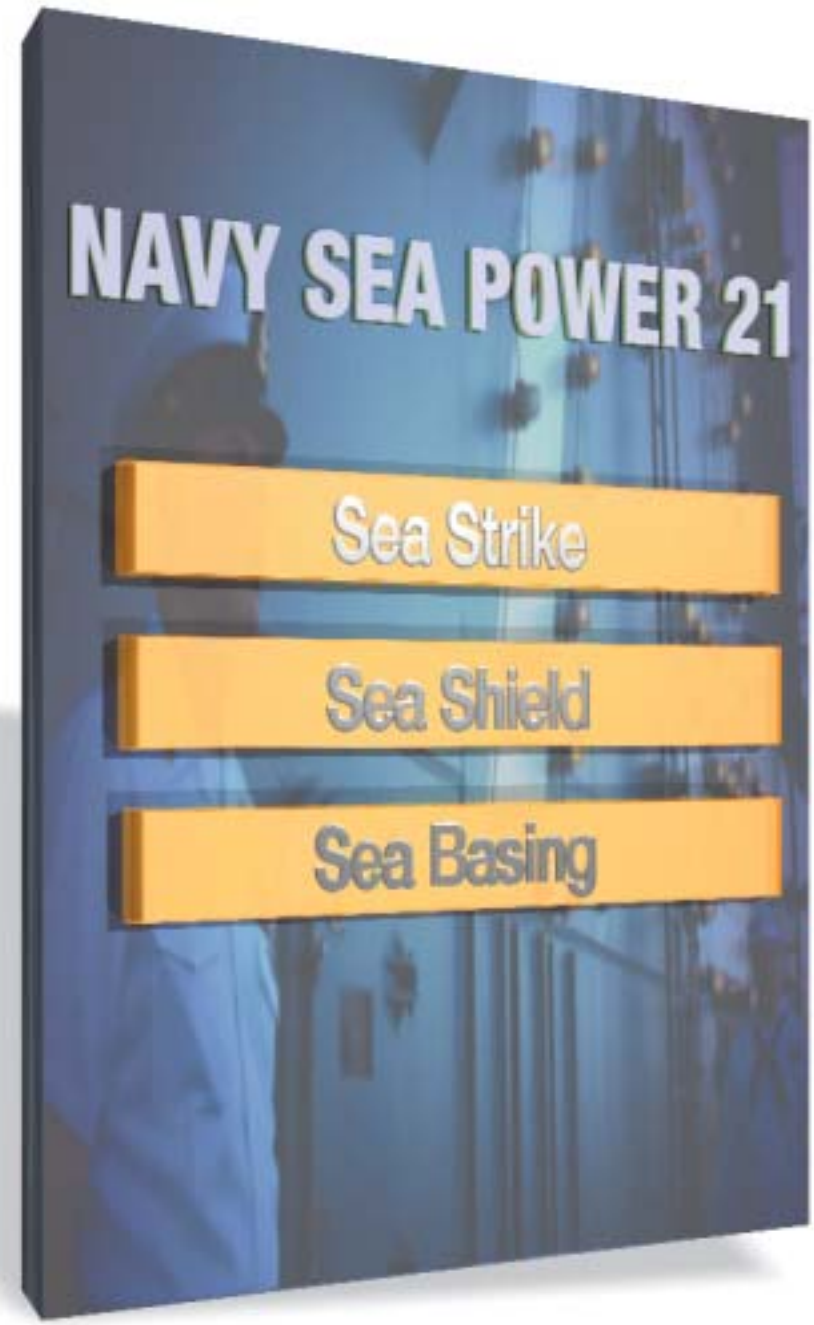
OA is critically important for the U.S. Navy as the service looks to execute the Sea Power 21 strategic concepts articulated by the Chief of Naval Operations, Admiral Vern Clark. Three operational concepts lie at the heart of the Navy's Sea Power 21 vision:

- Sea Strike, projecting precise and persistent offensive power



- Sea Shield, projecting global defensive assurance
- Sea Basing, projecting joint operational independence.

These three operational concepts are to be enabled by "Forcenet," what Admiral Clark explained as "an overarching effort to integrate warriors, sensors, networks, command and control, platforms and weapons into a fully netted, combat force." Forcenet is the "glue" that binds Sea Strike, Sea Shield, and Sea Basing. Open architecture enables Forcenet through the introduction of a modern technical and functional architecture that will ensure the Navy remains second to none in the years ahead.



"Forcenet" will enable implementation of the three operational concepts at the heart of Sea Power 21.

More Than Just Navy OA

The Navy's OA initiative follows the tenets of the Open Systems Joint Task Force definition and incorporates common engineering, information, protocol, computing, and interface standards across various computing environments and platforms. OA focuses attention on the need for thorough systems design and engineering to implement "open," not proprietary, specifications for interfaces, services, and supporting formats. OA will enable properly engineered and partitioned hardware and software components to be used across a wide range of systems and platforms.[2]

The OA design results in minimal system changes as either warfare requirements or the underlying commercial computing technologies change. The design also decreases interoperability problems because different platforms will now be able to use the same warfare applications. Further, the design is both portable and scalable, which means that it can be sized for the required task—whether it is a small combat system

or a full total ship computing environment like DD(X), the Navy's next generation land attack destroyer.

The OA concept and approach are already promoting heightened interaction among designers, suppliers, and end users. The Navy's OA approach seeks to utilize widely supported commercial interface standards, processes, and hardware and software products to develop and field warfighting systems that are superior to and more affordable than those acquired in the traditional MilSpec proprietary approach.

In November 2002, the Navy stood up several new Program Executive Offices (PEOs) focusing on submarine, surface, airborne, and space-based naval warfare technologies and systems. PEO Integrated Warfare Systems (IWS) was specifically created to coordinate the development of sea-based combat systems and to embrace the challenge of promoting naval and joint OA solutions.

The PEO IWS OA program is based on two major technical cornerstones:

- A single Navy-wide functional architecture that is extensible and scalable in function, capacity, and workload to meet joint warfighting requirements
- An Open Architecture Computing Environment (OACE) based on mainstream commercial off-the-shelf (COTS) technologies and systems and on widely adopted open commercial standards and non-proprietary standard interfaces, services, and formats.

The single Navy-wide functional allocation of the battle-space will ensure that the defense industry does not build warfare applications with duplicative content. The single computing environment enables the Navy to consolidate computing systems into a single open-system computing approach that is easily adaptable to all platforms and applications. OA will transform ship, submarine, aircraft, and warfare-focused shore commands by revolutionizing their computing plants and warfare applications.

OA will transform ship, submarine, aircraft, and warfare-focused shore commands by revolutionizing their computing plants and warfare applications.

PEO IWS will designate the functional allocation and select common standards and products in the areas of frameworks, middleware, resource management, and operating systems, using both established and evolving industry standards. The OA approach avoids proprietary solutions that all too often constrain rather than enhance interoperability and operational effectiveness.

The combination of the OA functional and technical environment maximizes fundamental commonality and interoperability across warships, aircraft, weapons, sensors, and virtually any program or capability that relies on computers. With a common functional architecture and computing environment, the Navy will be able to develop and evolve common warfare applications, services, and computing resources *one time* rather than developing them independently in multiple programs. Ultimately, the result will be a single common combat system designed from inception to evolve with the commercial market and flex with the needs of the warfighter.

Last summer, the Naval Sea Systems Command reached out to U.S. industry—both traditional defense as well as non-defense commercial companies—for leading-edge OA solutions to naval warfare computing requirements. The solicitation also included a concerted effort to provide opportunities for small businesses with innovative ideas to participate in the OA effort.

The goal remains to open channels of communication and promote even more fruitful collaboration among industry, government, and technical authorities. This technical interchange,

via government-organized integrated product/process teams, is already helping the Navy establish OA standards and define a technical and management approach to developing a non-platform-specific, multi-mission, open combat system architecture.

Multiplying Initiatives

The PEO IWS OA program will soon establish a laboratory-based Engineering Development Model (EDM) that runs on the OACE and contains selected common and unique services and applications. The first phase of this EDM will be operational in FY03. Additional combat system services and applications for differing ship classes and warfare mission areas will be added over time. These risk-reduction efforts are scheduled to conclude in FY05. The goal is to field an enhanced combat capability based on OA in FY08 and thereafter continue to field OA solutions under an evolutionary approach.

This work is based in part on the efforts of the High-Performance Distributed (HiPer-D) Computing team at the Naval Surface Warfare Center's Dahlgren Division. For more than a decade, the HiPer-D program sponsored by the Navy, along with the Defense Advanced Research Projects Agency, has been a highly successful technology development tool and test bed. Over the years, the team has proven that commercial products can in fact provide the necessary computing power required to drive the stressing warfare applications used on the modern battlefield. The commercial computing industry does not routinely address requirements that it is not aware of or does not understand.

The Navy's HiPer-D program has bridged the gap between the commercial marketplace and the battlefield by posing a collaborative OA "challenge" for the commercial sector. The result has been the integra-

tion of some COTS products while encouraging industry to mature and validate leading-edge products for military use. The HiPer-D program has been extremely productive for both commercial vendors and the Navy.

The principal results of the HiPer-D program include a growing list of validated commercial OA offerings for military applications and a new and expanding military market for commercial products. The Navy can increasingly implement combat systems with commercial products that possess the essential characteristics demanded by warfighting functions while, at the same time, providing enhanced ease of technology "refresh" and reduced total ownership costs. The HiPer-D program has already provided a significant return on the Navy's investment of scarce research and development resources, and it is the foundation for the Navy's development of the OACE EDM.

Likewise, several other joint and Navy programs have focused on the need for OA solutions:

- The multi-service and multinational Joint Strike Fighter (JSF) program approach supports a common production line for several different JSF variants—Air Force, Navy, Marine Corps, and Royal Navy, among others—based on commercial standards, technologies, and interfaces, particularly in command and control, communications, electrical, and mechanical components.
- The Marine Corps AV-8B Harrier II Open System Core Avionics Requirements program is providing a flight program software update and a new mission computer, the latter having applications in other aircraft, including the F/A-18 and the T-45.

The HiPer-D program has already provided a significant return on the Navy's investment of scarce research and development resources.

- The *Virginia* (SSN-774)-class nuclear-powered attack submarine program embraced an open-systems approach from the earliest stages of the design process, which has allowed extensive use of non-developmental items, COTS technologies and systems, and commercial standards, particularly in the submarine's combat system.

Open architecture solutions are of fundamental importance for America's future defense. The Navy's OA story is grounded in more than a decade of focused effort that has proven that even the most complex of combat systems can now be built using modular design concepts and widely supported commercial interface standards and products. OA, although technically complex, is achievable. However, the cultural changes required to achieve standardization through this approach should not be underestimated. Although it makes good business sense to embrace OA, the warfighter's needs of the future are clearly paramount. Sea Power 21 depends upon it.

About the Authors

Rear Admiral Bush is the Program Executive Officer, Integrated Warfare Systems. Captain Strei is the Program Manager, Open Architecture Program.

[1]Gregory E. Saunders, Director, Defense Standardization Program Office, "Director's Forum," *Defense Standardization Program Journal*, July 2002.

[2]An open systems approach is an integrated business and technical strategy that employs modular design and, where appropriate, defines key interfaces using widely supported, consensus-based standards that are published and maintained by a recognized industrial standards organization. See Open Systems Joint Task Force, *An Open System Approach to Weapon System Acquisition*, 2001.

Going Beyond MilSpecs for IETMs

A Cooperative International Effort to Develop Technical Data Standards

DSPO takes a common-sense approach to ensuring state-of-the-art IETM standards while slashing standards development and maintenance costs

By Hervé LeBoeuf, Ph.D., Joseph Fuller, and Eric Jorgensen

IETMs—Interactive Electronic Technical Manuals—are basic tools employed in the maintenance, operation, training, and logistics support of U.S. weapons systems. Because U.S. weapons systems and their prime contractor suppliers (air, sea, and land) increasingly have international sources and markets, it makes good economic and technical sense for the U.S. military services and their industry partners to cooperate with each other, with other countries' military services, and with international manufacturers to share development and maintenance costs of standards, or specifications, for IETMs. Doing so will ensure that IETMs can be developed and used in a common way.

Members of international government, military, and industry working group collaborate to develop IETM standards.

This article describes a collaborative process for developing IETM standards that will meet the requirements of the U.S. military services and DoD acquisition community. The Defense Standardization Program Office (DSPO) sponsored the effort, in keeping with its mission to (in part) "influence, develop…, and provide access to standardization processes…for Warfighters, the acquisition community, and the logistics community to promote interoperability, reduce total ownership costs, and sustain readiness."

The DSPO-sponsored support of a more effective IETM standards development process is consistent with DoD guidance for standards to be used by

Image of JSF © Lockheed Martin Corp.

The Joint Strike Fighter Program plans to use S1000D.

the service components (DoD 4120.24-M). This improved development model entails cooperation at a deep technical level among the U.S. services, international companies based in the United States and friendly nations, and the ministries of defense of several allies and friendly nations.

