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Interoperability

Managing DMSMS for F/A-18 Hornets Sold to Other Countries

ISO 8000

The Migration to Tactical Data Enterprise Services

Defense Standardization Program Journal

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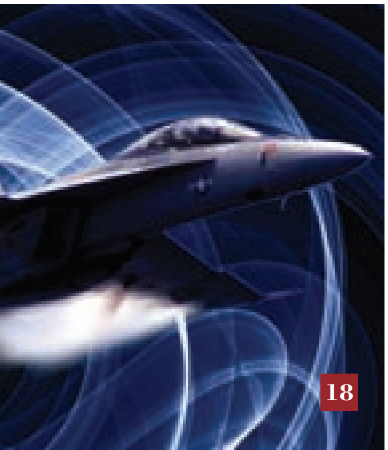

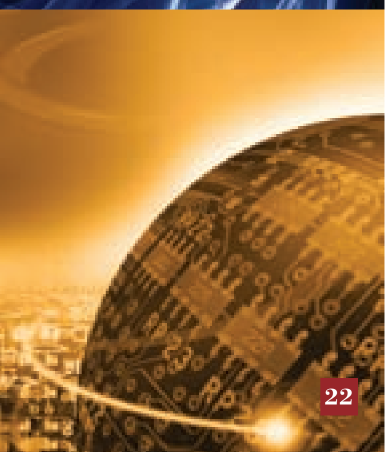

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Director's Forum

Interoperability is a perfect theme for the *DSP Journal*; standardization and interoperability are two sides of the same coin. This issue also announces a compelling business case for enterprise-wide access to non-government standards (NGSs), a topic of high-level interest in DoD.

Interoperability is increasingly important as joint operations of our forces and greater integration with our allies become necessary to conduct the complex military operations required in the 21st century. Interoperability is much more than just making things fit together. Our systems and our warfighters must effectively operate together to maximize the probability of mission success while minimizing the risks and danger to people and equipment. DSP is committed to making systems work together and to ensuring that we continuously improve how well they work together. Interoperability is manifested in many different ways. Interoperability is enabling forces throughout a theater to communicate effectively whether within a small team, among our military services, or with our allies. Interoperability is transmitting signals that enable friendly forces to distinguish friend from foe. It also is enabling U.S. tanker aircraft to refuel British aircraft, enabling the ammunition manufactured in one NATO nation to be used in the weapons of the other nations, and enabling soldiers of other NATO nations to read the maps produced for U.S. soldiers.

Recognition of the role and importance of interoperability has grown dramatically over the last three decades. This growth is in part a result of failures and lessons learned in Somalia, Bosnia, Iraq, Afghanistan, and other conflicts where joint and coalition operations are essential. Interoperability has become a significant requirement in virtually all systems being developed or upgraded.

What makes interoperability possible? We have been on a course of growing interoperability beginning in the late 1700s when Eli Whitney refined and applied the concept of uniformity that enabled the production of 10,000 muskets using interchangeable parts. The bureaucrats of the day scoffed at the idea, but Whitney demonstrated to President John Adams that the concept would work. He showed Adams that randomly selected parts would fit together as a whole working musket. Although there is disagreement about the veracity of the story (some say that the parts were custom manufactured and selected to ensure interchangeability), there is no disagreement that it was this insight that greatly fueled the industrial revolution and ultimately the development of production lines. The interchangeability of parts allowed for the development of a system of spare and repair parts that resulted in faster and more reliable equipment maintenance and repair.

Gregory E. Saunders
Director
Defense Standardization Program Office

The earliest interchangeability relied on the most fundamental form of standardization—commonality: items being made to the same dimensions, from the same materials, and usually with the same manufacturing methods. The concept of interchangeability has since evolved to one that allows for tremendous flexibility and innovation, all while retaining form, fit, and function. NATO defines standardization as commonality, interchangeability, and compatibility. These all lead to interoperability: the ability for systems to work together.

In this issue, several articles demonstrate both how important interoperability is and how far we have come. In "Joint DMSMS Mitigation Capability," you will learn how sharing data on Diminishing Manufacturing Sources and Material Shortages is helping to address DMSMS issues. In "Managing DMSMS for F/A-18 Hornets Sold to Other Countries," you will learn how sharing information about DMSMS issues, solutions, and mitigation approaches is crucial to maintaining interoperability among the U.S. military services and our coalition partners. In "ISO 8000: Leading the Way in Data Quality," the authors illustrate how that ISO standard provides a broad platform for interoperability. Another article, "Using the Semantic Web for Interoperability and Chaotic Data," shows how the Semantic Web, enabled by specifications, will lower the barriers to interoperability regardless of the data sources or destinations. "Migration to Tactical Data Enterprise Services" shows how technical data services are critical to joint and allied operations throughout the transformation to new networking capabilities. This issue also has two other articles you may find interesting. One addresses value engineering solutions to DMSMS problems, and the other discusses an approach to fostering adoption of hydrogen fuel cells.

Enterprise-wide access to NGSs is of high-level interest in DoD because of the potential for substantial savings. DSPO has long recognized the economic benefits of enterprise-wide (command-wide, if not DoD-wide) access to NGSs. Now, the Army Materiel Command (AMC) has successfully developed a business case to achieve that goal.

Earlier this year, I discussed the benefits of participating in NGS activities. One very important benefit is gaining a place at the private-sector standards table and having the opportunity to influence the shaping of industry standards that will meet DoD requirements. However, a reality of this participation is that DoD, along with everyone else, has to pay for the standards it contributes to developing. The price of the standards, however, is just the tip of the iceberg in regard to the cost associated with acquiring NGSs. When a DoD activity either buys an NGS individually or acquires these documents through contracted services, additional administrative and overhead costs are tacked onto the acquisition. For years, our office recognized this resource burden and, in 2003, began an earnest examination of the feasibility of consolidating NGS purchases. We knew consolidated access was possible because NASA had been using this approach for a few years. NASA ensured its success by building a compelling business case for consolidated document access. Our initial DoD-wide access survey and subsequent findings indicated DoD could anticipate an overall cost savings of 50 percent; however, the price tag for achieving these savings would be in the area of $5 to $10 million. Unfortunately, although the idea of DoD-wide access to NGSs was broadly supported, no funding source could be located to undertake such an initiative. Likewise, several services saw the financial benefits of pursuing consolidated service-wide NGS access, but for a variety of reasons, most of their efforts proved to be less than totally successful. Recently, however, after a months-long effort, AMC achieved success, developing a business case to overhaul its process for procuring NGSs and parts information. Now, instead of having multiple document access contracts, AMC has awarded a contract to a single document provider; the contract is estimated to save AMC $1 million per year in procurement costs.

I urge you to read about AMC's project (in Program News). The sooner you understand AMC's approach, the sooner you may be able to take advantage of the potential cost savings.

Joint DMSMS Mitigation Capability

Expanding Critical Support to Foreign Partners

By Susan Dadey and Bill Hayes

Achieving interoperability among the military services and coalition partner nations is one of the most daunting challenges faced by DoD. The interoperability challenge applies in many areas, including Diminishing Manufacturing Sources and Material Shortages (DMSMS). Considerable progress has been made on increasing the sharing of DMSMS data—including DMSMS analyses, solutions, and mitigation approaches—among the disparate information systems of the various U.S. military services and DoD-related manufacturing and supply industries. However, very little progress has been made on security cooperation, which includes foreign military sales (FMS). Any DMSMS issues related to DoD systems apply to the broader population of similar systems sold to other countries via the FMS program.

Multiple methods are used to leverage DMSMS information to monitor maintenance and other readiness indicators in support of the management and mitigation of obsolescence. However, these capabilities are not available to all potential users across the international military enterprise. The Joint DMSMS Mitigation Capability (JDMC) is designed to offer a wide range of DMSMS management capabilities to joint and allied customers.

Challenges

The primary challenge related to data interoperability with foreign nations is the level of disclosure authorized for specific data related to operations, training, maintenance, and so on. Disclosure of data to foreign countries is controlled in various ways. The Arms Export Control Act governs the export of defense articles and services to international organizations and foreign countries. The act authorizes controlled articles in the U.S. Munitions List, which is contained in the International Traffic in Arms Regulations (ITAR). ITAR, which is maintained by the U.S. Department of State, also contains rules and regulations concerning export controls and licenses. Depending on the status of countries' relationships with the United States, different levels of data can be provided based on the sensitivity and classification of the data and the data's relationship to the military programs. This exchange of data is considered to be technology transfer and can range from a government sale of a weapons system and its associated parts, training, and manuals to trade fairs, exhibits, and air shows.

The disclosure of DMSMS data necessitates determining the level and detail of data authorized to be provided to the specific country while complying with ITAR guidance and ensuring that only authorized personnel receive, use, and protect access to the data under the same rules as those used for DoD information security. DMSMS data normally consist of information related to specific piece-parts that are obsolete or being phased out of production. When those parts are related to a specific weapons system, however, the data become sensitive and subject to tighter control. Under DoD's FMS program, data disclosure decisions are made when the FMS case is initiated, so the releasability level of DMSMS data is already determined, which makes data control and access more manageable.

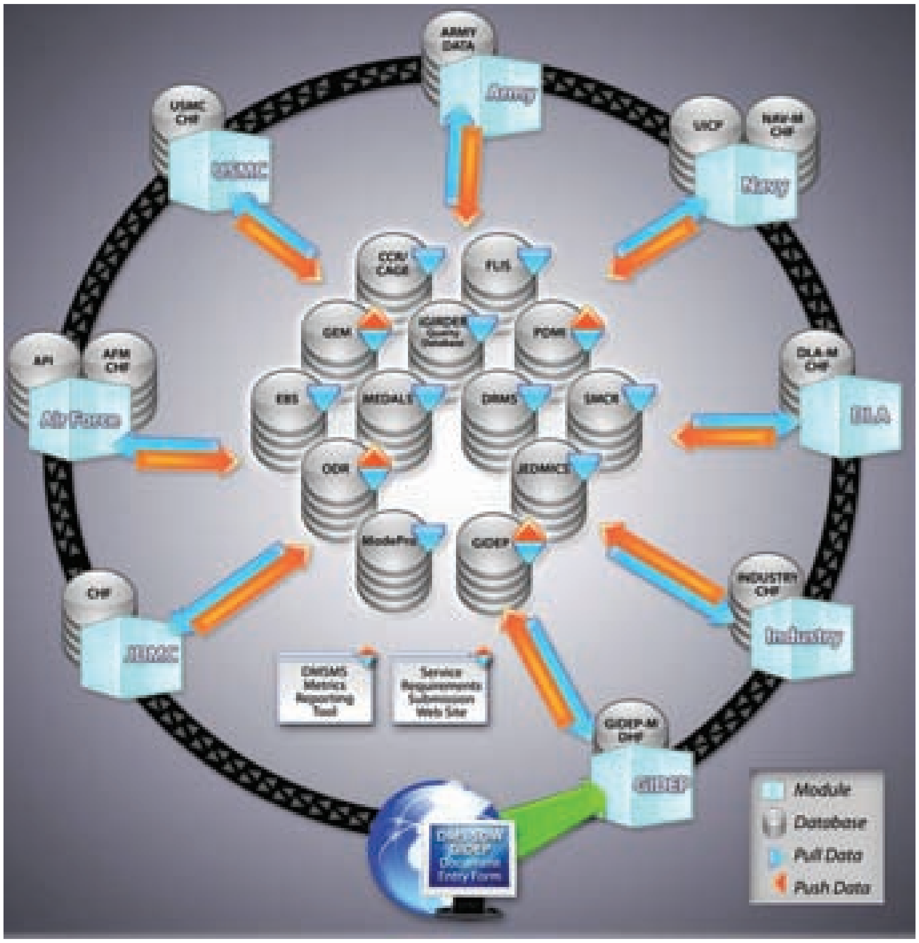
A secondary challenge concerns the existence of bills of materials (BOMs) or parts lists related to a specific weapons system. Many weapons systems do not have BOMs, because the BOMs were not procured by DoD, or the BOMs are not in an electronic format. To seamlessly relate part discontinuation notices to a weapons system BOM, the BOM must be created or modified in the correct format and placed in a data repository.

DMS SDW Overview

To improve the sustainability of weapons systems for the military services through effective identification and management of DMSMS parts, DoD established the Diminishing Manufacturing Sources Shared Data Warehouse (DMS SDW) Enterprise. The DMS SDW consists of a complex system of case management modules, data stores, and common-use tools configured and connected for interoperability to communicate notice, case, and DMSMS resolution data to each other via web services. Initially, the Defense Logistics Agency (DLA), Defense Supply Center Columbus, Navy, Marine Corps Logistics Command, Air Force Materiel Command, and Government-Industry Data Exchange Program (GIDEP) sponsored their respective portions of the DMS SDW Enterprise.