The Need for IETM Standards

IETMs are procured as part of a weapons system acquisition. After the "Perry Memorandum" resulted in canceling many MilSpecs, military services and agencies reduced their budgets for maintaining the specifications related to IETMs.

Because DoD has been unable to provide funding or personnel resources for the development and maintenance of IETM standards, individual programs were forced to develop and maintain unique Technical Manual Contract Requirements and other procurement requirements for individual programs. This meant that program managers also had to produce unique requirements documents for the IETMs they procured.

Now, program managers have access only to largely obsolete, non-maintainable standards, including U.S. IETM specifications issued about 10 years ago (MIL-PRF-87268 and MIL-PRF-87269) and not definitively updated since then. Somewhat of an exception is MIL-HDBK-511, which was issued in 2000. MIL-HDBK-511 addresses many IETM interoperability problems, including core user interface requirements. However, it provides no guidance for content standardization; instead, its emphasis is on making interoperable the content that already exists. In any case, MIL-HDBK-511 is not enforceable because it was issued for guidance only.

Lacking updated standards, the IETMs for multi-service and international weapons systems increasingly diverged, both in content and presentation format. Because of that divergence, data in the IETMs often cannot be used interoperably among programs, projects, or services—either in the United States or allied and other friendly nations.

Warfighters need up-to-date, interoperable electronic technical data products. That need is clearly stated in letters to the Office of the Secretary of Defense from the Joint Logistics Com-

manders (JLC) and the Joint Commanders Group for Communications and Electronics (JCG-CE):

- The JLC's June 1997 memorandum to the Deputy Under Secretary of Defense for Logistics—DUSD(L)—stated one of JLC's goals for IETM interoperability: "A uniform approach which will permit dissimilar DoD weapon-system IETMs, regardless of the source, to be read and viewed on a common user-interface system."
- A May 2000 JCG-CE memorandum to the Assistant Deputy Under Secretary of Defense for Logistics Architecture—ADUSD(LA)—recommended that acquisition policy be modified to identify IETM interoperability as a major goal. The group specifically recommended a sentence to become part of DoDI 5000.2: "DoD Program Managers will follow the guidelines contained in MIL-HDBK-511, *Department of Defense Handbook for Interoperability of Interactive Electronic Technical Manuals (IETMs)*, when acquiring IETMs."
- A follow-up letter in November 2000 from the JCG-CE to ADUSD(LA) expressed the additional need for international cooperation in the area of technical data standardization and, in particular, endorsed "an informal effort to introduce IETM interoperability standards and guidance to the NATO Interactive Technical Publications (ITP) Working Group." The letter also specifically stated that the effort, "if taken to a satisfactory conclusion, will further the goals of the JCG-CE by establishing an international standard to view and access IETM data…. International IETM standards will provide an opportunity to enhance support of Joint, Allied and Coalition operations."

Collaborative Development Begins

In response to the need for interoperable electronic technical data products and to a NATO CALS Management Board request, a group of representatives of interested international commercial and government defense entities met twice in 2000 to better identify the need and address potential solutions. Participants at these "exchange" meetings included the Air Transport Association (ATA); the Aerospace Industries Association (AIA); weapons systems manufacturers; representatives from the ministries of defense from several European countries, including France, Germany, Italy, Spain, Sweden, and the United Kingdom (UK);

Major Industry Participants

U.S.-based companies

Raytheon
Lockheed Martin
Northrop Grumman/Litton
General Dynamics
Boeing
Sikorsky
Pratt & Whitney

Europe-based companies

Saab Aerospace
Rolls-Royce
EADS Germany
LSC Group
Agusta Westlands
Dassault-Aviation
Alvis Vehicles Ltd.
EUROCOPTER France

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The European Land Combat Vehicle uses S1000D.

AECMA (a European association of commercial and military aerospace entities); and the U.S. DoD, represented by its Tri-Service IETM Technology Working Group. The group's goal was to develop a solution acceptable both to military services and to industry. Group members would also benefit by sharing the development costs.

From the initial information exchange meetings came a working group to develop a solution to the need for a specification for IETMs. The group—consisting of many of the original participants, but primarily AIA and AECMA—took the best from several existing specifications and began to develop a common way of portraying interactive technical data. Starting with AECMA Specification 1000D (S1000D) as a baseline, the participants incorporated aspects of U.S. MIL-STD-8088, UK DEFSTAN 0060 (which establishes the UK Ministry of Defense requirement to use S1000D), and the suite of U.S. MilStds for IETMs, including parts of MIL-PRF-87268, MIL-PRF-87269, and MIL-HDBK-511.

Some U.S. military programs, for example, the F-117, had adopted early versions of the specification, and other countries adopted S1000D as their IETM specification for U.S.-originated equipment.

In 2001, the AIA, which represents major U.S. manufacturers of aircraft, aircraft engines, missiles, spacecraft, ships, military ground vehicles, materials, and related components and equipment, established a formal project to support development of S1000D. AIA then took the overall U.S. lead for the project, with the support of the Tri-Service IETM Technology Working Group and the U.S. military services. The AIA alone contributed more than 225 workweeks of effort and provided more than 75 trips to support international meetings.

In February 2003, AIA and AECMA signed a formal memorandum of understanding. That memorandum sets parameters for continuing to work together on harmonizing U.S. and European guidance related to technical data. The overall group preparing this specification is now known as the AIA/AECMA Technical Publications Specification Maintenance Group (TPSMG).

S1000D Updates—Collaboration Continues

In addition to developing S1000D, the AIA/AECMA TPSMG, and its subsidiary Electronic Publications Working Group, is supporting the specification's continual improvement. Sustained maintenance of the specification will ensure that it remains current as technology evolves. To put it another way, with the continual infusion of new technology, S1000D will never be far behind the latest technology available. The collabo-

© Lockheed Martin Corp.

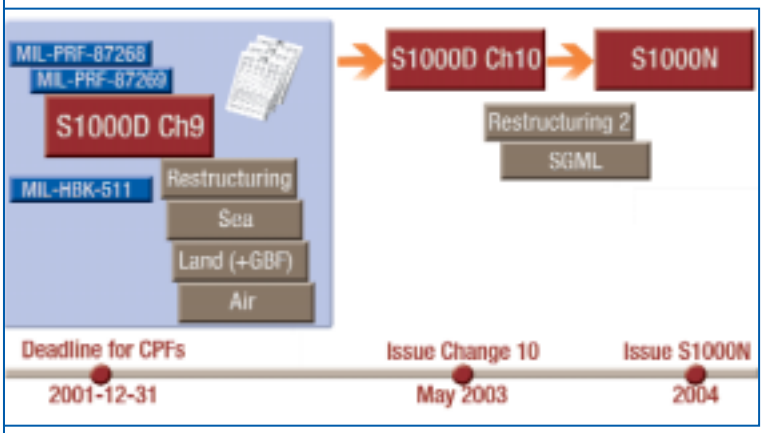
The F-117 also uses S1000D.

rative approach to developing and updating S1000D—to date, S1000D has been issued with changes nine times—also will ensure that other technical requirements—both military and commercial—are accommodated as they are identified.

Technical working groups, with both defense and commercial representatives from the United States and Europe, are continuing to identify needed changes to the specification. The newest version of the specification, Change 10, will be issued in mid-2003. Change 10 will

- restructure S1000D to incorporate requirements for land and sea systems;
- specify a method for storing data in electronic form and for providing information in electronic and, if necessary, paper formats; and
- incorporate specific changes proposed by U.S. participants so that the specification will be applicable to DoD's IETM needs.

The chart below shows milestones and dates for future releases of the specification. Changes are proposed using CPFs (Change Proposal Forms). The next major version of the specification after Change 10 will be titled S1000N, with the N representing greater participation by NATO.



Plan of Action Chart.

U.S. Tri-Service IETM Technology Working Group.

U.S. Participation in S1000D Development

Early in 2000, the U.S. Tri-Service IETM Technology Working Group recognized the promise of the collaborative approach being taken by U.S. and European companies to develop IETM standards. DSPO funding enabled the working group to participate in the AIA/AECMA meetings and to represent U.S. DoD interests.

DSPO sponsorship also enabled the Tri-Service IETM Technology Working Group—along with the Naval Surface Weapons Center Carderock Division, Defense Information Systems Agency, and Army Communications and Electronics Command—to undertake a review of Change 9 of S1000D. The purpose was to evaluate the potential for applying the specification to DoD's IETM needs. The AIA played a major role in the evaluation.

The U.S. entities reviewing the IETM specification identified six major technical issues—issues that needed to be resolved for DoD to use S1000D. Those issues concerned DoD's requirement for

- common web-enabled linking mechanisms,
- intelligent interactive functionality,
- interoperability of non-standard IETMs,
- XML methodology for run time,

- metadata standardization, and
- numbering and data model standards.

Within a year, the AIA and the Tri-Service IETM Technology Working Group, working closely together, had identified technical solutions and proposed that they be incorporated in S1000D as part of its continuing update program. In September 2001, the Tri-Service IETM Technology Working Group published an agreement on the following position pertaining to S1000D:

> The proposed technical solutions of the AIA/AECMA Electronic Publications Working Group show significant potential, when implemented, to resolve the six DoD technical issues identified.

The technical contributions made by the AIA and Tri-Service IETM Technology Working Group have been key to improving S1000D. For example, the U.S. participants introduced IETM interactivity, similar to that of MIL–PRF-87269. In fact, to date, they have contributed 12 formal change proposals that would not have been produced without U.S. involvement.

Now, S1000D is targeted as the solution specification for U.S. DoD IETMs. In June 2002, the Tri-Service IETM Technology Working Group agreed to the following principles:

- "An industry association standard that meets DoD requirements would be acceptable and could be used on U.S. DoD programs. This approach is entirely consistent with DoD guidance, i.e., S1000D could replace U.S. specs if augmented."
- "A coordinated U.S. review of S1000, and a positive report, is required, after release of Change 10, in order to formally adopt it for DoD use."
- "U.S. Services should participate in all management and technical working groups developing Change 10 of the S1000D; perform technical reviews of specification drafts to ensure Service minimum essential requirements are met and that no adverse impact on existing IETM programs; and pilot programs should be employed to test aspects of S1000 to reduce risk for major U.S. military programs."

Major internationally oriented U.S. weapons systems programs have already indicated their interest in using S1000D. The U.S.-led international Joint Strike Fighter Program intends to use S1000D as its IETM specification, and the Global Hawk Program is transitioning to its use.

About the Authors

Hervé LeBoeuf, Ph.D., is Vice President of IEM Technologies, Inc. He is program manager for technical data initiatives and represented the United States on the NATO CALS Management Board. He is now developing IT standards and supporting international efforts to develop new international electronic bidding and electronic contracting standards.

Joseph Fuller heads the Fleet User-Systems Design Branch at Naval Surface Weapons Center Carderock Division and chairs the Tri-Service IETM Technology Working Group. He is a recognized pioneer in IETM technology and standards.

Eric Jorgensen is manager for IETM technology at Naval Surface Weapons Center Carderock Division, with more than 20 years working in technology development and standards for IETMs in DoD. He is the DoD representative to international partners in industry and other ministries of defense.

The authors wish to acknowledge the technical contributions and oversight of the Aerospace Industries Association, AECMA Technical Publications Specification Maintenance Group, and Tri-Service IETM Technology Working Group. Those organizations have helped to ensure that service acquisition programs could use the proposed IETM standard effectively.

About S1000D

What Is It?

S1000D is an international specification for technical publications. It uses a common source database for all aspects of creating, maintaining, reusing, and publishing a technical information data set. Data are produced in modular form, in self-contained units. Data modules are not duplicated in the common database but reused as needed.

Though it relies on the standardization of source data for basic interoperability, the specification allows limited accommodation of non-standard legacy data while moving toward specifying a user interface. It provides a comprehensive specification for new procurements, and it is well suited for basic web presentation.

S1000D uses XML—a new technology for industry and military information exchange—and web technology, making technical data for promoting interoperability on the combat support infrastructure readily accessible to military and commercial viewers.

What Are Its Benefits?

AIA and AECMA identified numerous benefits that will accrue from using S1000D for IETMs:

- The standard is based on internationally approved and accepted standards (ISO and W3C).
- It allows transfer of information and electronic output among disparate IT systems.
- Many different output forms can be generated from the same base data set, ensuring strong, efficient data configuration control at the user interface.
- It is nonproprietary.
- It allows neutral delivery and management of data.
- It is in daily use for national and international projects.
- The modular approach is ideal for web delivery.
- It is responsive to emerging technology.

The Tri-Service IETM Technology Working Group added to that list of benefits. Specifically, the group noted that using S1000D will result in

- source data standardization and modularity,
- improved interoperability among different authoring systems,
- improved data reuse among support systems for disparate legacy systems,
- increased feasibility of presentation standardization,
- cost-effectiveness in use of commercial applications, and
- reduced times to delivery.

In short, using S1000D in programs from the beginning will immediately enhance understanding and, as a result, team building among the many military and commercial stakeholders. That, in turn, will enable them to achieve a key goal—international interoperability for joint and allied operations.

BSU-49/B Bomb Fin Standardization Project

Interoperability is a key performance parameter driving standardization of the BSU-49/B T-2

By Henry Patterson Jr.