Figure 1 is a graphical representation of the DMS SDW. Currently, GIDEP receives notices of discontinuance from original equipment manufacturers and sources of supply. Considering these notices, GIDEP issues DMSMS notices that are distributed electronically to the DMS SDW case management modules at the appropriate DLA or service obsolescence management activity. The DMS SDW provides access to current and legacy obsolescence data for resolution and management of DMSMS cases. The case management modules allow the data to be gathered within the Obsolescence Data Repository (ODR), a central repository housed within GIDEP. Obsolescence management activities and military services can access this shared information to assist their business processes and facilitate workflow toward ongoing DMSMS case resolution. GIDEP also hosts the Metrics Reporting Tool, which facilitates the development and reporting of both standardized DMSMS metrics and custom reports.

FIGURE 1. DMS SDW Enterprise



Notes:

AFM = Air Force Module
API = Applications/Programs/Indentures
CAGE = Commercial and Government Entity
CCR = Central Contractor Registration
CHF = Case History File
DHF = Document History File
DLA = Defense Logistics Agency
DLA-M = DLA Module
DMS SDW = Diminishing Manufacturing Sources Shared Data Warehouse
DRMS = Defense Reutilization and Marketing Service
EBS = Enterprise Business Systems
FLIS = Federal Logistics Information System
GEM = Generalized Emulation of Microcircuits
GIDEP = Government-Industry Data Exchange Program
GIDEP-M = GIDEP Module
iGIRDER = Interactive Government and Industry Reference Data Edit and Review
JDMC = Joint Depot Maintenance Command
JEDMICS = Joint Engineering Data Management Information Control System
MEDALS = Military Engineering Data Asset Locator System
NAV-M = Navy Module
ODR = Obsolescence Data Repository
PDMI = Product Data Management Initiative
SMCR = Standard Microcircuit Cross-Reference
UICP = Uniform Inventory Control Point
USMC = United States Marine Corps

JDMC Approach

The JDMC is a secure, web-enabled application that allows FMS customers access to data relating to weapons systems they have previously purchased from the United States via the FMS program. The project is sponsored by DSPO, with technical expertise provided by the DoD DMSMS Data Interoperability Working Group. The information technology design, development, and integration are being managed by the Johnstown, PA, office of Concurrent Technologies Corporation.

The JDMC will leverage and integrate DMSMS tools, processes, training, and tracking capabilities. Access to both public and private data (sensitive, proprietary, and so on) will be controlled and adjusted, depending upon the information accessed and level of authorization. FMS customers need obsolescence data, obsolescence notifications, a means to respond with requirements for obsolescence issues, DMSMS data, training, and tools. The JDMC will allow those customers to support the weapons systems platforms they have purchased with less direct assistance from DoD FMS contracts.

Using the existing infrastructures implemented with the DMS SDW, the JDMC is designed to offer a wide range of DMSMS management support to joint and allied customers. The specific research and development concepts supported by JDMC include DMSMS organizational interaction, BOM analysis and management, knowledge interchange, and training and education. Because of U.S. laws and regulations concerning the transfer of technology and information to foreign countries, individual countries' access allowances and requirements must be carefully examined, and innovative protocols must be developed to allow foreign customers to access a wide range of DMSMS tools and capabilities.

To fully support and satisfy FMS customers, the JDMC will focus on four main areas: utilization, awareness, access, and training.

UTILIZATION

Utilization addresses the basic area of understanding the FMS customer's needs, implementing the most effective solution, and making the solution user friendly and practical enough that the customer will make use of it. It should provide the capability for a customer to work a complete DMSMS case, from obtaining a parts list, to completing a health assessment, to researching aftermarket part availability. The integration of DMSMS tools with the Security Cooperation Information Portal (SCIP) will allow this to happen seamlessly. This integration will also allow for users to be directed to other sites, without a need for multiple user names and passwords or for logging in to each site.

AWARENESS

Awareness through outreach efforts is key to keeping users abreast of emerging capabilities and improvements in the realm of DMSMS management. Users must be advised of emergent tools and processes available to be accessed, as well as the level of access based on the disclosure permissions related to a specific country and specific FMS programs.

ACCESS

Access to private areas pertaining to parts lists, BOMs, country-specific data sharing, and so on will be controlled by SCIP and access permissions established based on countries' FMS cases and tied to specific weapons systems. All countries may, of course, access public areas, such as training, policy, and procedures.

TRAINING

Training will be tailored and provided to all customers (U.S. and foreign) based on identified needs. The provision of training via computer-based distance learning will ensure that the training is accessible to all FMS customers.

"Quick-Hit" Application

For an initial demonstration of the basic JDMC, Concurrent Technologies Corporation designed and developed a quick-hit application using FMS case information as the controlling aspect for data release to the foreign user. The quick-hit JDMC application has the following characteristics:

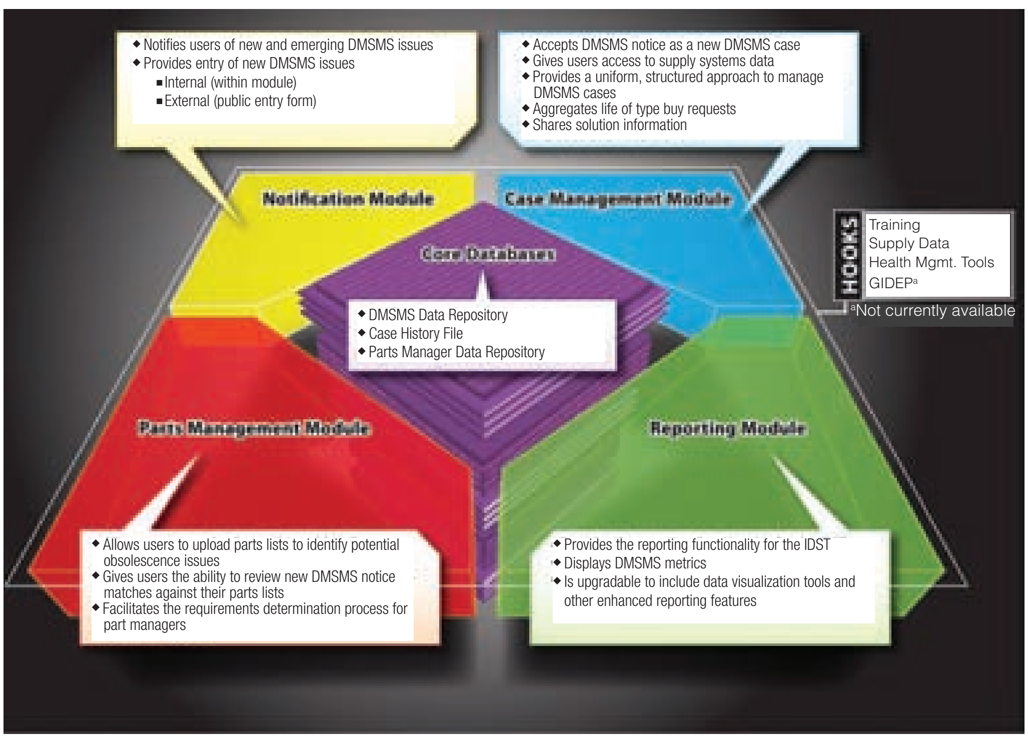
- User profiles differentiate U.S. government and foreign users. The profiles are used to set permissions related to the customer country and FMS case identifier. Users and their relationship to FMS cases must be approved by the U.S. administrator for the particular weapons systems.
- BOMs or parts lists can be uploaded to the system from a BOM repository designed and established as part of the quick-hit application. All uploaded BOMs must be reviewed and approved by the U.S. administrator.
- Uploaded BOMs are automatically screened against the ODR for any DMSMS case information and against any new discontinuation notices received by GIDEP. Any positive hits against either the ODR or GIDEP alerts generate an alert e-mail to both the U.S. administrator and the country user.
- For part numbers that have ODR matches, users can drill down to get specific information such as case manager and resolution data relating to the DMSMS case. Details concerning other part numbers listed on the GIDEP notices are also available.

Next Steps

The JDMC project continues to add capabilities and functionality. Capabilities developed for the DMS SDW case management modules are being considered to allow FMS support personnel to seamlessly interface with the DMS SDW Enterprise. Additional next steps include allowing FMS support personnel to seamlessly interface with the DLA module and provide FMS customer country parts requirements back to DLA item managers. Numerous issues remain concerning access to data not controlled by FMS cases and how the disclosure approval process will work. However, the JDMC design allows flexibility to adapt to a specific business process.

In addition, work remains to integrate JDMC with various obsolescence management tools, which depends greatly on individual customer preference. Countries have also expressed an interest in implementing their own "mini" DMS SDW, which would provide similar capabilities that DoD has without the concerns of data sharing or storage. This Integrated DMSMS Support Tool (IDST) would also allow countries to work DMSMS issues with weapons systems procured from other than U.S. sources. Figure 2 depicts the IDST concept.

FIGURE 2. IDST Concept



Conclusion

JDMC is the first attempt to share DMSMS data with foreign countries via a web-enabled process that is based on the DMS SDW. It is also the first attempt to create a BOM repository. To date, JDMC has been quite successful and has received considerable interest by our foreign partners. In this ever-changing world of achieving critical interoperability, this capability is impressive and promises to lay the foundation for even greater partnering as the DMS SDW Enterprise expands from national to global.

About the Authors

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Bill Hayes is a logistics specialist with Concurrent Technologies Corporation. A retired Navy Supply Corps officer, Mr. Hayes has expertise in both DMSMS and security cooperation. He has coordinated all aspects of Navy logistics policy related to security assistance and foreign military sales.

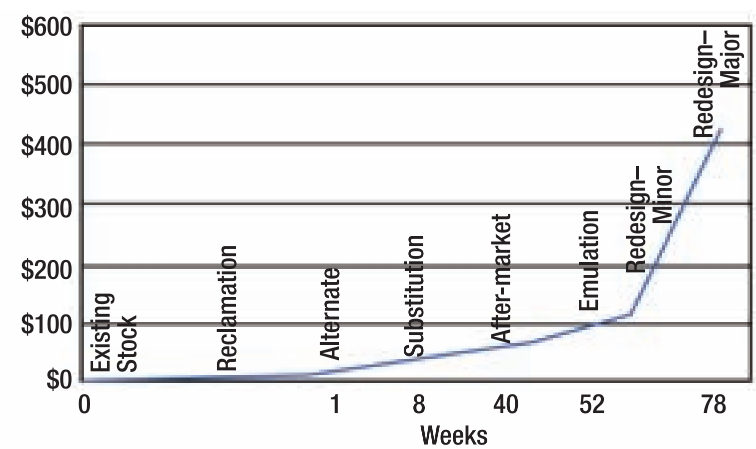
Value Engineering Solutions to Problems with Diminishing Manufacturing Sources and Material Shortages: Part 1

By Danny Reed and Jay Mandelbaum

An article in the January/March 2009 *Defense Standardization Program Journal* described a synergistic relationship between value engineering (VE) and Diminishing Manufacturing Sources and Material Shortages (DMSMS). It described similarities between the DMSMS risk management process and VE. The article concluded that VE is ideally suited for resolving DMSMS issues. Specifically, the DMSMS community identifies problems, and the VE community develops innovative solutions to those problems and also identifies funding options. This article illustrates that conclusion with some real-world examples of solutions that have no or low nonrecurring engineering costs and can be implemented quickly (8 weeks or less).[1]

As shown in Figure 1, four solutions meet those criteria: existing stock, reclamation, alternate source, and existing substitute. The examples in this article deal with three of them. No separate example is provided for an alternate source solution because of its similarities to the existing stock solution. The alternate source solution involves finding a part in production elsewhere whose form, fit, function, and interface make it a qualified replacement, such as a superseding part listed in a specification or standard. The drawbacks to this solution are similar to the existing stock solution as well. The new supplier may charge a higher price and may or may not continue producing the part for as long as it is needed by DoD. (From a VE perspective, the alternate source approach is different from the existing stock approach in two ways: the alternate source solution requires some limited engineering investigations and testing of form, fit, function, and interface; and VE may be used to increase the efficiency of the new supplier's production process.)