Increasingly, standardized ordnance components are being used in MK 80 series bombs. The United States and our allies share standardized ordnance components to ensure that systems work together—are interoperable—and to minimize the costs of components and subsystems while maximizing their availability.

The BSU-49/B T-2 fin assembly has potential to become the first standardized MK 82 500 lb. high-drag bomb fin in 20 years to meet the requirements of both the Air Force and the Navy.

Origin of the Standardized High-Drag Bomb Fin

The first widely deployed BSU-49/B high-drag bomb fin assembly—the Air Force BSU-49/B T-1—was intended to be the service standard. The possibility of using that assembly as the standard was shattered when the fin assembly failed a series of low-drag release tests from Navy strike fighter aircraft; the low-drag dispersion rate was less than acceptable.

With hopes of a joint Air Force and Navy standard fin diminishing, the Navy redesigned the older MK 15 SNAKE EYE mechanical high-drag bomb fin assembly. The redesigned bomb fin is referred to as the BSU-86/B.

The existence of two differently designed fin assemblies—Air Force BSU-49/B T-1 and Navy BSU-86/B—to satisfy MK 82 500 lb. bomb high-drag requirements led to a research project known as the BSU-49/B Air Inflatable Retarder Improvement Project. The project's purpose was to develop, produce, and make available to the services a single standardized high-drag bomb fin—the BSU-49/B T-2. Testing and evaluation done to date suggest that the BSU-49/B T-2 successfully combines the desired attributes of the BSU-49/B T-1 and BSU-86/B into a single high-drag bomb fin that meets the service's requirements for economy, performance, and standardization. The BSU-49/B T-2 promises better aerodynamic performance, an expanded delivery envelope, low-cost modification of existing BSU-49/Bs, and a lower logistics cost made possible by a proven structural design.

Services Ask the Hard Question

The key question the services are likely to ask is this: How does the BSU-49/B T-2 stack up against currently fielded high-drag fins used on the MK 82 500 lb. bomb? In terms of performance, the answer to that question can be summarized as follows:

- In its primary high-drag mode of operation, the BSU-49/B T-2 performs with greater accuracy and less dispersion than the BSU-86/B, and its high-drag capability is equivalent to that of the BSU-49/B T-1.
- In the low-drag mode, the T-2's performance is superior to that achieved by the BSU-49/B T-1; the T-2's higher aspect ratio cruciform fins provide more stability. The T-2 also provides an equal, if not a better, degree of low-drag stability than does the BSU-86/B.

Table 1 shows the ranking of data produced during a series of actual and simulated flight tests in both high- and low-drag configurations. The ranking increments are from 1 to 10, with 10 indicating the most stable flight and least amount of dispersion about the target.

Table 1. Comparison of Performance in High- and Low-Drag Configurations

Configuration	BSU-86/B	BSU-49/B T-1	BSU-49/B T-2
High drag	8	9	9
Low drag	8	6	9

Not only does the BSU-49/B T-2 compare favorably with the BSU-49/B T-1 and BSU-86/B fin assemblies in terms of aerodynamic performance, the T-2 also compares favorably when other characteristics are considered:

- BSU-49/B T-2 compared with the BSU-49/B T-1
  - Increased release compatibility with modern strike-fighter and fixed-wing aircraft, including the F-16, F/A-18, AV-8, P-3B Orion, and S-3A Viking
  - Low-cost provisions for retrofitting existing BSU-49/B inventory
  - Compatible software metrics with BSU-49/B
- BSU-49/B T-2 compared with the BSU-86/B
  - Expanded operational envelope—280 to 700 knots calibrated air speed
  - Compatible software metrics with BSU-86/B
  - Lower new production cost—approximately half the cost of BSU-86/B
  - Expanded mission range with lower aerodynamic carriage drag coefficient
  - Higher mechanical reliability, less wing pylon usage restrictions

- Increased accessibility to bomb fuse through fin canister access panel.

Aerodynamic Test Data

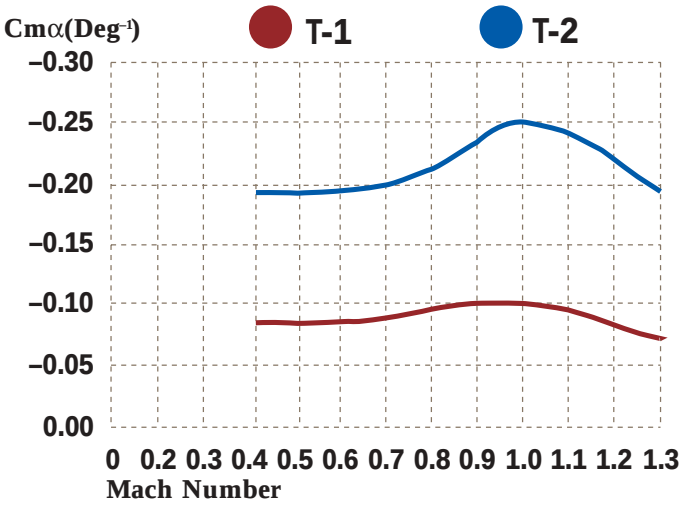
Wind tunnel tests and computer simulations of fluid dynamics done by the Air Force and industry compared the aerodynamic performance of the BSU-49/B T-1 and the BSU-49/B T-2 in their low-drag configurations. The tests looked at static stability coefficients, roll damping moment coefficients, non-rolling trim angle of attack, and pitch damping moment coefficients.

STATIC STABILITY COEFFICIENT

The weapon's dynamic center of gravity depends on the angular position of the weapon after launch. The dynamic center of gravity ranges from the most forward point to the most rearward point (known as the neutral point) on the weapon before it becomes unstable. The ratio from the most forward part of the weapon to any point in the range of the dynamic center of gravity to the neutral point is known as the static margin. If the weapon's center of gravity is forward of the neutral point, the static margin is positive and the static stability coefficient—Cmα—is negative, giving the weapon a stable trajectory. Compared with the T-1, the T-2 coefficient has an increased negative value, giving it better static stability characteristics throughout the Mach range (Figure 1).

FIGURE 1

Static Stability Coefficient

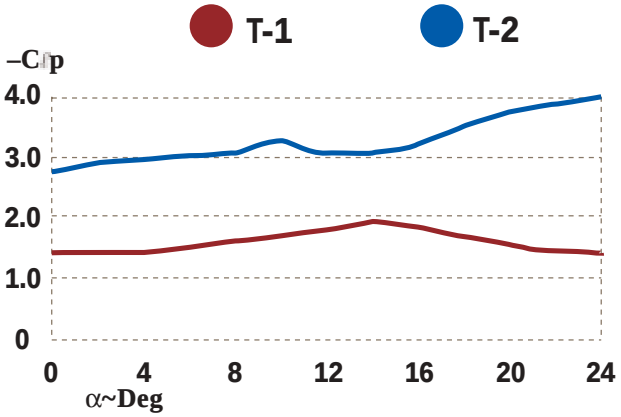


ROLL DAMPING MOMENT COEFFICIENTS

The roll damping moment coefficient increases with increased fin-plane area. The effective fin-plane area of the T-1 is 55.5 square inches, and that of the T-2 is 63.3 square inches. More stability is obtained when the coefficient is a large negative number. Figure 2 indicates that the roll damping coefficient in the subsonic Mach range for the T-2 is approximately double that for the T-1.

FIGURE 2

Comparison of Roll Damping Moment Coefficients with Angle of Attack at Mach 0.8



NON-ROLLING TRIM ANGLE OF ATTACK

The magnitude of the non-rolling trim angle of attack reflects the bomb and fin configuration aerodynamic asymmetry. A lower trim angle minimizes the tendency of the weapon to roll uncontrollably. The T-2 has a nominal angle of 2 degrees of non-rolling trim compared to approximately 4 degrees on the T-1 fin (Figure 3), giving the T-2 fin a better rating than the T-1 fin.

PITCH DAMPING MOMENT COEFFICIENTS

The stable trajectory of a weapon depends on its ability to counter a pitching change in motion with a motion that opposes that change. Increased stability is obtained when the pitch damping moment coefficient Cmq + Cmα values increase in a negative direction. The effects of the T-2 fin's greater surface area and increased span are greater pitch damping and greater restoring moment immediately after release and in flight to the target (Figure 4). Therefore the T-2 fin is rated higher for this characteristic.

FIGURE 3

Non-Rolling Trim Angle of Attack

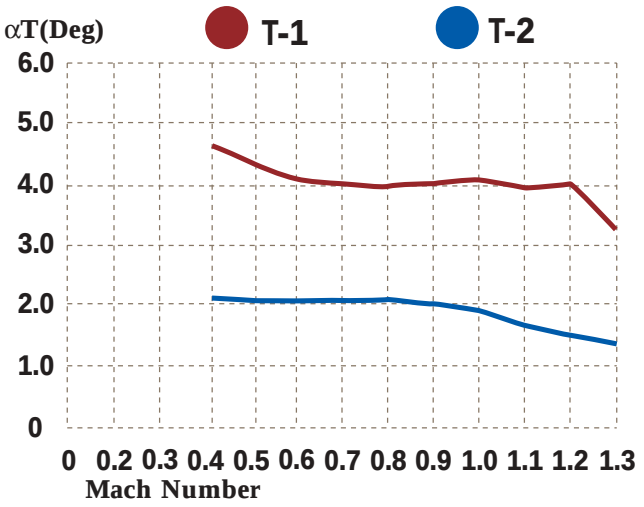
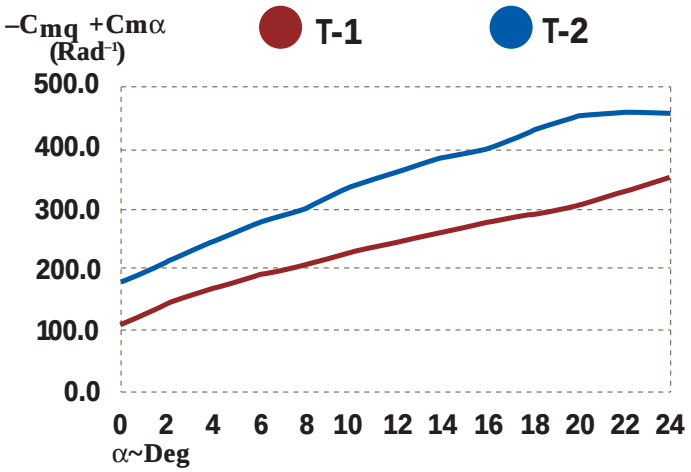


FIGURE 4

Comparison of Pitch Damping Moment Coefficients vs. Angle of Attack at Mach .80



CONCLUSION

The aerodynamic tests indicate that the low-drag performance of the BSU-49/B T-2 is clearly better than that of the BSU-49/B T-1. The enhanced dynamic stability of the BSU-49/B T-2 in the low-drag configuration suggests increased pitch damping characteristics and improved ballistic accuracy, resulting in greater flight stability, less dispersion, and a more accurate trajectory to the target during high-speed low-drag maneuvers. Table 2 compares the pitch damping moment coefficient Cmq + Cmα values for the BSU-86/B, BSU-49/B T-1, and BSU-49/B T-2. As the table shows, in their low-drag configurations, the BSU-86/B and BSU-49/B T-2 have pitching moment coefficients of –7.3, thereby producing similar desirable restoring moments. The BSU-49/B T-2 has a larger pitch damping coefficient, especially at transsonic and higher air speeds, that works to maximize the weapon's ability to maintain an accurate trajectory and hit the intended target.

Table 2. Dynamic Stability Characteristics in Low Drag

Weapon Configuration	Pitching Moment Coefficient (Cmα)	Pitch Damping Coefficient $-C_{mq} + Cm\alpha$ (Rad⁻¹)
MK 82/BSU-86/B	–7.3	–195 (sub Mach*, dive angle 0°)
MK 82/BSU-49/B T-1	–3.6	–170 (1.2 Mach, dive angle 0°)
MK 82/BSU-49/B T-2	–7.3	–222 (1.2 Mach, dive angle 0°)

*Sub-Mach wind tunnel test limits for BSU-86/B.