FIGURE 1. Cost and Time to Resolve DMSMS Problems, by Solution Type ($ thousand)



Source: Defense Standardization Program Office, *Diminishing Manufacturing Sources and Material Shortages: A Guidebook of Best Practices and Tools for Implementing a DMSMS Management Program*, SD-22, September 2009.

The following sections illustrate the power of VE in addressing DMSMS problems. Examples include both value engineering proposals and value engineering change proposals (VECPs). Although some of the examples may not apply to a DMSMS problem per se, the situations are analogous. In every case, VE was used to find another way to acquire expensive, hard-to-obtain parts in the same way that DMSMS approaches look for alternative ways to acquire potentially unavailable items or materials.

VE Contributions to an Existing Stock Solution

An existing stock solution to a DMSMS problem is one in which the current supplier uses on-hand inventories or agrees to continue to produce the item in question. We discuss the former situation first. In that situation, a large-quantity purchase is made in one of two ways:

- Life-of-type purchase—procurement of a sufficient quantity of the DMSMS part to support full production plus repair for the expected life cycle of the system
- Bridge purchase—procurement of enough of the DMSMS item to meet demand until another solution is implemented.

Although often used, a quantity purchase has some drawbacks. Costs for material management (including packaging, storage, transportation, shelf life, and upkeep of the inventory) must be considered. In addition, it is difficult to estimate demand accurately, especially for a life-of-type purchase. Frequently, items are retained in the operational inventory well beyond their originally expected life. When that occurs, the life-of-type purchase could be inadequate. On the other hand, if too many are purchased, there is waste associated with the excess inventory.

Example of VE Contribution to an Existing Stock Solution: Navy Standard Missile

The Standard Missile is a surface-to-air air defense weapon. Its primary mission is fleet area air defense and ship self-defense; its secondary mission is anti-surface ship warfare. Due to reduced program funding, the Navy halved its Standard Missile procurement rate, which had the potential to cause a DMSMS problem with radomes, which, under this particular missile program acquisition, are a high-cost item with high charges per lot.

The radome covers the radar on the outside of the missile. Radomes must be capable of withstanding high heat and acceleration while allowing signals to penetrate without distortion. Few suppliers are capable of machining the radome to make it smooth and distortion free, because this process is complex.

If the radomes were to be purchased and finished on the revised procurement schedule, the unit price would increase by 50 percent due to production slowdown. Because radomes do not change, the Navy wanted to make a quantity purchase to reduce the overall cost. In that way, the radome supplier would be able to level production to the quantities required for succeeding fiscal years. It would also be able to optimize manufacturing setup time, allowing savings to be passed to the contractor. However, the Navy did not have the resources to pay for the quantity purchase in the current fiscal year.

The contractor had the latitude to use its own funds to make the quantity radome purchase, but according to Federal Acquisition Regulation pricing principles, the contractor would be required to sell the radomes back to the Navy at the price paid, thus eliminating a return on investment for the contractor. Moreover, the contractor would incur inventory holding costs and lost opportunity costs. To address these issues, the contractor used a VECP. (The belief that a VECP requires a change in a specification is mistaken; it requires only a change in the contract.) Specifically, the contractor requested a contract modification of the business arrangement with an agreement on sharing future savings without any technical change to the configuration baseline. The contractor submitted the VECP on DD Form 1692, "Engineering Change Proposal." On Block 30 of the form, Configuration Items Affected, it entered "None." On Block 31, Effects on Performance Allocations and Interfaces in System Specification, it entered "This change will have no effect on the end item's system performance. This Value Engineering Proposal simply allows [the government] to take advantage of the substantial cost savings obtained by the multi-year contract that [the contractor] has negotiated."

Using the VE clause enabled the contractor to make the quantity purchase, manage the inventory, and sell future radome lots back to the Navy at the lower bulk-buy price, thus leading to significant savings. This particular case led to a total savings of $1.2 million, shared equally by the contractor and the Navy.

Value engineering has the potential to incentivize the contractor to perform the material management function and solve short-term budget problems associated with a quantity purchase. This potential is demonstrated in an example involving radomes for the Navy's Standard Missile. This example was enabled by a long-term relationship between the government and the supplier. In effect, the government had an opportunity to take advantage of a short-term opportunity for savings, but did not have the funding available. If VE had not been used, the government may have been put in a position where it would be forced to deal with speculators who buy inventory and sell it at a large profit. The example shows how using VE could allow the government to pay for a quantity purchase over time on future contracts rather than all at once on the current contract. In effect, the government provided the contractor with a forward pricing agreement based on shared VE savings.

In some cases, the supplier may agree to continue production of the DMSMS part. If costs remain competitive, there are no special or unique VE implications unless the supplier uses VE to improve production. Unfortunately, that is not always the case. The supplier may charge a premium price for continuing production of a marginally profitable (or unprofitable) item over an indefinite period. This situation typically drives DoD to make a quantity purchase as described above.

VE may contribute to the existing stock approach in one additional situation: startup of an inactive production line for an item. Situations arise in which the government pays the contractor to store old production equipment, test equipment, components, and so on, in case it is necessary to restart production. For example, this was done for the Phoenix missile. Exercising such an option would offer many opportunities for VE along the lines discussed in this article.

VE Contributions to a Reclamation Solution

A reclamation solution examines marginal or out-of-service equipment or supplies as a potential source of DMSMS parts. Another reclamation possibility is equipment that is in long supply, perhaps as a result of a planned product improvement or modernization effort in which baseline equipment could be cannibalized to address a DMSMS issue.

One potential drawback to reclamation is the condition of the reclaimed parts. They may be unserviceable or damaged. Also, a reclamation effort probably represents only a short-term solution to the DMSMS issue except in very unusual circumstances such as extremely low demand.

Value engineering can play an important role in making reclamation feasible, as demonstrated in the example of the reclamation of M106 8-inch high-explosive artillery projectile scrap steel for use in the Army M795 projectile.

Example of VE Contribution to a Reclamation Solution: Army M795 Projectile

The M795 is a 155-millimeter high-explosive artillery projectile with a high-fragmentation steel body. It provides increased effectiveness against major ground-force threats at greater ranges for anti-personnel and anti-materiel targets when compared to older 155-millimeter projectiles. Because of a worldwide scrap steel shortage, the contractor for the M795 program was finding it difficult to maintain a single source for M795 steel.

A VE study was initiated to develop a process to reuse the steel from a large stockpile of surplus M106 8-inch projectile shells stored openly at McAlester Army Ammunition Plant. The steel could not be reclaimed directly, because the projectiles contained trace amounts of explosives. The M106 projectiles were scheduled for demilitarization.

As a result of the VE study, a process was developed to decontaminate and mill the surplus M106 projectiles to reclaim the steel. This steel was then used as a constituent in the raw material for the manufacture of the M795 projectiles. M795 production costs were decreased, because the cost of the process to provide the raw material needed for production was below the purchase cost on the open market.

In addition to benefiting the M795 program, this VE effort reduced the demilitarization stockpile, reduced demilitarization costs, and eliminated the hazardous open storage of M106 projectiles at McAlester Army Ammunition Plant. Total cost avoidance savings in FY06 for the 197,000 projectiles processed amounted to $9.2 million.

(This example was adapted from the Army's FY06 special VE award nomination.)

VE Contributions to an Existing Substitute Solution

An existing substitute solution is one in which a part that is currently being produced for a different application is used to resolve the DMSMS issue. An existing substitute part must be capable of performing fully (in terms of form, fit, function, and interface) in place of the DMSMS part. In some cases, the part must be modified to make it a fully capable substitute for the DMSMS part. This may increase nonrecurring engineering expenses. A drawback of this approach is that the resolution may be temporary if market conditions do not have a favorable outcome for the new source. In addition, expenses will be incurred for qualifying and testing the substitute item, and the unit cost may be higher.

VE function analysis identifies viable options for items that can be used as substitutes and incentivizes the prime contractor to invest in them. This area probably represents the most prevalent use of VE for weapon systems. The Navy Phalanx example illustrates the point. It also illustrates the opportunity to make other desirable changes at the same time:

- Some of the changes may not have been economical to make on a standalone basis.
- The marginal cost of making the changes may be minimal when done in conjunction with the VE project.
- Some changes may be funded by the VE savings.

Thus, in the example, the cost of the commercial derivative joystick was in reality less than the $2,100 quoted. Similarly, the cost of the military standard controller was greater than $7,600.

Example of VE Contribution to an Existing Substitute Solution: Navy Phalanx

The Phalanx Close-In Weapons System is a fast-reaction, rapid-fire 20-millimeter gun system that provides Navy ships with a terminal defense against anti-ship missiles and fixed-wing aircraft that have penetrated other fleet defenses. It can also be used against small gunboats, standard and guided artillery, and helicopters. Phalanx uses advanced radar and computer technology to locate, identify, and direct a stream of armor-piercing projectiles to the target. The Navy awarded a contract to retrofit Phalanx with a manual controller to direct fire against targets of opportunity.

Using VE function analysis, the contractor identified an opportunity to replace a military standard fixed hand controller (similar to a joystick) with a derivative of a commercial unit not built to military standards. On its own initiative, the contractor worked with the commercial source to produce a modified unit and tested the unit against the requirements for the military standard version. Considering the test results, the contractor had confidence that the commercial derivative would meet all of the technical requirements at a lower cost. Therefore, the contractor submitted a VECP to replace the standard military controller with ruggedized commercial derivatives. The military standard controller would cost $7,600, while the commercial derivative costs only $2,100. Because each gun requires three controllers, the net savings are $16,500 per system. Approximately $2 million in savings were shared by the Navy and the contractor. Eventually, the Navy may save more than $9 million if the new controller is applied to all ships. In addition, the VECP provided for earlier implementation of the improved system.

Both in this case and in general, additional changes identified through VE can be designed to mitigate other potential DMSMS issues.

Conclusions

A proactive management strategy is an important aspect of minimizing the impact of DMSMS problems. Such a strategy identifies potential issues with sufficient lead-time to implement mitigating actions. But proactive management is not enough. Solutions must be developed and implemented before readiness decreases or excessive costs are incurred. This article and its predecessor illustrate how the robustness of the VE approach, combined with cost-sharing incentives for industry, can make an important contribution to determining such actions.

Because of the contribution of VE, DMSMS leaders in the military departments and defense agencies could disseminate information to programs in the field about VE options. For example, material could be distributed to field managers concerning VE capabilities. Guidance could be issued to recommend that field managers contact a VE advocate for their organization. Trained VE facilitators could be made available to help develop mitigation approaches. A typical scenario for doing this is in the context of a VE study. Study objectives would be defined in an information-gathering phase. A VE workshop would then be conducted to examine the problem in depth. VE tools such as function analysis would be used to pinpoint the most fruitful areas to address. Creative brainstorming would identify a large number of options, the most promising of which would be evaluated and recommended, as appropriate, in later phases of the study.

This approach combines the analytical skills and subject matter expertise of the DMSMS community and other technical and managerial elements of the program with the professional problem-solving skills of the VE community. Such a partnership enhances the likelihood of successfully mitigating DMSMS issues.

[1]This article was adapted from Institute for Defense Analyses Document D-3598, *A Partnership between Value Engineering and the Diminishing Manufacturing Sources and Material Shortages Community to Reduce Ownership Costs*, Jay Mandelbaum, Royce R. Kneece, and Danny L. Reed, September 2008.

About the Authors

Danny Reed and Jay Mandelbaum are staff members at the Institute for Defense Analyses, supporting the Office of the Secretary of Defense. Dr. Reed leads initiatives on value engineering and reduction of total ownership cost. Previously, he worked for 27 years on manufacturing development for the F-16 program at Lockheed Martin.

Dr. Mandelbaum leads technology research focusing on readiness assessments, quality assurance, and systems engineering. He has spent 30 years in the federal government.

Managing DMSMS for F/A-18 Hornets Sold to Other Countries

A Model for Joint Platform-Level DMSMS Mitigation

By Greg Geiger

DoD has long had a foreign military sales (FMS) program for selling U.S. defense equipment to other countries. However, until recently, very little progress has been made on sharing information about managing Diminishing Manufacturing Sources and Material Shortages (DMSMS) affecting the equipment sold via the FMS program. Sharing information about DMSMS issues, solutions, and mitigation approaches is crucial to maintaining interoperability among the U.S. military services and coalition partner nations.