Other Characteristics of the Fins

In addition to performance, the project considered price, availability, and compatibility with different airframes—characteristics that are important when standardizing components to achieve interoperability:

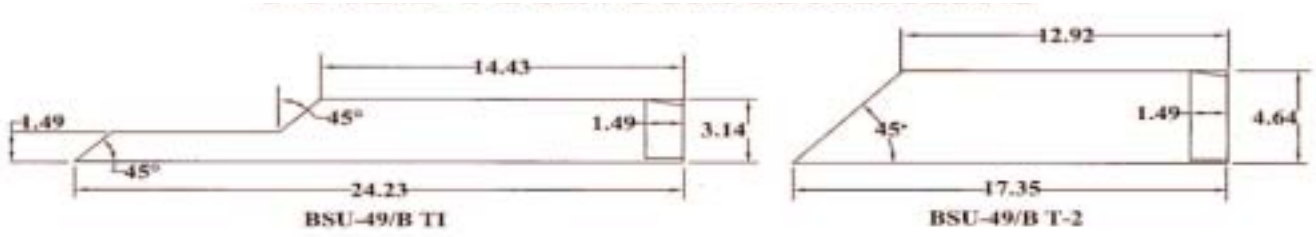
- Price. The BSU-49/B T-2 and the BSU-49/B T-1 each have a price of approximately $1,000. In contrast, the cost to build the BSU-86/B is an estimated $1,800 per fin assembly.
- Availability. The BSU-49/B T-2, which has a similar canister and balute retarding device as the BSU-49/B T-1, has an availability date of 3 to 6 months after contract award. In contrast, the BSU-86/B, which requires labor-intensive manufacturing procedures (elaborate bending, forming, shaping, and extrusion of the major metal components), has an availability date of 9 to 15 months after contract award.
- Compatibility with different airframes. Although the BSU-49/B T-2 fin has a shorter fin cord and a larger fin span compared with the BSU-49/B T-1 (Figure 5), the two fins have the same dimensional footprint on the bomb rack. Fit and function

measurements done on various U.S. Air Force and Navy planes indicated that the T-2, with its larger fin span, can be accommodated in the current weapon physical envelope allotted on bomb racks and wing pylons. An exception is the internal bomb storage equipment on the Air Force bomber, which is designed to accommodate the original BSU-49/B T-1 with its fin span of 3.14 inches. The BSU-86/B is compatible with Air Force F-16 externally mounted bomb racks, but cannot be carried on Air Force planes with high-density bombing systems.

BSU-49/B T-2. Flight certification testing is the next step in the development of the BSU-49/B T-2. Production of BSU-49/B T-2 certification units are nearing completion. Now, moving the BSU-49/B T-2 through flight certification requires the participation and resources of U.S. defense agencies and the armed forces of our allies that will benefit from the availability of the BSU-49/B T-2 configuration.

With the successful completion of flight certification tests, the armed forces of the United States and our allies will have a standardized bomb fin with superior operational performance compared to the Navy's BSU-86/B and the Air Force's BSU-49/B T-1. The BSU-49/B T-2 also promises an expanded delivery envelope, low-cost modification of existing BSU-49/Bs, and a lower logistics cost made possible by a proven structural design.

FIGURE 5
T-1 and T-2 Fin Configurations



Interoperability and Standardization

Joint Vision 2020 CJCSI Instruction 3170.01A makes interoperability a key performance parameter. If the efficiency of our logistics infrastructure is to be maximized, the military services must be able to share components, subassemblies, and systems to the largest extent possible. That requires standardization.

Standardization of the bomb fins for the MK 82 500 lb. warhead is the goal of the BSU-49/B Air Inflatable Retarder Improvement Project. Specifically, the BSU-49/B T-2 design supports the DoD policy of standardizing materials, weapon assemblies, and engineering practices to improve operational readiness, reduce total ownership costs, and minimize acquisition cycle times.

Call for Participation

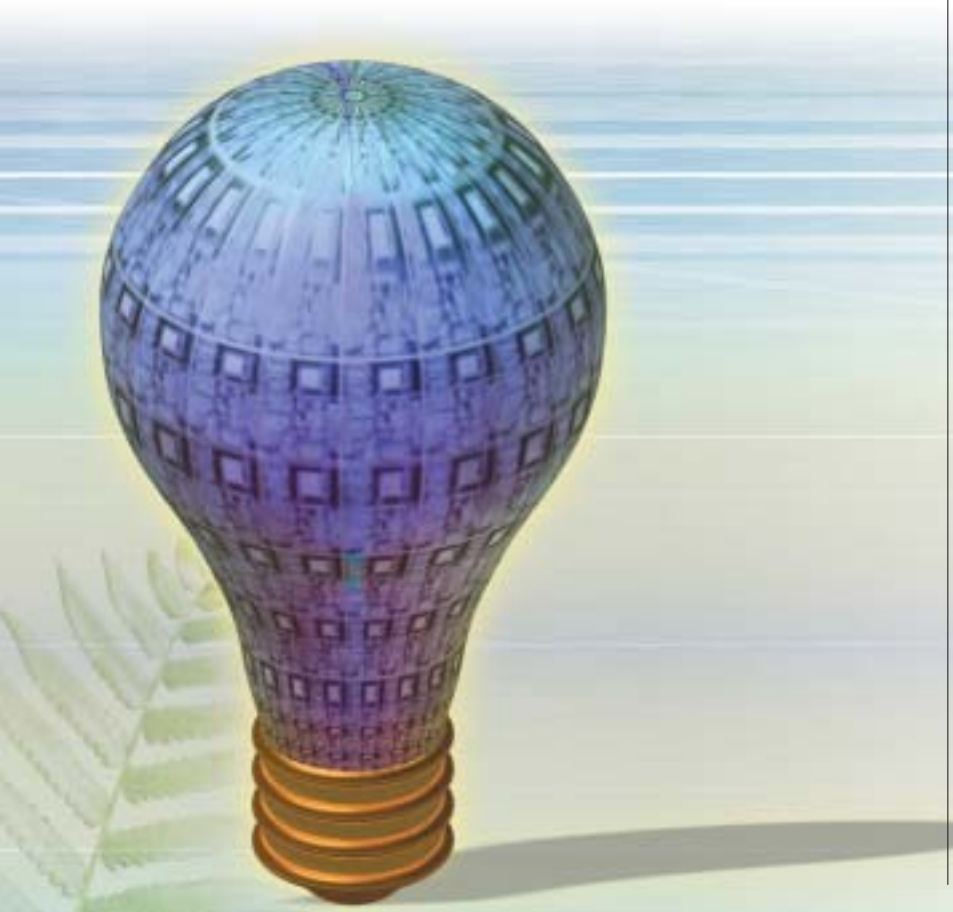
The Air Force and Navy provided the resources for the design, development, and laboratory testing of the

About the Author

Henry Patterson works at the Naval Air Warfare Center, Point Mugu, CA, as the foreign military sales engineering coordinator with NATO and allied countries. Previously, he served as the acquisition manager for the Navy's HARPOON and Conventional Weapons Program. Mr. Patterson is a member of the Society of Logistics Engineers and the Institute of Industrial Engineers.

The NSD Program: Saving the Environment Through Standardization

By Bill Leach, Frank Magnifico, and Eric Rasmussen



THIS ARTICLE DESCRIBES THE NAVY Standardized Document (NSD) Program, the process it has followed for reducing hazardous material requirements in Navy-wide documents, and its consolidation of related information into the DoD Acquisition Documents Database (DADD).

Genesis of the Program

The Chief of Naval Operations (CNO-N45) established the NSD Program to address Executive Order 12856 (1993) and, later on, Executive Order 13101 (1998). Those orders deal with reducing the amount of hazardous materials the government uses, and they mandate the review and updating of standardized documents to support that cause. The documents considered under the Navy's program include specifications, standards, common maintenance manuals, product descriptions, and in some cases, non-government standards (NGS).

In 1999, the Chief of Naval Operations transferred the centralized management of the program to the Naval Air Systems Command (NAVAIR), owing to its expertise in identifying and revising documents affecting hazardous materials throughout naval aviation. NAVAIR subsequently revised the program direction and established the team's new mission statement and goals. In essence, the NSD Program strives to reduce requirements for the use of hazardous materials throughout Navy standardized documents (such as specifications, standards, and manuals). In addition, it maintains databases of hazardous material information.

Process Elements

In pursuit of its newly stated mission and goals, the NSD Program began several efforts to gather standardized documents and analyze the need for revisions or updating. The following subsections describe the main elements of the process.

Technical Specification Assessment Team

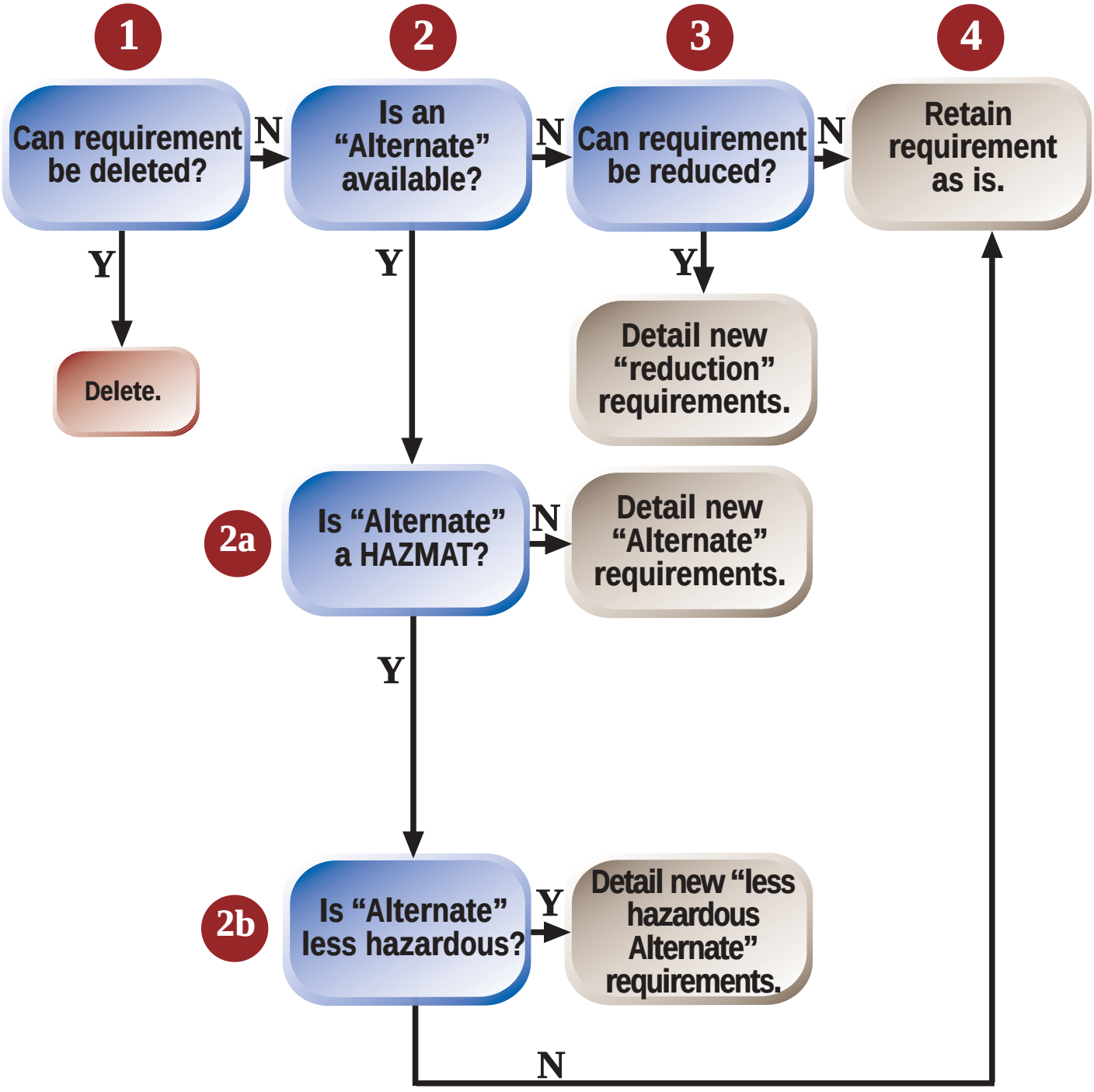


Figure 1. Decision Logic Flow Chart

Details NAVAIR Technical Specification Assessment Team systems approach for resolving materials requirements.

DOCUMENTATION SEARCHES AND ANALYSIS

We first examined existing sources of hazardous material data—in particular, the results of an Air Force project that electronically identified hazardous materials in all specifications and standards available in a digital format. The electronic search yielded 15,874 DoD specifications and standards found to have hazardous material references.

Next, using the combined results of the Air Force digitization and our preliminary review, the NSD team prioritized and technically reviewed 1,684 documents used in NAVAIR acquisitions or prepared by the Naval Facilities Command that actually required the use of hazardous materials. We performed technical reviews using a systems approach (Figure 1). Our reviews focused on whether the required hazardous material could be eliminated or reduced.

In addition to military specifications and standards, the team decided to review some key NGS. This step was necessary because DoD cites numerous NGS to convey requirements to contractors. Consequently, we reviewed 3,192 American Society of Testing and Materials (ASTM) standards to locate hazardous materials requirements. (We chose ASTM documents to review because they are the most widely referenced NGS in military specifications and standards.) We found 1,329 ASTM documents that require the use of hazardous materials.

ASSIST PROGRAM

The NSD team also used the data compiled in the Acquisition Streamlining and Standardization Information System (ASSIST). This automated program is maintained by the Document Automation and Production Service in Philadelphia, PA.

ASSIST provided the team with vital information on more than 110,000 defense and federal specifications, standards, and related standardization documents. For example, information for an extracted document includes such data as the specification number, title, document date, revision, preparing activity, and custodians.