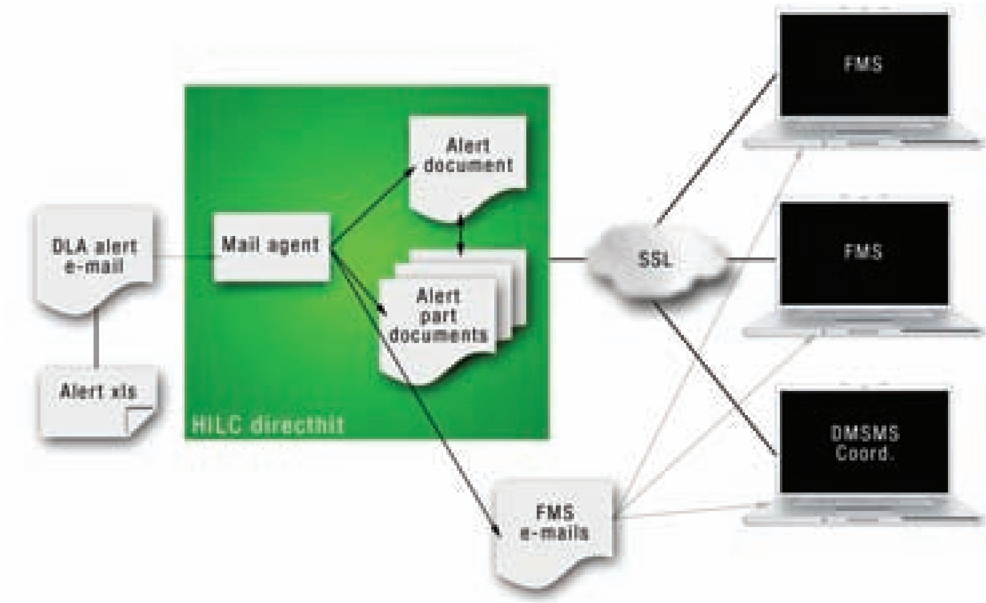
The Naval Air Systems Command (NAVAIR) has addressed the challenges of managing DMSMS for FMS programs at the platform level, specifically, the F/A-18 Hornet, which has been procured by seven FMS customers: Australia, Canada, Finland, Kuwait, Malaysia, Spain, and Switzerland. The F/A-18 FMS Product Support Team Leader (PSTL) team is working to implement both a reactive and a proactive approach to managing DMSMS for the seven F/A-18 FMS programs.

Reactive Approach

Historically, the Naval Inventory Control Point (NAVICP)—after screening DMSMS alerts from the Defense Logistics Agency (DLA) for platform and FMS applicability—has sent the alerts via e-mail directly to FMS program points of contact (POCs). Little, if any, communication occurred across programs and system teams to verify the alerts and find alternative solutions. The reactive approach involves managing DLA's DMSMS alerts pertinent to the F/A-18 FMS programs in a central information management system called the Hornet International Logistics Community (HILC) directhit DMSMS module, or HILC directhit. The F/A-18 FMS PSTL team implemented HILC directhit as an approved, secure website designed to store, communicate, and mitigate DMSMS alerts from a single location. Access to the HILC directhit website and its information is controlled by the F/A-18 FMS PSTL team and the F/A-18 FMS program teams.

Figure 1 is a high-level view of the DMSMS alert information flow enabled by HILC directhit. As the figure shows, DLA's alert e-mails are sent from NAVICP directly to the HILC directhit server. Using a mail agent, the information in the alerts is parsed into a database within HILC directhit. HILC directhit then automatically sends the alert information to the respective F/A-18 FMS programs via e-mails containing links to the HILC directhit website. Distribution lists, as well as the feedback from the countries using DMSMS alert task forms, are maintained within HILC directhit.

FIGURE 1. Information Flow: DLA DMSMS Alerts to F/A-18 FMS Programs



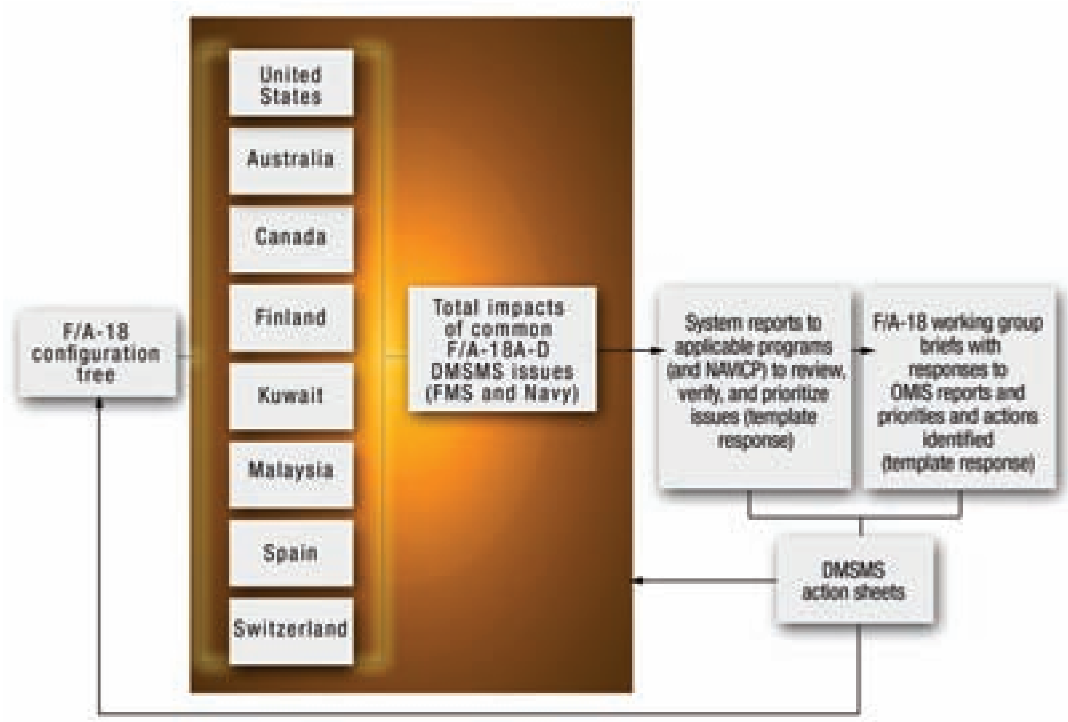
Proactive Approach

The proactive approach being used by the F/A-18 FMS PSTL team for the F/A-18 FMS programs involves using DMSMS predictive tools and working to mitigate potential DMSMS issues as an F/A-18 community instead of by individual program teams. Because the FMS fleet makes up close to 40 percent of the entire F/A-18A-D fleet, integrating the F/A-18 FMS programs is a critical component in the arena of DMSMS mitigation.

NAVICP chose the Obsolescence Management Information System (OMIS) as the tool to manage DMSMS for the F/A-18 FMS programs. To date, NAVICP has loaded data on 19 F/A-18 systems into OMIS. Over the past 3 years, the F/A-18 FMS PSTL team has screened the health analysis reports from the OMIS database for these 19 systems and delivered applicable DMSMS information to the F/A-18 FMS programs. However, this screening process for FMS applicability is extremely time consuming. The PSTL team's goal is to automate this screening process within the OMIS tool and HILC directhit through the use of FMS configuration trees. Figure 2 depicts the concept. The configuration trees will be used to screen the OMIS database electronically and to develop DMSMS health analysis reports that apply to country-specific FMS programs. The F/A-18 FMS PSTL team will have visibility of all DMSMS issues and will be able to work common DMSMS issues across the F/A-18 FMS programs.

Another effort being implemented by the F/A-18 FMS PSTL team to proactively manage DMSMS for the FMS community involves improving the integration of DMSMS issues affecting FMS programs and DMSMS issues affecting the Navy system teams. The PSTL team chose the F/A-18 radar system as the model to use for identifying DMSMS issues being experienced by the Navy, identifying the effects on FMS programs,

FIGURE 2. Information Flow: F/A-18 DMSMS Information to FMS Programs



and working as a community to find common solutions. The Navy radar system team identified the potential DMSMS issues, provided this information to FMS customers for review, and requested each FMS program to provide the F/A-18 FMS PSTL team with information on demand rate per year, life cycle, spares, maintenance concept, and a subject matter expert POC. After the responses are received from the FMS programs, an action team, including the subject matter expert POCs, will be formed to analyze the information and work on common solutions. All information pertaining to these potential issues will be distributed and maintained via HILC directhit.

Next Steps

The F/A-18 FMS PSTL team continues to develop and implement reactive and proactive processes for managing DMSMS across the F/A-18 FMS programs. These processes will be further refined and, eventually, replicated across the other NAVAIR FMS platforms. These efforts at the platform level will be critical in implementing DMSMS programs for FMS across system commands and DoD.

About the Author

Greg Geiger has more than 12 years of experience supporting NAVAIR FMS programs in the areas of acquisition and logistics. Currently, he is the F/A-18 FMS PSTL overseeing NAVAIR logistics support for Australia, Canada, Finland, Kuwait, Malaysia, Spain, and Switzerland. Mr. Geiger chairs the Hornet International Logistics Community Conference and Workshop and the DoD DMSMS FMS Interoperability Committee/Working Group, and he recently became a member of the DoD DMSMS Executive Board.

ISO 8000
Leading the Way in Data Quality

By Steven Arnett

I imagine anyone reading this article has heard a lot lately about data quality. It is a subject that has had quite a bit of attention in recent years as enterprises become more and more dependent on their information systems and have come to realize how vital data quality is and—conversely—how expensive bad data quality can be. Furthermore, as organizations have converted their systems to enterprise resource planning systems and connected to the World Wide Web, it is more important than ever to be able to send and receive high-quality data. Data quality has become an issue in DoD no less than it has in industry. Equally important within DoD has been the idea of adopting commercial standards and integrating with industry to the extent that it makes economic and mission sense.

Fortunately, a standard has come along during the past couple of years that will help DoD both achieve better data quality and become more integrated with industry standards. That standard is ISO 8000, which has the name, simply, of "Data Quality." With support from the Defense Logistics Information Service (DLIS) and NATO Allied Committee 135 (AC/135), ISO 8000 is being developed by ISO Technical Committee 184 (TC184), Subcommittee 4 (SC4). TC184, which is responsible for developing and managing standards for industrial data, comprises representatives from countries and companies throughout the industrialized world. SC4 manages ISO Standard 10303, "Product Data Representation and Exchange," and ISO Standard 22745, "Open Technical Dictionary." ISO 10303, first developed during the 1980s, has become the worldwide standard for the exchange of design engineering data. The idea behind ISO 22745 was to develop an international standard for cataloging items based on the Federal Catalog System, managed by DLIS, and the NATO Codification System, managed by AC/135. ISO 22745, in turn, became the foundation upon which ISO 8000 is being built.

ISO 8000 specifies criteria for data quality, including categories for syntax, semantic encoding, provenance, accuracy, and completeness that define requirements for the exchange of master data between organizations and systems. The term "master data," as defined by ISO 8000 as well as by ISO 22745, refers to all the data needed by an organization for its operations and processes. The key idea behind both standards is a common system for naming and describing items, including services (even human resources), using computer-sensible codes to identify names and properties. For example, a washer can be called many different names, including shim, spacer, and disk in English and innumerable names in other languages. In a world with millions of items of supply that can be purchased by many different buyers from many different suppliers, it is crucial to be able to identify and describe items in a way that bridges the ambiguity of language.

ISO 8000 Basics

ISO 8000 lays out the principles of data quality, the characteristics of data that determine its quality, and the processes to ensure data quality. The standard is being developed in parts to encompass the various aspects of data quality. ISO 22745 and 8000 both require that terms and definitions be based on publicly available systems. Using a public syntax or format ensures that any software can read the data without having to pay royalties. Using a public dictionary to encode data ensures that the data can be decoded, without losing meaning, by any application now or in the future. These standards also guard an organization against having a proprietary "Trojan horse" in their systems—in other words, data that are copyright protected and for which other organizations must pay royalties to use. High-quality master data are portable master data, data that can be moved from one application to another legally and reliably with minimal mapping costs.

Table 1 lists the ISO 8000 parts that have either been developed or are planned for development by SC4.

TABLE 1. ISO 8000 Parts

Part no.	Title
1	Data quality—Part 1: Overview, principles and general requirements
100	Data quality—Part 100: Master data: Exchange of characteristic data: Overview
102	Data quality—Part 102: Master data: Exchange of characteristic data: Terminology
110	Data quality—Part 110: Master data: Exchange of characteristic data: Syntax, semantic encoding, and conformance to data specification
120	Data quality—Part 120: Master data: Exchange of characteristic data: Provenance
130	Data quality—Part 130: Master data: Exchange of characteristic data: Accuracy
140	Data quality—Part 140: Master data: Exchange of characteristic data: Completeness

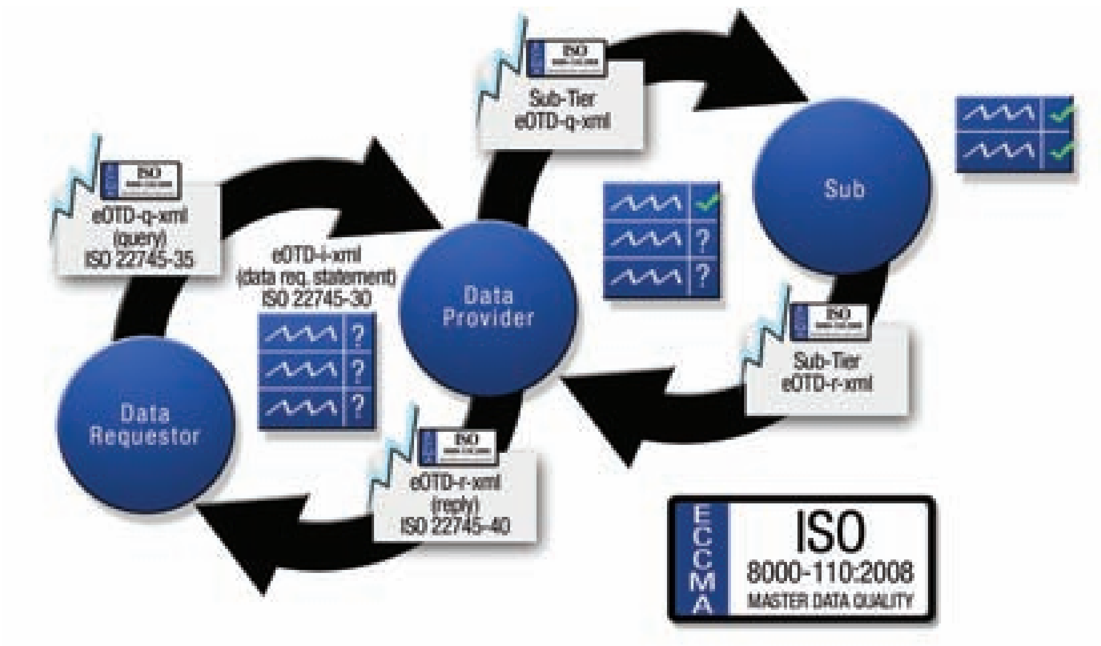
The nations participating on SC4 have already approved Part 110, and the Electronic Commerce Code Management Association (ECCMA) has developed a three-part certification process. (Any organization may develop a certification program under ISO 8000, but to date, only ECCMA has done so.) The types of certification are as follows:

- *Master Data Quality Manager*™. ECCMA certifies and registers that a Master Data Quality Manager requesting data is ISO 8000-110:2008 compliant. Specifically, ECCMA reviews the ability of an organization to create descriptive identification guides, generate queries, and read data in XML format, in compliance with ISO 22745.

- *Software Certification Application*. ECCMA certifies and registers that a specific version and release of a software application is ISO 8000-110:2008 compliant. Specifically, ECCMA examines the ability of the application to access the ECCMA Open Technical Dictionary (eOTD) using web services, to import and export identification guides, to import and export master data, and to generate queries in XML format, in compliance with ISO 22745. Currently, eOTD is the only open technical dictionary that complies with ISO 22745.
- *Data Service Provider.* ECCMA certifies and registers that a data service provided by an organization is ISO 8000-110:2008 compliant. Specifically, ECCMA examines the ability of an organization to access the eOTD using web services, to import and export identification guides, to import and export master data, and to generate queries in XML format, in compliance with ISO 22745.

Figure 1 illustrates data exchange using the principles of ISO 8000 and ISO 22745.

FIGURE 1. The Data Supply Chain



Data Quality Is Key to Interoperability

ISO 8000 will likely provide a broad platform for interoperability, because both SC4 and AC/135 are supporting and participating in its development. SC4 comprises representatives from industry, government, and standardization organizations from throughout the industrialized world, and the NATO Codification System is used by 59 countries in North America, Europe, Asia, and Africa, with more joining every year. Further, data quality is an important facet of interoperability. Without high-quality data, interoperability is of little value.

Organizations will benefit from ISO 8000, because it will allow them to define their requirements for data and make requests for data in a standard way that will allow their systems to talk to other systems—within their enterprise or outside it—using a common language. It provides the hope that, finally, DoD and industry systems will be able to communicate much more seamlessly, with less or no manual intervention.

ISO 8000 will also benefit the broader DoD community. It supports DoD, as one of the largest buyers, by providing suppliers with a standard against which items can be compared more advantageously than currently and alternative sources can be more readily identified and compared. Ultimately, ISO 8000 will enable improved acquisition and sustainment.

Finally, ISO 8000 will provide the ability and incentive for software application providers and data service providers to differentiate themselves from their competitors based on the ability of their applications to import and export high-quality master data that are ISO 8000 compliant, the ultimate proof of data portability.

If you would like further information on this topic, these websites will be of interest:

- ISO TC184/SC4: http://www.tc184-sc4.org
- NATO AC/135: http://www.nato.int/codification
- ECCMA: http://www.eccma.org.

If you have any ideas to share on this subject, please feel free to contact me at steven.arnett@dla.mil or call me at 269-961-7299.

About the Author

Steven Arnett is chief of the National Codification Bureau at the Defense Logistics Information Service in Battle Creek, MI. Mr. Arnett has worked in the field of NATO codification policies and procedures for 20 years and has represented the United States at many meetings of NATO Allied Committee 135 (NATO Codification).

Using the Semantic Web for Interoperability and Chaotic Data

By Scott Streit and Greg Wilson

The amount of information on the World Wide Web and within organizations continues to grow at an astounding rate. However, the technology to store and process this information has not kept pace. Over the past decade, the focus has been on easing information exchanges across organizational and system boundaries. DoD's Net-Centric Enterprise Services program has been a key player in creating better access to information by building the infrastructure that enables net-centric operations to drive collaboration among people and systems. Also central to easing information exchanges has been the development of standards for XML, Web Services, and service-oriented architecture (SOA). XML schemas (and Document Type Definitions before that) have become the default solution to the problem of how otherwise-disconnected systems should be glued together.

Although the technologies developed to date work well for static environments in which the interfaces between systems do not change repeatedly, it remains difficult for systems to interoperate in an environment of disconnected technologies and protocols. Moreover, while content grows exponentially, search engines can go only so far and return an overwhelming array of results, forcing users to wade through countless possible hits to locate the one item they are looking for.

Increasingly, defense agencies need to identify better ways to organize, share, and search vast amounts of data in a dynamic environment. This article introduces Semantic Web technologies as a solution that can help defense agencies more effectively meet their needs. The Semantic Web solves problems that were previously difficult to solve by overcoming the shortcomings associated with fixed ontologies. Also, it supports the coexistence of various ontologies and allows the interchange format to change on the fly, without affecting the operation of currently functioning systems.

Some Definitions

Semantic Web. The Semantic Web is a vision of the next generation of the Internet, enabled by a set of technologies that make it easier to share, connect, and discover information. Currently, the World Wide Web is a web of documents, intended for human consumption. The Semantic Web envisions a web of data, in which software agents (as well as people) can process web content and make better use of the information on the web.

Chaotic data. This term refers to large sets of data housed within disparate systems that are relatively unstable in that they are aligned with schemas that are regularly in flux.

Ontology. In computer science and information science, an ontology is a formal representation of a set of concepts within a domain and the relationships between those concepts. It is used to reason about the properties of that domain and may be used to define the domain. (See http://en.wikipedia.org/wiki/Ontology_(information_science).)

Various business drivers (such as reasoning, visualization, search, annotation, validation, collaboration) are propelling the adoption of Semantic Web technologies, but the primary drivers are as follows:

- The Semantic Web makes it easy to manage changing requirements and ontologies through pluggable ontologies or vocabularies.
- The Semantic Web provides a framework to unambiguously define interchange formats irrespective of how dynamic these formats are.
- The Semantic Web provides the ability to build compositional systems based on preexisting ontological components.

Many of the fundamental problems associated with fixed ontologies or nonchaotic data processing problems are solved. Increasingly, organizations will be faced with difficult problems that previous processing models could not handle. Every 20 years or so, computer science experiences a fundamental shift. For example, the early 1980s saw the emergence of relational data stores to replace older data storage technologies. The Semantic Web and cloud computing now represent a new shift in the way data are processed and stored and the way that next-generation software systems will be built. This article outlines aspects of the Semantic Web; it does not cover cloud computing.

The Semantic Web Solution

The Semantic Web is not new. The initial Resource Description Framework (RDF) specification was developed in 1997 and finalized in 1999. The first implementation tools became available in 2001. By 2006, Semantic Web technologies began appearing in production systems handling enterprise-quality service-level agreements. The early web was designed around HTML to display text and images in browsers, with the ability to link between pages. Unfortunately, computers still cannot use this HTML information in an automated way or perform complex tasks against it. HTML renders content in a browser, but it was not designed to support processing against the data embodied within that content. For a number of years, the designers of the original web—the World Wide Web Consortium—have worked to fix this problem by developing and deploying Semantic Web technologies.

With the Semantic Web, data processing and systems interoperability are augmented by communicating in one of two formats: RDF/XML or Notation3 (N3). Both formats are functionally equivalent, with RDF/XML providing description information for consumption by analysts and N3 allowing more efficient processing and a smaller footprint. The result is twofold:

- Communications between systems are simpler.
- Systems are significantly more impervious to the need for expensive software changes.

RDF was designed to support open (rather than constrained) information models that interact over an Internet scale. It provides a "metaontology," which is a description of ontologies and not an ontology itself. With RDF, interoperability between systems becomes dynamic with regard to data interfaces, and Semantic Web software systems are designed to be ontology agnostic.

In addition to understanding the types of problems for which the Semantic Web is most effective, one should also understand the types of problems that are poorly suited to the Semantic Web. Consider an easily defined, fixed ontology such as a general ledger. Double-ledger bookkeeping has existed for more than 3,000 years, and the current technology of relational databases with fixed viewing capabilities is more than sufficient for this type of problem. Using a Semantic Web solution to solve a general ledger data problem would increase system complexity without adding value. This example underscores the notion that the Semantic Web is built to address the problem of large sets of data that are spread across ownership domains and undergo recurrent change.

To be sure, myriad DoD organizations are faced with the problem of how to manage increasingly more content and data with increasingly less time. The following subsections focus on three aspects of this fundamental problem:

- Retrieving large amounts of textual data quickly and easily
- Integrating data across organizational boundaries
- Using annotations to support better knowledge management.

Before we outline how the Semantic Web addresses each of these problems, let's first take a retrospective look at how we arrived at the chaotic data problem.

Historically, the computer science community has created solutions that work in a limited, enclosed environment. As system scalability needs increased, solutions frequently failed. Early computer science could not effectively address the problems of concurrent processing. Through the 1950s and early 1960s, time-sharing operating systems failed to meet the needs of ever-increasing processing demands. Singular, or low-scale, processing worked without issues, but large-scale processing or multiprocessing failed using available algorithms. A Dutch mathematician, E.W. Dijkstra, introduced a solution that created the preemptive operating systems used today.

Once the time-sharing operating system proliferated, the problem domain shifted to data processing. In 1972, Dr. E.F. Codd developed the relational model. This model extended the principles of linear algebra into data processing. These mathematical abstractions created new opportunities for informational retrieval. The solution created a relational calculus as a formal mechanism to access data. Early implementations failed in the usage pattern of more than one or two concurrent accesses. These failures led to new algorithms, as created by Michael Stonebraker and Robert Epstein of the University of California, Berkeley. These new algorithms handled high degrees of concurrency on reads, as well as writes. Relational processing allowed highly concurrent access to data, modeled in a normalized fashion. This processing typifies accounting systems or other well-defined systems.

RDF and other Semantic Web technologies leverage a data persistence model that is different from the classic relational database model. This distinction is beyond the scope of this article, but is mentioned as an opportunity for additional exploration by the reader. These new persistence models are designed to support a more fluid data model. Indeed, as information management problems gain in complexity, solutions must handle an increasingly large measure of chaos. The surge in complexity derives primarily from changing requirements, data structures, and the relationship between the two. The Semantic Web offers a solution to the chaotic data problem. We will now look at how the Semantic Web addresses the three problems mentioned earlier.