HMIS DATA

The Hazardous Material Information System (HMIS) is another significant data source, maintained by the Defense Supply Center in Richmond, VA. It is a repository of Material Safety Data Sheets (MSDSs), which contain specification manufacturers and their product formulations. The product formulation information is important for consumable item specifications, because the document itself might contain no references to, or direct requirements for, hazardous materials.

Program Mission and Goals

The mission and goals of the Navy Standardized Document Program are as follows:

Mission:

Provide technical and centralized expertise for the reduction of hazardous material requirements specified in Navy-wide standardized documents (military and federal specifications and standards, common maintenance manuals, and non-government standards).

Goals:

1. Identify, analyze, and technically disposition textual and supplier formulation hazardous material requirements referenced in Navy standardized documents.
2. Update documents to reduce or eliminate hazardous material requirements as a result of team analyses, dispositions, or completed R&D advances.
3. Compile and provide access to all hazardous material information and team output using two team-developed databases: the DoD Acquisition Documents Database and HMAUL Analysis Tool.

Air Force Digitization Effort

In 1992, the Air Force completed its effort to digitize specifications and standards for all documents listed in the DoD Index of Specifications and Standards. This endeavor, performed at the request of the Defense Standardization Program Office, identified 15,874 documents referencing a total of 173,344 matching chemical search terms.

The NSD performed a preliminary review of the documents to verify the accuracy of the search output. For example, the chemical element "lead" is a hazardous material match, but the verb "lead" is not a match; the initial electronic search could not distinguish between the two. The NSD team weeded out these extraneous results.

The output of the Air Force digitization and subsequent fine-tuning via the NSD team review became the original baseline data for the DoD Acquisition Documents Database.

Other important elements of HMIS data are the national stock numbers (NSNs) for the consumable items and their corresponding specifications. A consumable item's national stock number is the vital link between the hazardous material and its use in the operational Navy environment. HMIS contains more than 182,000 relevant NSNs.

RESEARCH AND DEVELOPMENT

While many formal documentation revisions result from basic engineering analyses or technical reviews, R&D also plays a major role. NAVAIR's pollution prevention R&D program—formally known as the Aviation Pollution Prevention Technology Program, or APPTec—is also sponsored by CNO-N45. Besides furnishing document reviews and existing engineering solutions, APPTec is the key mechanism for developing new environmental solutions.

MAINTENANCE MANUALS INDEX

In a cooperative effort with the NAVAIR Lead Maintenance Technology Center for the Environment, we indexed more than 8,000 NAVAIR maintenance manuals in electronic format to identify which contain any of the 110,000-plus ASSIST specifications and 182,000-plus HMIS NSNs. This information is crucial in tying identified hazardous material specifications to the maintenance procedures requiring their use. Since the NSD Program is Navy-wide, we have also indexed Naval Sea Systems Command and Naval Facilities Command manuals, and ongoing efforts will include more.

Applying the Results

All of the above elements are building blocks for the NSD Program, and each plays a key role in meeting program goals. Data from digitization, preliminary reviews, ASSIST, and HMIS all aid in identifying requirements that use hazardous materials. However, NSD technical team reviews and assessments of those required hazardous materials provide the basis for many document revisions—and actually updating the standardized documents is one of the primary goals.

Early program initiatives focused on updating specifications and standards. However, to reduce the use of hazardous materials in the operational naval environment, the key documents for updating are the maintenance manuals. They provide the requirements for fleet personnel to use substances for scheduled maintenance on naval equipment and systems. That is why it is imperative to review and update the manuals to reflect initiatives for reducing hazardous materials. Specifications and corresponding national stock numbers for consumable items are the main link to hazardous material requirements in maintenance manuals.

To sum up our process, we must review specifications to determine the extent of hazardous material requirements. Then we must compare the

most current document information using ASSIST. Next it is necessary to further investigate hazardous material product formulation data using HMIS; actively monitor R&D initiatives in an effort to seek new solutions; and then review and analyze the maintenance manuals, so that one can actually reduce hazardous materials in the operational environment. Last, appropriate specifications and maintenance manuals must be formally revised—no small task.

Responding to Environmental Legislation

Although the information developed in the process outlined above is considerable, it all resides in a database developed and maintained by the NSD Program: the DoD Acquisition Documents Database. DADD is a user-friendly database application that encapsulates the sources used by the NSD, as well as the output from hazardous material reviews (Figure 2).

In essence, DADD enables the acquisition and standardization community to easily determine the impact of current and future environmental regulations. To see how useful this tool can be, take a hypothetical example of a new environmental regulation that bans the use of methyl ethyl ketone (MEK). Within minutes, DADD could identify the specifications—along with their dates, titles, preparing activities, and so on—that

- specify the use of MEK in their text (as well as the page and paragraph of the reference);
- are used to purchase products containing MEK as an ingredient, including the percentage of MEK in the product and the supplier's name, address, and phone number;
- are connected with current NAVAIR hazardous material R&D efforts to potentially remove the use of MEK; and

The Issue of Non-Government Standards

While DoD has identified hazardous material requirements within its own documents, little is known about non-government standards (NGS). It has become apparent that some NGS organizations have neither digitized nor searched their documents to identify hazardous materials.

This fact indicates that such organizations have no disciplined approach in place to react to, or assess the impact of, initiatives to reduce environmental hazards. Such a deficiency is a prominent issue for DoD, considering the advent of initiatives for acquisition reform that emphasize the use of NGS in place of military specifications and standards. To our knowledge, the NSD effort is the only one to have digitized and searched some of the key NGS for hazardous material requirements.

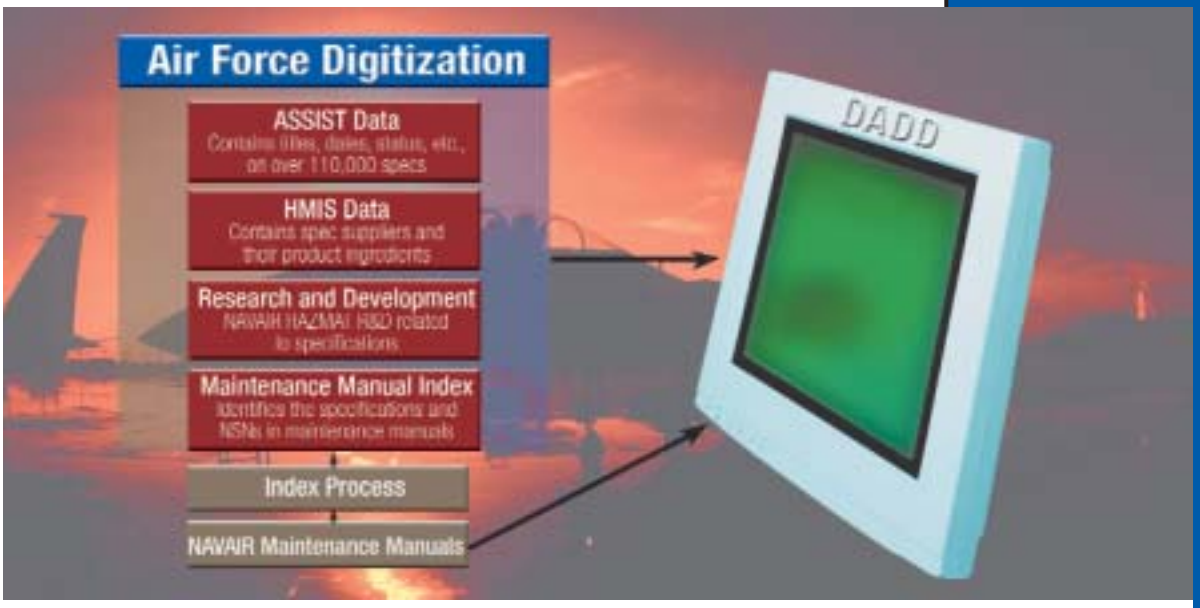


Figure 2. DADD Components
Details all related documentation information and related hazardous materials data.

Figure 3. Screen Shot

- are referenced in NAVAIR maintenance manuals, including the pages citing the specifications and the systems (for example, F-18E/F) the manuals fall under.

Figure 3 illustrates just part of the output that the DADD would produce. In this case, it has compiled a list of more than 3,000 requirement-specified products containing MEK. At the top of the screen image is a list of the products and the documents they appear in, their manufacturers, the MSDS number, and other data. The bottom part of the screen lists the ingredients of the selected product (in this example, a lacquer), as well as the percentage of the product consisting of MEK or other substances.

By integrating various databases into the DADD, the NSD has successfully developed a tool that can react to virtually any chemical-based environmental issue. Since the DADD also contains ASSIST data on all of the more than 110,000 DoD specifications, it can be used to manage standardization issues involving non-hazardous materials as well.

How the NSD Can Help You

The NSD can be used by all to improve the management of hazardous materials efforts—from incorporating the commonsense changes that are still needed, to tackling core research initiatives that target the more difficult challenges. If you see an opportunity or a need for change in how your organization handles its standardized documents, contact any one of the authors. You can truly be a part of saving the environment through standardization.

About the Authors

Bill Leach has worked at the Naval Air Systems Command in Lakehurst, NJ, for the past 16 years. He is the program manager for the NSD Program and team leader for the NAVAIR Fire Protection Team.

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A Study of Processes for Cleaning Military Uniforms

Environmentally friendly dry-cleaning technologies will contribute to a safer workplace and a cleaner environment

By Joseph Nilsen

Professional dry cleaners are one of the largest groups of civilian chemical users that come into direct contact with military personnel and their families. Commercial and government-operated cleaners are located at more than 500 U.S. military bases domestically and abroad (according to a 1995 DoD census report).

The primary process for cleaning military dress uniforms uses a chemical solvent, usually perchloroethylene, or "perc." In recent years, the Defense Supply Center, Philadelphia (DSCP)—whose responsibilities include procuring a wide range of medical, subsistence, general/industrial, and clothing services for the military—has become increasingly concerned about the exposures of military personnel and their dependents to hazardous chemicals at military installations. Therefore, as part of its broader pollution prevention and waste minimization programs, the DSCP undertook a study to explore the feasibility of replacing the traditional dry-cleaning solvents with environmentally preferable and commercially available alternatives.

DSCP's goal is to reduce the use of chemicals that are potentially harmful to human health and the environment. Reducing the use of hazardous chemicals also will reduce the costs of storing, transporting, and disposing of them. Another goal is to adopt the "Professional Garment Care" label that American consumers currently get on purchased apparel.

Overview of the Study

In 1992, the Environmental Protection Agency (EPA) established a partnership with the dry-cleaning industry and other stakeholders, including the DSCP, as a result of shared health and environmental concerns about perc—the chemical solvent used by most dry cleaners. The DSCP, a field command of the Defense Logistics Agency (DLA), is managing the study with technical support from EPA's Design for the Environment: Garment and Textile Care Program.

In general, the study, which is currently progressing to the Phase II level, involves cleaning standard military garments labeled "Dry Clean Only" in three professional cleaning processes: the traditional process using perc, a wet-cleaning process, and a process using liquid carbon dioxide. The garments are tested to identify how they may have been changed by the different processes. Phase I, completed in FY00, consisted of 10 consecutive cleanings using the three processes and visual appearance evaluations. Lansing Cleaners, a major

commercial dry cleaner in Lansing, IL, is cleaning the garments, and the DLA Physical Testing Analytical Laboratory is performing the tests.

To date, testing has been limited to appearance evaluations only. Phase II garments are in process at Lansing Cleaners, with testing expected to be completed by September 2003. The study may be expanded to include other new cleaning processes such as one using a silicone-based solvent.

Study Methods

DLA's Directorate of Clothing and Textiles supplied four identical sets of garments, selecting them from the same lot and contract to ensure uniformity of fabric and construction. The garments are a man's coat, a woman's skirt, a woman's slacks, and an all-weather coat (parts of Army green enlisted polyester/wool blend uniforms).

Joe Nilsen (left) and Tom Ustanik of Lansing Cleaners check one of the garments in the study.

To allow comparisons among processes, three of the sets of four garments are each cleaned several times using a different process. One set is cleaned using a perchloroethylene process; the second set is cleaned in a Unimac wet-cleaning system, and the third, in a Micare liquid carbon dioxide process. The fourth set of garments was set aside as standard samples for comparison with the other cleaned garments.

The study design calls for three rounds of cleaning and testing. Each round consists of cleaning the garments five times, then sending them to the DLA Physical Testing Analytical Laboratory. The standardized tests cover visual appearance, dimensional stability, color fastness, and break and tear strength.

All cleaning procedures, including detergents and additives, are industry standard for the processes tested. In order to employ real-world conditions, Lansing Cleaners handled, cleaned, and finished all test garments exactly as it would have done for a regular Lansing Cleaners customer. Altogether, the sets of garments will be cleaned 15 times, which is considered normal garment life cycle.

Results to Date

Phase II garments were sent to Lansing, IL, in December 2002, and are currently undergoing the cleaning process. When ready, they will be

tested for appearance, dimensional stability, color shade, and tear strength. Appearance evaluations have shown that the liquid carbon dioxide process caused the least amount of surface damage on the garments, while dry cleaning using perc caused the most damage.

In Phase III, the garments will be evaluated for shrinkage and color fastness. The DSCP also plans to test the effectiveness of the different processes on common stains such as coffee, ink, and others, which have not yet been determined.

Effect on Dry Cleaners at Military Sites

The study results will be used to support a DoD recommendation to place an instruction such as "Professional Fabricare" or "Professionally Clean" on the care label of selected military garments. Such labeling would officially allow dry cleaners that provide service to military personnel to use processes that are environmentally preferable instead of traditional processes using chemical dry-cleaning solvents. In addition, information collected in this study may be used as the basis for revising the military specification by replacing the term "dry cleaning" with a term such as "professional cleaning"; opening the door for use of cleaner technologies on military bases worldwide and on U.S. Navy vessels.

Professional cleaners at military sites will be able to offer cleaner technologies to their customers. The use of cleaner technologies will reduce dry cleaners' costs of complying with regulations concerning handling and disposing of regulated chemicals. By joining EPA and DoD in their commitment to safer and cleaner technologies, dry cleaners can maintain a competitive edge in the marketplace. By offering environmentally preferable process choices to their customers, dry cleaners can reduce the exposure of hazardous chemicals to their employees and reduce their operational costs and increase their profit while contributing to a cleaner environment and safer workplace.

As consumers, military personnel and civilians increasingly opt for "green" environmentally sound products and services. Dry cleaners that consider the health and environmental impact of their business decisions are more likely to sustain solid support from both their customers and neighbors.

About the Author

Joe Nilsen is a 19-year federal employee. For the last 12 years, he has worked in the Directorate of Clothing and Textiles at the Defense Logistics Agency's Defense Supply Center, Philadelphia, on issues regarding hazard minimization and the non-government standards program. He is a member of the American Society for Testing and Materials International and the American Association of Textile Chemists and Colorists.

Interoperability and Standardization Agreements

By John Tascher

In addition to highly trained, motivated athletes and crafty coaches, championship football teams share a common element for success. Their offensive squads effectively carry out their assignments as choreographed in the team's playbook by the coaches. Although each player has a unique assignment, when each fulfills that assignment, the play is effective and productive. On the best teams, where roles are clearly understood, the offense continues to function even when a substitution must be made. When the roles are not clearly understood or when one of the members of the team fails to follow the play as diagrammed, the offense usually does not advance and may even be thrown for a loss.

As high as the stakes may be in a championship football game, the importance of an agreed upon, clear set of procedures is even more critical for choreographing the combined operations of coalition forces, where the need for interoperability is paramount. To meet the operational goals of coalition and joint warfare, it is essential that U.S. and allied forces be interoperable.

Defining Interoperability

In recent years, many have come to think of interoperability as being able to communicate with each other and share information—but it means so much more than that.

Simply defined, interoperability is the ability of systems or key elements of systems to work with each other. Having the same size ammunition is essential, if we are to share ammunition. Having interoperable fueling nozzles and receptacles is essential, if we are to refuel each other's aircraft in flight. Having interoperable replenishment capabilities is essential, if ships from different nations are to transfer munitions and supplies at sea.

Although most would agree that interoperability is vital, it is a daunting challenge to achieve and maintain. This is where international standardization agreements (ISAs) can help.

Support for Key DoD Goals

Two key DoD documents define how we will conduct war in the future, how we will define our requirements, and how we will buy and support the major systems: Joint Vision 2020, and Chairman of the Joint Chiefs of Staff Instruction 3170.01A, "Requirements Generation System." Three of the basic tenets of Joint Vision 2020[1] depend on interoperability:

- Coalition warfare and joint operations will be possible only if our systems can work together.
- The success of future operations will depend heavily on information superiority—knowing things about the enemy, transmitting that information to our allies, and communicating a course of action. Information superiority is achievable only if we can all communicate with each other electronically, which requires interoperability of communications equipment and information systems.
- If we are to minimize our logistics footprint, we must do a better job of sharing parts, components, and subsystems. These elements do not have to be identical, but they do have to be interoperable.

To support those goals, the Joint Chiefs have made interoperability a key performance parameter in the operational requirements document for new weapons systems or major modifications. Program managers identify interoperability requirements and explain how they will meet them in their acquisition planning.

Promoting Interoperability

The Defense Standardization Program (DSP) does not dictate interoperability requirements, but it can assist with interoperability in many different ways.

To ensure interoperability with U.S. allies, program managers should identify any ISAs and their implementing documents that apply to the program. The DSP's network of experts can help with that. In many cases, these agreements require a supplemental implementing specification or standard. If one does not exist, the DSP can help identify appropriate resources in the military departments, other government agencies, and industry for developing one.

Beyond that, the DSP can help avert tunnel vision. Typically, program offices are most concerned with ensuring that programs conclude on schedule and within budget and that they meet the system requirements. This focus can unintentionally narrow one's view to only those options developed within the program office, overlooking solutions other programs may have already developed to meet a comparable need. One of the challenges for interoperability is to provide interface standards and hardware solutions that cut across such program stovepipes.

Developing specifications and standards under the DSP is a consensus process that involves many individuals in DoD, other government agencies, and industry. This process helps ensure that when we develop common technical solutions to common technical problems, they are documented and widely disseminated.

In addition, DSP documents enjoy widespread visibility. The DSP's most popular resource is the Acquisition Streamlining and Standardization Information System (ASSIST) database, which lists tens of thousands of government specifications and standards.

With the ASSIST database, users can view military specifications and standards online and download them. It also provides other useful information, such as points of contact for questions about a document, whether the document requires use of hazardous substances, and when the document was last updated. The database lists associated qualified products (if they exist) and tiered referenced documents, identifies implementing documents for many ISAs, and provides other information.

New Acquisition Tools

The Defense Standardization Program continues to search for and develop new tools to help program offices and others in the acquisition community. One currently under construction is the Program Manager's Tool (PMT) based on the work breakdown structure (WBS), which will identify ISAs and their implementing documents, as well as other specifications and standards required by statute or regulation.

The PMT will allow program offices to identify specifications and standards considered essential for interoperability, and to analyze the rationale for their use. It will also enable program managers to identify ISAs and implementing documents that apply to their programs. Because it follows the framework of the WBS, it will ease the review of thousands of ISAs—materiel, operational, doctrinal, and administrative—to determine which apply to the particular weapons system or subsystem.

The systems engineering process for a weapons system involves developing a WBS. Using the WBS as a starting point, program managers can quickly identify areas that need attention to see whether a weapons system will be interoperable with NATO or other partners. For a weapons system in development, the program manager or design team can make sure that it will be compliant.

Of thousands of materiel ISAs, many hundreds may affect any given weapons system. Program managers currently have no central repository of ISAs to consult, nor any categorizing of them according to the WBS. The Defense Standardization Program Office and the military services are putting all ISAs into

ASSIST. Each ISA and its implementing documents will be analyzed and categorized into the WBS framework.

Thereafter, a program manager will be able to enter the database and, for any given level in the WBS, get a list of all the ISAs that might impact a particular weapons system or subsystem and a list of all implementing documents. If the implementing document is a military specification or standard, the system will also contain a link to it.

More Selective ISA Participation

Since the advent of MilSpec reform, DoD has become much more selective about the ISAs it will support for development or ratification. Some in the acquisition community harbor a concern that some ISAs—both current and under development—are not or will not be useful in furthering interoperability.

For that reason, during this analysis of each ISA, the Defense Standardization Program Office, working with the military services, may recommend that the United States withdraw its previous ratification if a materiel ISA does not meet an interoperability or other pressing need. We also will be pushing to stop U.S. participation in developing and ratifying materiel ISAs that are not essential for interoperability or other purposes.

U.S. participation and ratification should be limited to ISAs that are necessary for at least one of the following:

- Supporting operational requirements needed to accomplish approved military objectives, missions, or tasks
- Ensuring interoperability for a "family of systems" or between systems, subsystems, or materiel among military treaty organization allies
- Meeting the goals of enhanced readiness, a reduced logistics footprint, complete supply chain visibility, improved transportation, or reduced and improved maintenance
- Ensuring safety.

By tightening our procedures to limit U.S. participation in the development and ratification of ISAs needed for interoperability, we will be able to free up resources for more useful purposes.

The more disciplined football team—the one that avoids distractions, follows its game plan, and properly executes the plays in its playbook—is the one more likely to make it to the league championship and, maybe, even win the Super Bowl. But this will happen only if the plays and the game plan were the right ones in the first place. In the case of coalition operations, the stakes are much higher and the need for cooperation and interoperability among coalition forces is much more critical than any game. So, too, it is even more important that we collectively focus first and foremost on developing the best possible international standards, and then on applying them in a disciplined, consistent manner, to put our forces in the best possible position to achieve victory on the battlefield.

About the Author

John Tascher is a member of the Defense Standardization Program Office staff.

[1]The Joint Vision 2020 goal is full-spectrum dominance—the ability of U.S. forces, operating unilaterally or in combination with multilateral and interagency partners, to defeat any adversary and control any situation across the full range of military operations. Further information can be found at http://www.dtic.mil/jv2020/.

The following is an excerpt from an October 2002 article published by the American National Standards Institute (ANSI) on its website: http://www.ansi.org/public/news.

STANDARDS ARE "SOLE" SUPPORTERS OF NEW YORK CITY MARATHON

Athletic Footwear Key for Success of Marathon Runners

It takes a brave and committed individual to train for and complete a marathon; long-distance running is a rigorous challenge for the both the mind and body. Over the course of 26.2 miles (the length of the entire marathon), a runner's feet will hit the pavement approximately 40,000 times. Due to this concentrated impact on a runner's feet, the most important piece of equipment for a marathoner is athletic footwear. Training, nutrition, and overall health will carry a committed runner through the course only so far, without the critical support of proper footwear.

Thanks to the efforts of members of the standards community, standards for use by the designers of athletic footwear can help to ease the tension and discomfort that may result during this long distance run, and perhaps improve performance. ASTM International, an ANSI member and ANSI-accredited standards developer (specifically, its committee F08 on Sports Equipment and Facilities), has developed a series of American National Standards (ANSs) for athletic shoes. [The ANSs] include F539-01, Standard Practice for Fitting Athletic Footwear; F869-01, Standard Terminology Relating to Athletic Shoes and Biomechanics; and F1976-99, Standard Test Method for Cushioning Properties of Athletic Shoes Using an Impact Test. These standards, in conjunction with work from organizations such as the International Organization for Standardization (reference ISO 9407, Shoe Sizes), help to ensure that shoes fit their runners well on race day and carry them over the finish line in comfort.

The following is the World Standards Day paper that won first place this year.
This paper is reproduced by permission of the Standards Engineering Society in cooperation with the U.S. World Standards Day 2002 Planning Committee. The paper was first published in *Standards Engineering, The Journal of the Standards Engineering Society*, Vol. 54, No. 6, November/December 2002. For membership information, contact SES, 13340 SW 96th Avenue, Miami, FL 33176

Standards During Times of Change: Aerospace Strategies for Keeping Standards and Business Linked

By Laura E. Hitchcock
Senior Standards Specialist, External Standards Management, The Boeing Company

Today, as the aerospace industry gears up to celebrate the 100th anniversary of powered flight, the world is a far more complex and technologically driven place than the one encountered by Wilber and Orville Wright. We went from Kitty Hawk to the moon in 66 years. Now, significant change is occurring in ever increasingly shorter time spans. The aerospace industry has become a global business, not just from the standpoint of those that use our products, but also as designers and producers of these products. And the world of standards plays a significant role in supporting this change. Like the business of building aerospace products, the business of standards must adapt to meet the demands of a changing environment. To do this, aerospace companies continue to evolve their strategies for the development, management, and use of their standards to successfully respond to and manage change.

Standards Strategies to Drive Quality Through a Complex Supply Chain

ISO 9000 changed the way the world looked at managing quality. But to implement ISO 9000, the aerospace industry required a new strategy for developing an international quality system and for implementing the standards required to successfully drive those changes down through one of the largest and most complex supply chains of any industry. The Boeing Company for example, has over 15,000 suppliers in over 80 countries. And those suppliers have suppliers. How the aerospace industry has addressed the need for global quality standards is becoming quite a success story.

Given that the members of the aerospace industry share the same pool of customers and suppliers, it only made sense to standardize on a single aerospace quality management system. The industry needed to get together and decide how best to implement the requirements of ISO 9000. Additionally, they needed to develop supplemental quality standards to accommodate the aerospace unique requirements demanded for the production of supremely complex, highly reliable products expected to perform over a long period of time (commercial aircraft have an expected life span of 50 years).

This challenge meant not only creating standards that met the needs of the aerospace industry, but also creating a new standards system in which to develop, promote, and implement these new quality standards. Boeing and other industry leaders had very specific requirements for the standards system needed to support a global aerospace quality system. It needed to be international in scope and membership. Industry wanted direct participation and wanted to include aerospace regulatory agencies and customers. It was critical that the system had a fast, responsive standards development cycle. And, most importantly, that the results were a single globally used and recognized standard.