RETRIEVING LARGE AMOUNTS OF TEXTUAL DATA QUICKLY AND EASILY

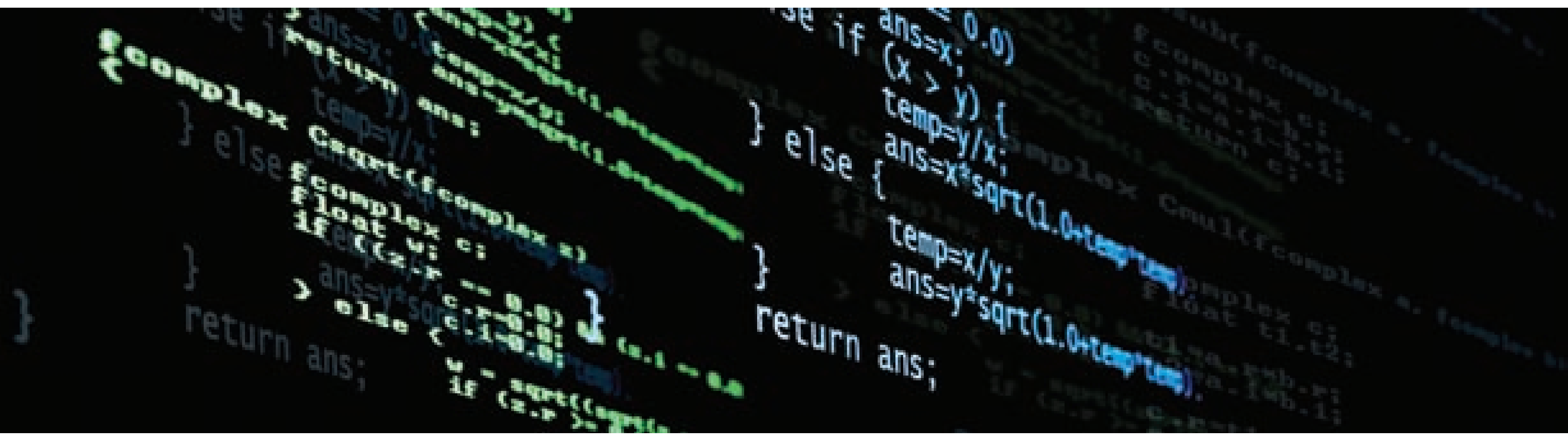
Increasingly, defense agencies are faced with the problem of retrieving meaningful content from unstructured, text-based documents. Such collections of chaotic data have a continually morphing ontology and, therefore, require a Semantic Web solution. As envisioned by Tim Berners-Lee, the Semantic Web allows machines to see information within context, no matter where the data reside. We no longer care where we find our compositional components.

The technical underpinnings of the Semantic Web—RDF and the Web Ontology Language—enable information to be processed automatically by tools (as well as manually) and can infer potential relationships among pieces of data, offering valuable knowledge-discovery opportunities. It extends principles of the World Wide Web from documents to data, through the development of a common framework that allows data to be shared and reused across application, enterprise, and community boundaries. Many organizations need to search large amounts of textual data and relate those data to other, pertinent data sets. To accomplish this, we combine the use of a triple store[1] and a text-based search engine. Performance metrics show that combining these technologies allows us to retrieve up to 25 graphs in less than a second, searching more than a terabyte of graph data. Performance does not vary for up to 10 terms.

The reason for the improved performance is that a triple store performs exceedingly well if given a Uniform Resource Indicator (URI) as a starting point. The text-based search engine accepts a textual request and returns a set of URIs—each providing a starting point for the triple store. The merging of these technologies allows each component to do what it does best. Previously, the only available alternative was to access data through a triple store. This approach fails during multiterm requests due to the performance issues associated with self-joins.[2] Using the same set of terabyte data, a four-term search would take hours.

INTEGRATING DATA ACROSS ORGANIZATIONAL BOUNDARIES

For the past several years, Web Services and SOA have emerged as the prominent methods to bridge application and data silos. Although these technologies continue to offer effective solutions, agencies should begin to investigate the relationship of these approaches to dynamic knowledge discovery. The term "knowledge management" refers to a range of practices used in an organization to identify, create, represent, distribute, and enable adoption of insights and experiences. A recurring business case for knowledge management is the ability to explore related, but distinct, data sets and to readily identify interesting and meaningful data and relationships. In such scenarios, the path to discover meaningful data relationships is typically not known at the outset.



For example, assume we want to track quarterbacks in the National Football League (NFL). We want to identify the best quarterback in the NFL. After a search and application of an algorithm,[3] we believe Peyton Manning is the premier quarterback in the NFL. Now we wish to examine his pedigree. We look at his father, Archie Manning, and discover, by way of a linkage, that he too is a quarterback. Through another link, we discover that his brother, Eli Manning, is also an NFL quarterback. Another linkage finds that both Archie and Eli went to the University of Mississippi and that all were raised in Louisiana. Finally, another linkage shows us that the State of Louisiana places a disproportionate amount of quarterbacks in the NFL.

The Semantic Web is centered around the idea that relationships among data are often more important than the data themselves. In today's DoD environment, as content continues to grow and evolve, so too do the underlying relationships among data contained in that dynamic content. To continually add relationships, we need the ability for ontologies to change dynamically. The Semantic Web is the representation of data and the relationship among data expressed in a way that is accessible to both machines and humans. It relies on technologies such as RDF and RDF viewers to "see" data and data relationships. In classic software terms, the Semantic Web can be likened to the model portion of the Model View Controller architecture. It provides for interchangeable format systems to exchange data, removing the possibilities for rewrites when information changes, and it provides the mechanisms to represent artificial intelligence and the decision-making process behind it.

At its core, the Semantic Web is a variable ontology. The concept of a variable ontology allows an application to enhance functionality by making the application aware of new ontologies of interest to the user base. This composition of ontologies allows the application to incorporate new requirements without rewriting the software. The Semantic Web was designed to support chaos.

USING ANNOTATIONS TO SUPPORT BETTER KNOWLEDGE MANAGEMENT

Frequently, we annotate our work with Post-It Notes and "cheat sheets." The Semantic Web allows us to annotate content on the web by embellishing it with additional facts and statements. We can add higher order operators (leading to reasoning) such as asserting that one thing is the same as another, or describing a variety of other processing rules. As our knowledge base contains additional higher order operators, we can leverage these operators in future processing.

Basic reasoning such as SameAs operators have little overall impact on performance, whereas others are impractical for automation.[4] Reasoning provides two solutions for knowledge management; one is finding more high-value relationships, and the other is answering specific questions. For instance, in our last example, the leap from Louisiana and the number of NFL quarterbacks from Louisiana is an indirect relationship. This is because there is no formal relationship between the Mannings and other NFL quarterbacks from Louisiana. To add this high-value relationship, we use reasoning. Another application of reasoning could be to consider another quarterback, say Kurt Warner, and query if he has a relationship with or is from Louisiana. Isolated reasoning applications are available today in a scalable enterprise fashion, but most reasoning components are viable only for demonstrations. They require more research before they can move to production systems.

Conclusion

The Semantic Web represents the next generation of computer processing. Over the coming years, it will have a profound impact on the way that software systems are built and integrated. Also, it will have a profound impact on how people and computers discover new information and, therefore, how the web will augment our professional and personal lives. The Semantic Web is enabled by specifications that lower the barrier to interoperability regardless of the data sources or destinations. Just as the relational database changed computer science in ways we could not imagine at the time, the Semantic Web is doing this today. The Semantic Web is real, scalable, and in production.

[1]Many of those focusing on semantic persistence now treat the triple store as an abstract concept. The interface will appear as a triple store; the actual storage will vary.

[2]Most who study combinatorial mathematics believe a multiterm self-join is nonpolynomial (NP) and therefore not suitable for automation.

[3]A Semantic Web algorithm typically takes RDF as input and returns RDF. The algorithm also may take one or more ontologies as input.

[4]Something as simple as Not SameAs is NP and impractical for an automation.

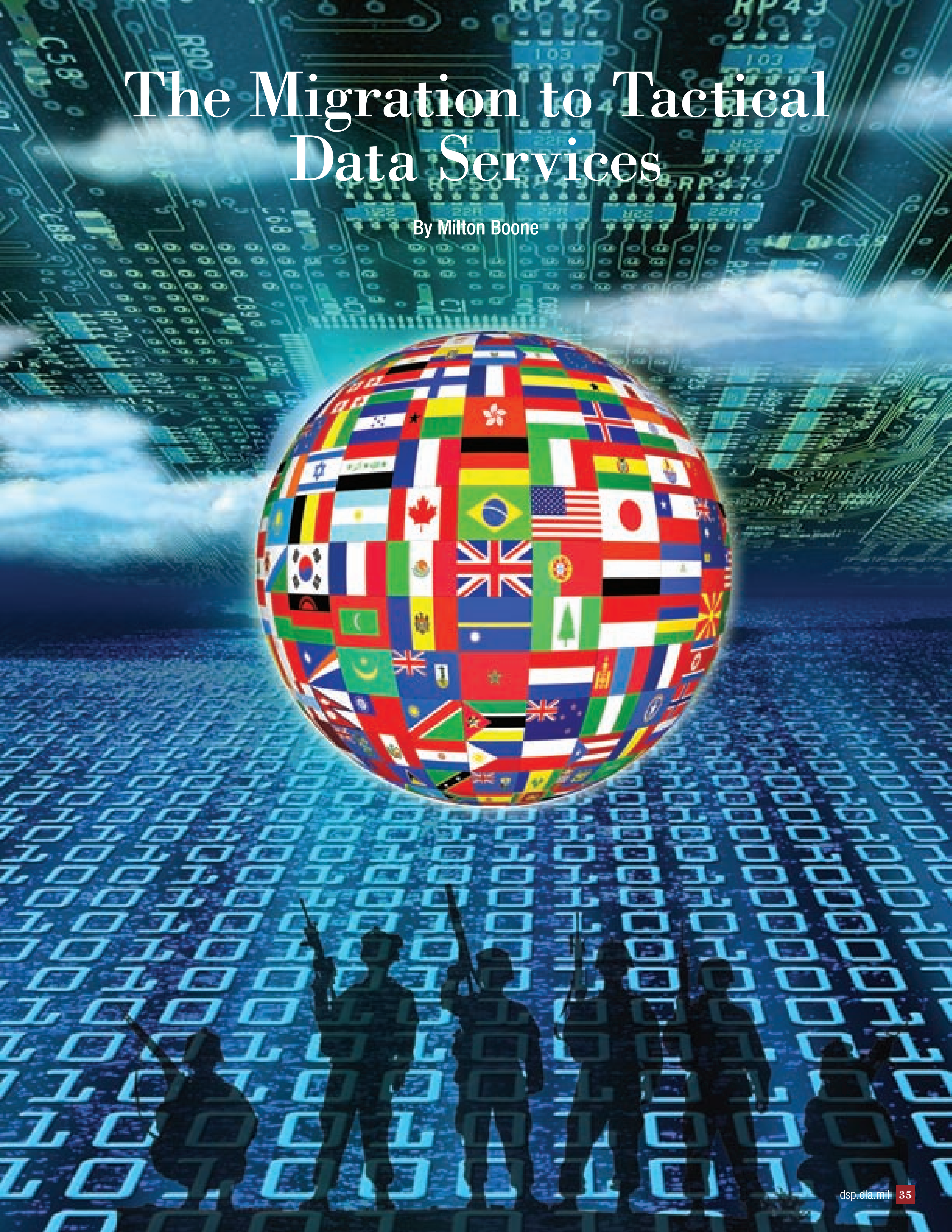
About the Authors

Scott Streit is an internationally recognized computer scientist with more than 25 years of experience as a technical leader/project manager. His areas of expertise include open source development, Semantic Web development, SQL Server, Sybase, and Oracle. Currently, Mr. Streit is leading an effort for civil agencies and corporate clients in the areas of Semantic Web and cloud computing.

Greg Wilson is a program manager at LMI, a not-for-profit consulting company based in McLean, VA. He has extensive experience assisting clients with systems interoperability (leveraging XML, Web Services, and SOA) and governance, which are increasingly pertinent to building systems that span multiple agency and technology boundaries, and with developing practical solutions using semantic technologies.