While the industry was reluctant to create a new standards developing organization, there was no existing venue that met all the above requirements. So the industry went to three of the major aerospace standards developers and requested a special alliance to support a whole new standardization model. The result was the International Aerospace Quality Group (IAQG). The IAQG is a cooperative organization of the global aerospace industry. It is not a legal entity, but rather a dynamic cooperation based on trust between international aerospace companies for the purpose of establishing and maintaining

standards and initiatives to make significant improvements in quality performance and reductions in cost throughout the aerospace value stream. To facilitate its work and to take advantage of existing infrastructures, the IAQG is divided into three sectors: Europe, the Americas, and Asia; and is sponsored by three aerospace standards organizations: the European Association of Aerospace Industries (AECMA), the Society of Automotive Engineers (SAE), and the Society of Japanese Aerospace Companies (SJAC) (Figure 1).

FIGURE 1

This creative cooperative includes 47 of the largest members of the aerospace industry. The three regional sectors coordinate requirements for quality related standards and the results are then harmonized by the IAQG. The globally harmonized standard is then published simultaneously by each of the three sponsoring organizations. Thus, we have AS/prEN/SJAC 9100 which defines the additional requirements for an aerospace quality management system which must be addressed when implementing an ISO 9001:2000-based quality system. And each sector has then authorized translations by other standards developing organizations to provide language specific standards across the international community.

Developing a single aerospace quality system in just over a year, and follow-on quality standards in 9–12 months is quite an achievement. But the real power of the IAQG comes from the commitment of the member companies. There is a signed agreement of intent to implement the resulting IAQG standards by the upper management of all involved companies prior to the development of the standard. Since a standard only has value if it is used, the commitment to implement from the highest levels of the companies involved is the key to success. This is the first time in the aerospace industry that signed commitments from upper management were required prior to participation in the development of international standards. What's more, implementation statistics for each member company are tracked at every IAQG meeting. More than 60 percent of IAQG members have implemented the AS/prEN/SJAC 9100 standard internally and are flowing it down to their suppliers. Most members will require suppliers to comply by December 2003, consistent with the transition from the old ISO 9001 to the new version.

As AS/prEN/SJAC 9100 becomes established within the industry, the standard's benefits are becoming quite apparent. There is now a common industry voice to suppliers and a consistent set of expectations. The standard is non-prescriptive so it allows suppliers to implement best practices. There is a consistency in verification methodology and audit results can now be shared. The industry has developed a cooperative oversight process to assure the integrity of "other party" audits. Suppliers report a reduction in verification audits and, as a direct result, suppliers' customers are seeing a reduction in oversight costs and an improvement in supplier performance.

Aerospace manufacturers are also beginning to reap the benefits of this standards strategy. Industry leaders are projecting significant cost savings and reductions in variability through the implementation of a globally harmonized quality system. This is the power of a strategy that brings together an

entire community, forges alliances of standards developers, and solicits corporate commitment to implement standards to improve business.

Strategies for Managing Standards in a Virtual Product Enterprise

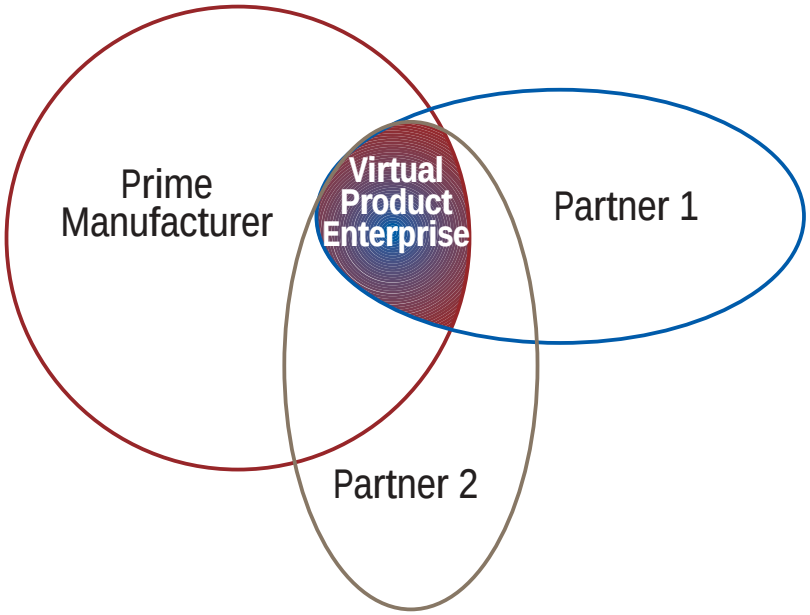
Aerospace products are huge, complex platforms requiring years to develop and billions of dollars of investments. Gone are the days when a single company will undertake to bring out a new aircraft (military or commercial) alone. Today's new products are being developed more and more by teams, not by individual companies, or even by individual countries. The result of this teaming is the creation of the virtual product enterprise—partners, electronically linked together in a shared collaborative environment to support the joint design and development of a specific product. This virtual product enterprise exists solely to produce a specific product, and companies teamed together on one product can be fierce competitors for another. The ability to collaborate has become the key to the success of an enterprise. And just as standards are vital to supporting the business of an individual company, they are critical to the business of these product partnerships. This means developing new strategies for managing standards in a virtual product enterprise.

In the past, negotiations between companies to establish a partnering relationship centered on things like work splits, cost sharing, patent rights, and final authority over design decisions. Today, standards are included as an essential part of the teaming arrangement. There is a recognition that the standards chosen during the design phase of a product and the system established for managing them will have significant cost implications which extend far beyond engineering and throughout the entire life cycle and support of the product. Because standards are called out on the product drawings and are an integral part of the Product Definition, which is what the Federal Aviation Administration (FAA) or the Department of Defense (DoD) certifies, each teaming arrangement must include a strategy for the management of standards data in a shared design environment which protects the data integrity, ensures configuration management, and results in optimum product quality. Such a strategy involves a number of decisions.

The first issue to be resolved is one of standards selection in a collaborative design environment. Which company has selection authority? Does the Prime Manufacturer have ultimate say over the choice of a standard or does each partner retain the right to choose the standards governing their part of the design? This issue feeds into the question of "Yours, Mine, Ours, or Theirs." The aerospace industry still relies heavily on company unique standards for parts, materials, and engineering processes. Will the Prime Manufacturer (the company ultimately responsible for the product definition and the holder of the Type Design Certificate) allow other companies' standards to be called out on the Prime's drawings? Or will all standards be converted into the Prime's standards, either directly or by cover sheeting? Another option is to create team specifications for use only on the specific product. This then brings up the issue of numbering. If company standards are cover-sheeted or converted into team specifications, how will they

FIGURE 2

The Standards Management Strategy for the Virtual Product Enterprise has a direct impact on business and the bottom line.



be numbered? Part numbers and material identifications are usually based on the standard's number. If the standard is converted to a team standard or coversheeted with a different number, there is now a disconnect between the standard and the part or material it defines in the shared collaboration environment.

Which selection strategy is chosen will have multiple maintenance implications. Configuration management—controlling and tracking all changes to the product definition and manufacturing process—is absolutely critical to the aerospace industry. If a standard called out as part of a product definition is changed in such a way that it impacts the product definition, the Type Certificate or Production Certificate for that product is jeopardized. In a worse case scenario, these Certificates can be revoked, production halted, and even all models of a product grounded. Imagine all Airbus 340s or Boeing 747s grounded because a critical standard used to build the plane was changed so it was no longer suitable for that design and the standards management system in place never caught the change. Ensuring a comprehensive standards management strategy is paramount.

So, if the Prime allows a partner's standards to be called out on an electronic product definition, what happens when the partner decides to revise that standard? If the standards called out on a product drawing—which is now a computer aided design model—are frozen at that revision level, then the opportunity is lost to benefit from any process improvements or best practices which are incorporated in later revisions of the standard. However, if the standard is not frozen, then what reporting mechanisms need to be put into place to ensure that the Prime and any other impacted partners, suppliers, etc. are notified of revisions? What approval or buyoff system needs to be established to ensure that the revised standard still meets the product requirements and what are the alternatives if a partner wants to change a company standard even though it won't then meet a particular program's needs? Of course, much of this can be avoided if an industry standard is used, since all partners have equal visibility and say in its revision. However, this choice carries its own implications in terms of the program's ability to codify proprietary materials or processes, or to quickly revise a standard to implement a change or address a production problem.

A final issue to be addressed by a standards strategy is access and distribution of the standards. Since design is now carried out in an electronic environment, using CAD/CAM tools and linking intranets over the web, how are the standards integrated into this? Are all the various standards, including a partner's company standards, placed on the Prime's web or does every partner get copies of all the standards to house internally? Is a separate Virtual Product Enterprise web environment created and all standards placed there? If these are company standards, are they copies of the originals back on the company sites (which then brings up the maintenance issue)? And how will these standards be passed down the supply chain?

As complex an undertaking as building an airplane or space vehicle is, managing the standards behind the product is every bit as challenging. Each of the

issues inherent in a standards strategy for partnering involves choices that carry with them pros, cons, and implications for other issues, which must be carefully weighed as part of the whole strategy. How well a company designs a standards strategy for a Virtual Product Enterprise plays a key role in the success, and profitability, of the resulting product. Having a well thought-out and defined standards strategy is critical to a successful design partnership and to avoiding a host of problems throughout the production and support life cycle of the product.

Strategies for Shifting the Standards Landscape with the Business Landscape

The aerospace industry is learning how to design, build, and market its products in ways different from ever before. It's also implementing change at a rate much faster than ever imagined. Information technology is now fundamental to all our business processes, it's a key component of our products, and it controls the environment in which our products operate. And to ensure that these new IT products and processes can be successfully—and profitably—integrated into aerospace products, the industry is having to evolve its strategies for standards development to include these new areas.

Information technology is taking the industry into areas that are not the domain of aerospace alone. Where once, a good portion of the technology used to build our products was ours to control, we're now utilizing and incorporating technologies which are used far beyond the aerospace industry, and what's more, were not even originally intended for use by aerospace. Information technologies, and the standards used to define them, are shared by a broad range of industries and products. Company specifications are no longer always an option. Participation in IT standards developing organizations is the fastest growing area of aerospace standards work. To ensure interoperability and interconnectivity, you must have standards. And moving outside aerospace dominated standards bodies carries with it the demand for new standards development skills. Participants must be able to articulate aerospace unique requirements in such a way that non-aerospace members will not only understand them, but also be willing to accommodate them.

In-flight entertainment systems are an example of an area where the aerospace industry is not leading the technology, but rather is trying to take advantage of all the innovations in personal entertainment equipment. But to do this, the industry has to drive some very special needs into the standards for these products and this technology. Personal DVDs, video games, rapid improvements in liquid crystal displays for small TVs are all happening outside of the aerospace industry. In the past, the entertainment system was hard-wired into the plane. This ensured that all components were controlled and did not interfere with the operation of flight critical electronics. However, that meant ripping everything out to install an upgraded system. The aerospace industry has had to develop new standards for interconnectivity—connectors, wires, power systems—to allow airlines the ability to choose their entertainment systems and upgrade them when they wish without

radically impacting cost or the functionality and integrity of the aircraft itself.

Computer modeling and simulation are two more areas aerospace is increasingly using. But it will take the development of a whole range of industry standards to move these technologies out of the labs and "special project status" and into the production world. Standards strategies are targeting key areas that will pull these systems together and allow them to operate in huge distributed networks.

Information technology will improve the convenience of air travel for the passenger. The aerospace industry is now working with the banking industry to develop standards for smart cards containing biometric data which would allow a trusted traveler to be identified and pre-cleared for customs, check-in and increased security. Again, a strategy involving a technology, and an alliance, not thought of ten years ago.

And finally, there is the area of global connectivity—allowing passengers to stay connected even from 35,000 ft. Systems like Connexion by Boeing are being installed in aircraft to allow passengers real-time connection to the Internet and e-mail. And to support this new demand by the flying public, aerospace companies are populating the standards forums dealing with the Internet and sitting side-by-side with members of other industries, such as automotive, who want the same for their customers.

Information technology and systems integration capability are opening the way for the industry to dramatically change the environment in which our products operate. Air traffic management systems are moving to rapidly incorporate advances in IT. Global positioning satellite systems and terrain mapping databases will allow aircraft to operate with more efficient routings and much more safely.

And probably the best demonstration of the impact of information technology is for integrated defense—where aircraft, spacecraft, unmanned vehicles, and ground equipment are all linked together to provide our defense systems the ultimate in information superiority. Data from surface, air and space systems will be merged and transmitted throughout an information network in a huge integrated system of systems. And it will be standards that ensure that every element in this system is able to process, send and receive information. Aerospace companies are strategically placing their experts at the tables to ensure that standards for the interoperability and interconnectivity of these technologies are developed.

Information technology has forced the aerospace industry to change its business models—its products, processes, in sum, its vision. It will change the way we control airplanes, the way we move people through airports, and how we keep them connected. And as information technology continues to radically change the world and our industry, it is imperative that we have the foresight and the strategic planning to ensure that we are a part of defining the standards that will enable these new technologies.

The key for an aerospace manufacturer in ensuring cost-effective adoption and

integration of these technologies is recognizing where they can take the company and its products and then getting in on the development of the standards that define these technologies. Otherwise, adopting products and systems not developed solely for aerospace means kludges, patches, and lots of expensive customization. The successful company, the one with the competitive edge, is the one whose strategies include shifting standards development work to support its shift in products and processes.

Strategies for Developing, Managing, and Using Standards Must Continue to Evolve

The aerospace industry is about the future—it always has been and always will be. Our heritage has been to reach beyond our grasp—to the skies, to the moon, to the solar system, and beyond. And we've taken our standards with us. Technology has made these journeys possible. But standards help make them practicable. In order to support these technological advances and keep our balance through all the changes, we've had to develop new standards and new ways of managing the business of standards.

The keys to strategically using standards to implement and manage change (as illustrated in the examples above) are simple to articulate, but often difficult to implement:

- Understand the changing requirements of your business
- Understand how standards can support these changes
- Utilize existing infrastructures whenever possible, but don't hesitate to change them if needed
- Understand teaming and alliances in the business world and understand the impact of partnerships on standards systems
- Search for the standards angle in everything that your company does. Don't let standards be an afterthought as you move to embrace new technologies, but incorporate standards as a key part of your company's business strategy.

The company that can successfully utilize and manage standards as it negotiates the range of changes needed to survive in today's global market will have a powerful tool for success.

The aerospace standardization system has always responded to new technical and managerial problems. Though standardization will probably never make front page news, those who have a stake in the future of the aerospace industry realize they cannot afford to be unaware of the standards system, the challenges it faces, and the key role standards play in ensuring our business continues to forever reach for new frontiers.

Aerospace Systems Vehicle Institute

DoD is a participating member in the Aerospace Systems Vehicle Institute (AVSI). A fast-track cooperative, AVSI was formed in 1999 to "facilitate cooperation between industry, government, and academia to dramatically reduce life-cycle cost and accelerate development of aerospace vehicle systems, architectures, tools, and processes."

Administered by the Texas Engineering Experimental Station of Texas A&M University, AVSI conducts specific projects, jointly funded by members, with the following objectives:

- Develop new value-added systems architecture and components
- Foster creation of standard systems architectures
- Create a financial and technical "critical mass" of industry members
- Use a "lean" management style/philosophy.

In projects underway at AVSI, much of the effort is focused on electronics due to the rapid changes occurring in modern components, assemblies, and systems. The following are the titles of three current projects:

- Mitigating Radiation Effect on Current and Future Avionics Systems
- Methods to Account for Accelerated Semiconductor Device Wearout
- Thermal Management of COTS Based Avionics.

DoD's interest and active participation in AVSI projects is essential if our warfighters are to achieve and maintain excellence in the complex military and aerospace world of the 21st century. For more information, please contact Joe Chapman—the point of contact for DoD participants in AVSI projects—at (915) 697-9970 or jvchapy @aol.com.

March 31–April 3, 2003, Phoenix, AZ
National Defense Industrial Association 2003 Interoperability Conference

The second annual Interoperability Conference will be held March 31–April 3, 2003, at the Hilton Phoenix East/Mesa, Phoenix, AZ. For more information or to be added to the mailing list, contact Derek Jenks at (703) 247-2582 or e-mail djenks@ndia.org.

May 4–7, 2003, Washington, DC
Electronic Industries Alliance 2003 Annual Spring Conference

The EIA is holding its spring conference on May 4–7, 2003, at the Grand Hyatt, Washington, DC. The conference brings together chief executive officers and senior managers from EIA's 2,300 member companies, which represent the entire scope of the high-tech industry. For questions, contact Gail Tannenbaum at gtannenbaum@eia.org.

May 12, 2003, Long Beach, CA
Society for the Advancement of Material and Process Engineering Spring Meeting

SAMPE is looking forward to its spring meeting, which is being held in Long Beach, CA, starting May 12, 2003. Founded in 1944, SAMPE is an international education and scientific association dedicated to the advancement of new materials and processes. The Society sponsors technical conferences and exhibitions and publishes proceedings, technical books, and other documents. SAMPE's 34th International SAMPE Technical Conference (ISTC), held in November 2002, was very successful. Allan Goldberg, Cochair of the 34th ISTC, stated that "this was one of the largest exhibits ever for an ISTC, with over 600 people attending both the technical program and exhibits area."

Exhibit space is still available for the spring meeting. Call Rosemary Loggia, Exhibits Manager, at (626) 331-0616, ext. 601.

October 27–30, 2003, King of Prussia, PA
DoD Maintenance Symposium and Exhibition

SAE International is hosting a DoD Maintenance Symposium and Exhibition. The symposium will be held October 27–30, 2003, at the Valley Force Convention Center, King of Prussia, PA. This symposium will focus on "Maintenance—Turning Logistics Resources into Readiness." For information about the symposium and exhibition, visit the SAE webpage at www.sae.org.

Australian Department of Defence Team Visits DSPO

Karim Abdian, Army Departmental Standardization Officer, along with John Logan, Fire Support Systems Specialist Engineer, and Terry Dowling, both from the Australian Department of Defence, Defence Materiel Organization, Land Systems Division, Land Engineering Agency, visit with Gregory Saunders, Director, Defense Standardization Program Office (DSPO).

During their visit to DSPO, Mr. Logan and Mr. Dowling received a briefing on DoD standardization and the overall standardization strategic plan. Australia is restarting its Defence Materiel Standardization Program and has established a Defence Materiel Standardization Committee, with representatives from each of its services. Both Australians were delegates to the 6 QWG Mats, the international forum that met to discuss and develop materiel standardization. While in the United States, Mr. Logan and Mr. Dowling also visited the Army's Picatinny Arsenal. Australia's Department of Defence wants to gain from the experience of their American allies on key issues and establish contacts that will be mutually beneficial.

New DISA Standardization Executive

Frank M. Holderness is the new Standardization Executive at the Defense Information Systems Agency (DISA). A member of the Senior Executive Service, Mr. Holderness is the new Principal Director for Interoperability. Formerly, Mr. Holderness was the Chief, Plans, Concepts and C2 Applications, and Chief, Office of Spectrum Analysis and Management, Operations Directorate, DISA. Before joining DISA, he was the Army's Spectrum Manager in a dual-hatted position, as the Director of Army's Communications-Electronics Services Office (CESO) in the Office of the Director of Information Systems for Command, Control, Communications and Computers, Headquarters, Department of the Army. Mr. Holderness also served as the Deputy Director of the Army, Sustaining Base Systems Division, C4 Modernization and Integration Directorate, and as the Spectrum Manager of the U.S. Army Forces Command in Atlanta, GA.

A native of Kenosha, WI, Mr. Holderness attended the Milwaukee School of Engineering and the University of Wisconsin-Milwaukee. He served in the U.S. Army in various assignments, including overseas tours of Germany, Vietnam, and Okinawa. Other assignments included tours with the 5th Infantry Division, III Corps Artillery, and the 101st Airborne Division.

In private industry, Mr. Holderness worked as an international sales representative for Snap-On Tools Corporation and as a spectrum management engineer on the Electromagnetic Compatibility Analysis Center contract at the Illinois Institute of Technology, Research Institute.

New Navy Standardization Officer

Captain Michael G. Ahern, SC, USN, is the Navy's newest Departmental Standardization Officer. He is also serving as the Navy Standardization Executive until someone is appointed. This will be a busy time for the Navy's newest member because the Navy's Standardization Office reports to the Deputy Assistant Secretary of the Navy for Logistics (DASN-L) and has moved from Crystal City to the DASN-L offices in the Pentagon.

Captain Ahern received his commission through Officer Candidate School, Newport, RI, in 1980. For his first tour, he served as Assistant Supply Officer aboard the USS *Buchanan*; many tours followed. From 1994 to 1996, Captain Ahern was assigned overseas duty at the Fleet Industrial Supply Center, Guam. He was initially assigned as Freight Terminal Director, but later served as the Customer Service Director. Captain Ahern reported to the Naval Air Systems Command for a 3-year tour in the V-22 Program Office as the Deputy Program Manager for Business and Financial Management.

In 2000, Captain Ahern was ordered to the USNS *Concord* as the Officer-in-Charge, and after an East Coast to West Coast ship swap, he served as the Officer-in-Charge of the USNS *Spica*. His personal awards include the Defense Meritorious Service Medal, Meritorious Service Medal, Navy and Marine Corps Commendation Medal, and the Navy and Marine Corps Achievement Medal.

Captain Ahern is a member of the Navy Acquisition Professional Community, a member of SOLE, and a Certified Professional Logistician. He holds a Bachelor of Science in business administration from John Carroll University, Cleveland, OH; a Master of Science in management (logistics and systems inventory management) from the Naval Postgraduate School, Monterey, CA; and a Master of Science in national resource strategy from the Industrial College of the Armed Forces, Washington, DC.

Editor's Corner

Sharon Strickland
Defense Standardization Program Journal

As we go to press with this issue, filled with articles on interoperability, I am very aware of just how rapidly our military is changing and working with our allies to fight terrorism and our enemies. As the editor of the *Defense Standardization Program Journal*, I am very proud of the authors because they worked hard to get this information to you—the readers. I welcome your comments.

I am also very proud of our warfighters that are already abroad or leaving daily to stand and deliver. My neighbor, Captain Adam Points, has orders for Kuwait and, like others in our nation, we are proud of him but fearful of what could happen. I have known Adam since his birth and watched him grow into this wonderful, witty, and very intellectual young officer. He is with the 3rd Armored Division, Fort Stewart, GA. His father, a former Marine Corps officer, and his mother know that their son, like other sons and daughters, are ready to serve our nation. I assured his parents that our standardization community, and the many other DoD workers that support our services, have done their best to make sure Captain Adam has equipment to protect and defend himself as he serves his nation. I thank you—our standardization community—for all that you constantly do so well to care for our warfighters.

More Retirements

Andrew D. (Andy) Certo finally did it—he retired January 3. Andy, former Director, Defense Standardization Program Office (DSPO) from the mid-1980s until 1998, has moved on to a whole new world called retirement. Since he keeps in touch with many of us, we know he is very busy on new projects. Andy will be honored during the evening reception, March 4, at the 2003 DSPO Symposium, at the OMNI Shoreham Hotel, in Washington, DC. That's Andy's style—just mingle with his former colleagues and chat. We wish him a lifetime filled with happiness and good health.

We wish hail and farewell to four DLA members of our standardization community: James Gambert, DSCC; Carl Muncie, DSCC; Danny Long, DSCR; and Tom Kenny, DSCR. We knew these people well, and they will be missed!

The Army's Shirley Bentley retired. Another talented member of our standardization community, Shirley had been at Redstone Arsenal for a long time. We will miss calling her and seeing her happy face at meetings. She wanted a simple farewell and she exited quietly, but as her friends, we wish her a great retirement!

Fond Farewells

Cary Anderson, a longtime member of our standardization community, has been reassigned from the Operations Support Command, Rock Island, to the TACOM Rock Island, Ground Support Industrial Enterprise. Many of us went on TDY with Cary, and we always looked forward to working with him. TDY with Cary was fun. Cary, good luck in your new position!

Scott Robinson recently left NAVSEA standardization team to join NASA. He will be working as a program manager in NASA's Facilities Engineering Division. The staff at NAVSEA standardization sent me the notice on Scott's farewell. They wrote, "Although the NAVSEA Standardization Team shares in Scott's happiness as he embarks on new adventures, we are yet saddened by his departure. Our best to Scott as he continues to spread his wings and soar to higher heights." Well, I can't write any farewell better than that. Good luck, Scott.

Warm Welcome

Ricky Williams, AMSOS-PBQ, will assume Cary Anderson's position. Cary wrote that Ricky is a great person and that he is looking forward to the challenges. Ricky will be working for Greg Zelnio, who is replacing George Rivard as the Operations Support Command Senior Engineer. Ricky can be reached at DSN 793-6501 and e-mail: williamsr@osc.army.mil. We look forward to meeting Ricky at future meetings.

Passing

We say goodbye to the Air Force's Joyce Williams, a former supervisor, Specs and Standards Group, Wright-Patterson AFB. Joyce had retired from the group in the early 1990s after 39 years of government service.

Upcoming Issues—
Call for Contributors

We are always seeking articles that relate to our themes or other standardization topics. We invite anyone involved in standardization—government employees, military personnel, industry leaders, members of academia, and others—to submit proposed articles for use in the *DSP Journal*. Please let us know if you would like to contribute.

Following are our themes for upcoming issues:

Issue	Theme	Deadline for Articles
October–December 2003	Voluntary Standards	May 15, 2003
January–March 2004	Army Standardization	August 15, 2003
April–June 2004	Logistics	November 15, 2003
July–September 2004	Standardization and Contracting	February 15, 2004

If you have ideas for articles or want more information, contact Sharon Strickland, J-330, Defense Standardization Program Office, J-3, 8725 John J. Kingman Road, Stop 6233, Fort Belvoir, VA 22060-6221, or e-mail her at sharon.strickland@dla.mil.

Our office reserves the right to modify or reject any submission as deemed appropriate. We will be glad to send out our editorial guidelines and work with any author to get his or her material shaped into an article.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