The Migration to Tactical Data Services

By Milton Boone



A DoD team recently issued an updated document addressing the migration from tactical data links (TDLs) for exchanging mission-critical data to Tactical Data Enterprise Services (TDES) within the Global Information Grid (GIG) enterprise. The document—the Joint TDES Migration Plan (JTMP)—identifies and prioritizes joint interoperability policy and programs, including assessment of service funding and adherence to prescribed guidance. Throughout the transformation to new networking capabilities, the legacy TDLs will remain critical to joint and allied operations. Therefore, a clear policy to ensure TDL interoperability continues to be important.

Background and Overview

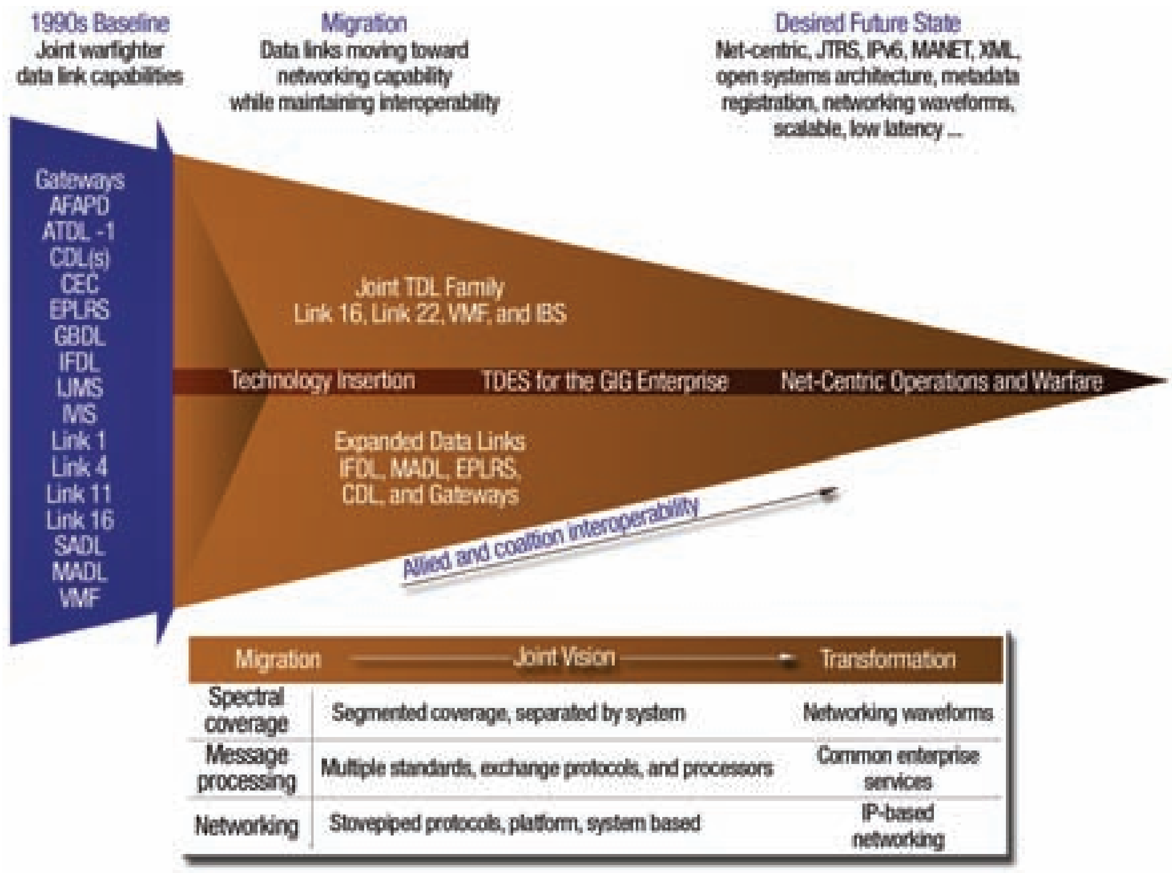
The JTMP's precursor (Joint Tactical Data Link Management Plan) facilitated interoperability through planned migration from disparate TDLs to a joint family of TDL message standards based on standardized message formats, common data elements, and standardized data link information exchange architectures. The JTMP addresses migration of this joint family and other tactical data exchanges to a future state in the GIG enterprise. The specific objectives of the JTMP are to promote senior leadership's vision of future tactical data exchanges and to outline the migration of the warfighter's functional capabilities within the context of tactical communications. The JTMP places special emphasis on service migration plans that identify planned dates for migrating TDLs currently in use to TDES. Access to the JTMP policy may be obtained through Defense Knowledge Online at https://www.us.army.mil/suite/page/455401.

TDES migration will transition and expand the services provided to tactical-edge networks. The key tenet of the migration is to achieve interoperability and to ensure that the operationally driven tactical functions and capabilities of TDLs are captured and applied effectively in achieving the TDES future state. This future state will define the tactical-edge networks that enhance operations for the warrior component of the GIG enterprise. The migration to TDES will be an ongoing process, evolving to support future tactical data exchange requirements for joint warfighters.

The focus of the current JTMP is to ensure successful transformation of tactical exchanges of information in support of warfighter requirements and emerging Joint Mission Threads (JMTs). A JMT is an operational and technical description of the end-to-end set of activities and systems that accomplish the execution of a joint mission. Further, a JMT is a task deemed essential to mission accomplishment and is defined by using the common language of the Universal Joint Task List in terms of task, condition, and standard. The JTMP addresses the need for increased commonality of communications waveforms, media, and protocols at the tactical level to significantly reduce the proliferation of gateways. However, the capabilities provided by gateways must support connectivity and interoperability as TDLs transform to TDES. Efforts are underway on how to best host some of these gateway functions in support of tactical communications. Improving the connectivity between current TDL systems is critical in the near term. During the migration to TDES, existing gateway capabilities will need to be used, while at the same time, gateways suitable for initial consolidation efforts must be identified.

Figure 1 depicts the migration to TDES.

FIGURE 1. Overview of the Migration to Tactical Data Enterprise Services



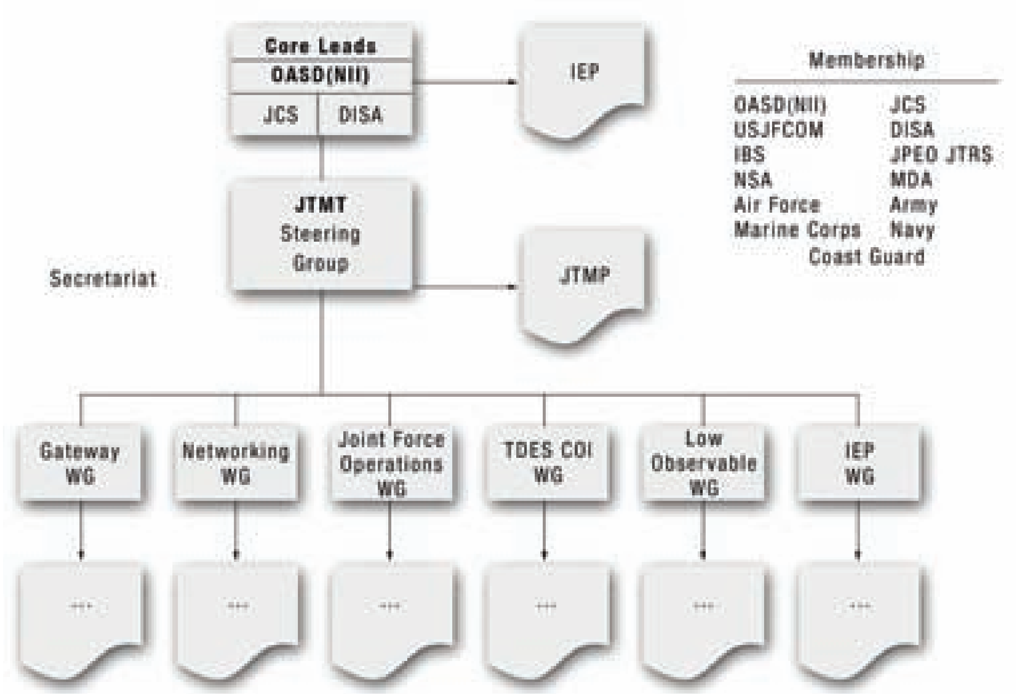
Notes: IPv6 = Internet Protocol version 6 and MANET = mobile ad hoc network.

Organizational Teaming

The migration to TDES is under the purview of the Office of the Assistant Secretary of Defense for Networks and Information, or OASD(NII). The Joint Chiefs of Staff (JCS) and the Defense Information Systems Agency (DISA), the core leads, oversee the Joint TDES Migration Team (JTMT), which has members from all of the services as well as from the United States Joint Forces Command (USJFCOM), Integrated Broadcast System (IBS), Joint Program Executive Office for the Joint Tactical Radio System (JPEO JTRS), National Security Agency (NSA), and Missile Defense Agency (MDA). In addition to participating in the JTMT, the combatant commands' inputs include integrated product lists, operational reports, and Joint Requirements Board visits.

As shown in Figure 2, the JTMT is supported by several task-oriented working groups (WGs) such as a TDES Community of Interest (COI) WG and an Interoperability Enhancement Process (IEP) WG. Each WG is addressing a specific set of TDES migration issues.

FIGURE 2. Organizational Teaming for the Migration to TDES



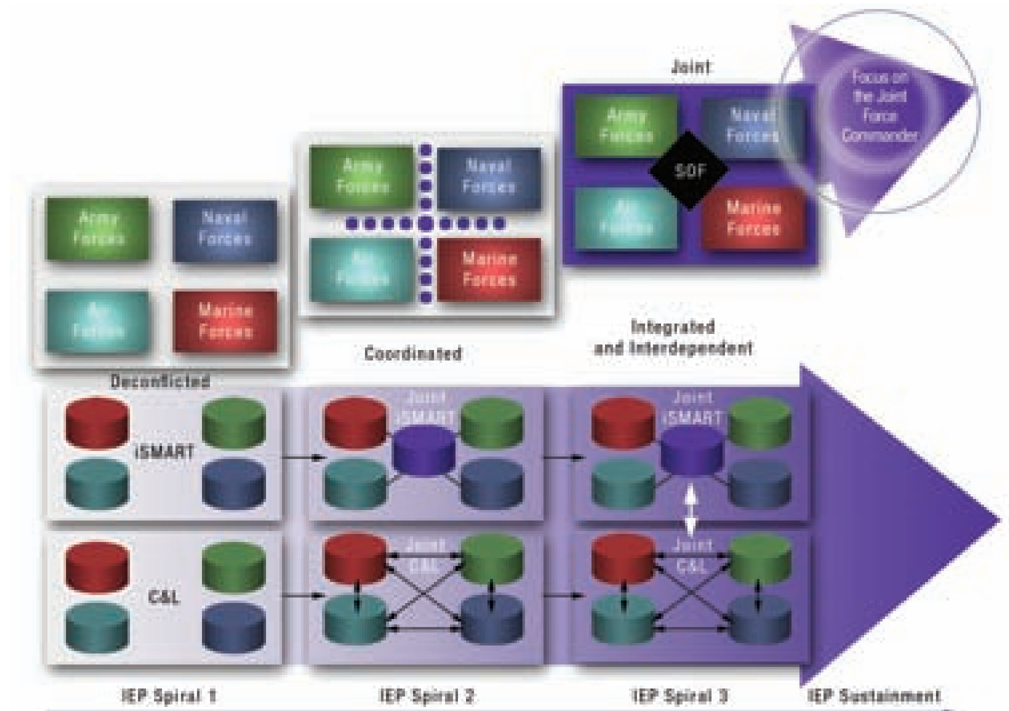
Interoperability Enhancement Process

Development of an effective IEP is a key initiative related to the migration to TDES. The initiative's focus is on interoperability improvements to support joint capability developments. Figure 3 depicts the IEP transformation.

An IEP is needed to support the resolution of TDES implementation issues, the development of TDES capability, and TDES verification and certification. The overarching objective of the IEP will be to support the realization and maintenance of interoperable net-centric weapons, sensors, and command and control (C2) systems at the tactical edge. The IEP will utilize the joint set of net-ready key performance parameters as the metrics for interoperability assessment. These parameters will be applied to all legacy or new weapons, sensors, and C2 systems.

The IEP will use a jointly defined and developed interoperability tool set to determine the TDES interoperability capabilities of weapons, sensors, and C2 systems. Interoperability shortfalls (gaps) will be identified for each weapon, sensor, and C2 system. The gaps will be based on demonstrated information exchange capabilities of the respective weapon, sensor, or C2 system being analyzed with respect to the current policies, doc-

FIGURE 3. Transforming a Joint Force through the Interoperability Enhancement Process



Realize IEP Objectives:

- Assess a platform's ability to effectively contribute to JMTs
- Improve interoperability throughout a system's life cycle
- Maximize operational impact of complex, integrated systems

Notes: C&L = Capabilities and Limitations, iSMART = Interoperable Systems Management and Requirements Transformation, and SOF = Special Operations Forces.

trines, architectures, operational concepts, concepts of employment, standards, road maps, and the JMTs that collectively form the standard view of the TDES architecture. The interoperability gaps will be documented to provide each weapon, sensor, and C2 system a common format implementation specification for TDES interoperability. This requirements process will be updated consistent with the maintenance and upgrade cycle for each weapon, sensor, and C2 system. For each emerging (future) system, the IEP will be conducted before Milestone C. DISA will support this process via the establishment and maintenance of the IEP databases that contain platform sensor, weapon, and C2 system interoperability capabilities; the jointly approved standard view of the TDES architecture; and the implementation specifications for TDES interoperability.

The services will be responsible for developing the material solutions that provide weapon, sensor, or C2 system compliance with their respective implementation specifications for TDES interoperability. The services will update the DISA IEP databases with weapon, sensor, and C2 system interoperability capabilities as validated by flag-level review. Validated data will include capability deviations and schedules for full joint certification.

A second component of the IEP will provide warfighters with operationally relevant information to maximize employment of net-enabled systems. The services have agreed upon common capability characteristics to identify system performance in a joint environment. The collection of these efforts, when synchronized across the services and available to joint warfighters via net-centric capabilities, is called "joint capabilities and limitations."

Next Steps

The primary objective of the initiative to migrate to TDES is threefold: improve interoperability, simplify fielding, and reduce cost. Although considerable progress has been made, much remains to be done. To advance progress, future iterations of the JTMP will detail interoperability considerations for joint, allied, and coalition operations. An example of an interoperability consideration is sustaining a Link 11 capability beyond FY15 in support of our allied and coalition partners based on combatant command requirements.

Future JTMP iterations also will

- identify the components, characteristics, and value of TDES migration within the net-centric operational environment;
- present DoD strategy, policy, and guidance for the exchange of tactical information;
- present guidance to ensure preservation of joint force operational and tactical warfighting functions, capabilities, and approved requirements during the migration;
- outline the background, characteristics, components, and necessity of TDES in joint, allied, and coalition environments;
- assess the status of key transformation technologies affecting or relating to TDL migration; and
- provide recommendations and identify responsibilities for applying desired future-state TDES technologies.

The following are some additional steps to be taken to further the migration to TDES:

- Refine and mature the scope of the TDES COI (establish the processes and provide the forum for the TDES community to resolve implementation and interoperability issues). The TDES COI was created by the DISA GIG Enterprise Services Engineering Directorate, which is the configuration management authority of the TDL standards in accordance with "TDL Standardization Implementation Plan" (Chairman of the Joint Chiefs of Staff Instruction 6610.01). The JTMT will provide oversight for the TDES COI.
- Participate in, and provide oversight for, the development of a TDES architecture that serves as an element of the GIG architecture:
  - Support the development of the TDES Operational View via coordination and

collaboration with the services and USJFCOM JMTs to define the tactical information exchange needed in the tactical-edge networks by the COIs within the net-centric operational environment

- Support the development of the TDES Technical View via coordination and collaboration with DISA and the acquisition community to define the standards and specifications needed for system development that supports the TDES Operational View
- Support the development of the TDES Systems View via coordination and collaboration with the services and their respective acquisition communities to define the material solutions to implement the Technical View and support the TDES Operational View.

- Continue to refine the fit of the TDES in the GIG enterprise, for example, the warrior component, capability portfolio management concept, and intra- and inter-governmental interoperability.
- Support USJFCOM in the development of JMTs that promote TDES migration, for example, by conducting interoperability assessments and advocating improvements that support interoperability and integration to enhance warfighting effectiveness.
- Support DISA and USJFCOM in the development of the IEP.
- Create a repository for documents—such as service road maps and migration plans—that describe, influence, or otherwise affect the migration to TDES.
- Continue to foster the TDES concept and approach.
- Continue to provide the community with information on progress toward reaching the tactical edge in the GIG enterprise.

About the Author

Milton Boone is a computer scientist in the Interface Standards Division of the Defense Information Systems Agency, DoD's Executive Agent for centralized life-cycle management of IT standards. Mr. Boone has been principally involved in the development and promulgation of DoD policy and processes that support the interoperability and supportability of information technology and national security systems.

Several people contributed to this article: David Narkevicius, OASD(NII) (Communications Programs), JTMT co-chair; CDR James Smelley, JCS (Command, Control, Communications, and Computer Systems), JTMT co-chair; Edwin Martson, DISA (Standards Management Branch), IEP co-chair; Elmer Reyes, DISA (Standards Management Branch), JTMP content manager; and Lance Thomson, OASD(NII) (Support).

A Multidisciplined Approach to Fostering Adoption of Hydrogen Fuel Cells

By Leo Plonsky, Rob Hardison, Mike Canes, and Tom Joseph

The past two decades have seen promising advancements in hydrogen and fuel cell technologies. These technologies offer potential solutions to energy challenges related to battlefield logistics, energy security, and environmental sustainability. Because of the potential, the Defense Logistics Agency (DLA), in 2004, commissioned a study to investigate the use of hydrogen as a logistics fuel and kicked off a program to explore how DoD may benefit from these potential solutions in battlefield and support applications.

DLA's Hydrogen and Fuel Cell R&D Program manages a broad range of activities. The program's progress is due to the collaboration and smooth interactions among representatives of numerous, highly diverse specialties: theoretical research, manufacturing, construction, operations, codes and standards, and financial analysis, to name a few. The work of these external experts is being synchronized through an integrated process team.

Today, through the program, DLA is implementing some of the country's most exciting fuel cell research and demonstration projects. These projects range from basic hydrogen storage R&D to a fully integrated site with hydrogen generated from renewable sources and used in fuel cell-powered material handling equipment (MHE), such as forklifts. In this article, we introduce the program, describe four pilot projects, and then delve into two areas involving complex multidisciplinary interactions: site approval and business case analysis.

Overview of the Program

The role of the Hydrogen and Fuel Cell R&D Program is to provide and enhance the tools DLA uses to deliver logistics capability in support of DoD. A primary focus of the program is on logistics and manufacturing technologies and on approaches for integrating them into DLA's processes, systems, and operations to improve support to the warfighter and other DLA customers. The program seeks to enhance its capabilities and value by actively collaborating with the services, other government agencies, industry, and academia to leverage emerging technologies for its customer base.

An illustrative example of such collaboration is a recent DoD workshop hosted by the DLA Hydrogen and Fuel Cell R&D Program with the goal of eliciting expert opinion to inform the program's investment decisions. The 3-day event brought together almost 60 government and industry leaders to identify technical and policy hurdles to widespread deployment of fuel cells. Considering the recommendations developed by these stakeholders during the workshop, DoD will be better able to evaluate how it might invest its R&D budget to best support its mission while working to advance the state of these technologies.

The lion's share of the program's investment to date has gone toward four MHE pilot projects, detailed below. Through these projects, DLA acts as a "first adopter" and "principle demonstrator" of hydrogen and fuel cell technologies. In these roles, DLA influences the evolution of the industry and develops internal capacity to expand DoD's use of fuel cells. The projects are designed to push manufacturers to improve technology readiness levels and manufacturing readiness levels, and thus improve the long-term viability of commercially available fuel cells.

A critical component of each pilot project is the collection and analysis of operational data to evaluate the long-term business case of the particular applications, for example, comparing fuel cells powered with hydrogen produced onsite to batteries charged from the grid. To gather and analyze data, DLA has teamed with the National Renewable Energy Laboratory (NREL), which is gathering extensive fuel cell performance data from commercial projects for the Department of Energy (DOE), and with LMI, which is analyzing the cost and performance of DLA's pilot project operations.

Once these pilot projects are established, significant investment will have been made in developing the hydrogen fueling infrastructure and user awareness. DLA is working to leverage this investment through a "spiral development" approach to exploring additional fuel cell technologies at the project sites. DLA is developing plans to use fuel cells in other types of MHE and to deploy vehicles that push the limits of onboard hydrogen storage. In parallel, the program is working in partnership with DOE, the Office of Naval Research, and cutting-edge academic institutions to research innovative technologies for hydrogen storage.

Pilot Projects

The centerpiece of DLA's Hydrogen and Fuel Cell R&D Program comprises four pilot projects: three at defense distribution depots—Susquehanna, PA (DDSP), Warner Robins, GA (DDWG), and San Joaquin, CA (DDJC)—and one at Fort Lewis, WA. The 2-year projects, which are in various stages of development, are designed to demonstrate fuel cell-powered MHE. In total, the projects will deploy nearly 100 fuel cell-powered industrial vehicles used for handling material, one fuel cell bus, and a range of hydrogen production and dispensing technologies.

The project at DDSP began operations in February 2009 with 40 fuel cell units and an indoor hydrogen-dispensing system. The fuel cells replace batteries to power the MHE. Half of the units are retrofitted with custom-designed fuel cells, while the other half are new, with coordinated fuel cell/MHE integration. Liquid hydrogen is delivered for onsite storage in outdoor storage infrastructure, which is designed for potential vehicle fueling in the future. Gaseous hydrogen is conveyed through underground pipes to indoor dispensers, where it is used by the MHE. Indoor dispensing introduced numerous fire and safety considerations, due primarily to the lack of thorough codes and standards and to the lack of experience with the technologies by site safety personnel. These issues were resolved through collaboration with NREL, which conducted a fire hazard analysis. This collaboration had not previously been done in commercial settings due to the business-sensitive nature of limited deployments of fuel cell forklifts in warehouse operations. The effort produced templates of industry codes and standards for use in public- and private-sector applications and will inform future industry codes and standards.

DDWG is replacing 20 electric and propane forklifts with new fuel cell forklifts; this project will begin operations by the end of 2009. Hydrogen will be produced on site via natural gas reformation and will be distributed using mobile refuelers. The project will continue with the data collection and analysis begun at DDSP to expand the business case analysis. During the project siting and development phase, DLA communicated extensively with personnel in the Air Force Advanced Power Technology Office to leverage its work to implement several fuel cell projects at the collocated Robins Air Force Base.

To fully exploit the environmental and energy security benefits afforded by fuel cells, hydrogen production technologies must use renewable energy sources. Two of the pilot projects will explore green technologies (solar and biogas) to address the greenhouse gas emissions associated with conventional hydrogen production and to contribute to sustainable energy solutions. At Fort Lewis, WA, the pilot project will harness methane emitted from the installation's wastewater treatment plant, which is currently flared to the atmosphere. To ensure proper equipment sizing to match methane flows, DLA coordinated extensively with installation public works personnel. Beginning in 2010, the produced hydrogen will power fuel cell forklifts operating in a nearby Army warehouse, as well as a fuel cell-powered bus used to transport personnel to and from Madigan Army Medical Center.

The pilot project at DDJC will deploy 20 new fuel cell forklifts to replace propane-powered units. The infrastructure will create hydrogen on site, using solar power to electrolyze water. It will investigate the technical issues and business case for using solar energy instead of natural gas to produce hydrogen. To fund the solar power for this project, DLA is investigating a power purchase agreement, an innovative financing mechanism for renewable energy sources. Operations are expected to start in 2010.

As is evident, the complexity and nascent nature of these projects require integration over a broad range of technical, policy, and implementation considerations. Below we discuss in detail the expertise brought together for the site approval and the business case analysis aspects of the pilot projects.

Site Approval

For the pilot projects, the responsibility for obtaining site safety approval falls to the performing contractor. However, a great deal of coordination was required to ensure command buy-in and full compliance with the range of standards. The project at DDSP was the first to begin and thus has provided many learning opportunities to be carried forward into the other projects.

Industrial gas companies have been complying with various codes and standards for the past 40 years, and they have experience with hundreds of industrial installations in North America where hydrogen is used for various applications as a process gas. An ongoing code revision process has helped the industry to refine codes and standards over the years. Updates are largely driven by the necessity introduced by new applications and advances in technological capability. Relatively recent changes incorporated lessons learned from operating experience, including a number of indoor processes like generator cooling, hydrogenation, and float glass. However, the high-pressure dispensing requirements and the indoor extension for fueling MHE brought new dimensions to using hydrogen as a fuel.

In 2003, various industry groups began creating codes and standards to address safety requirements for dispensing hydrogen fuel. These requirements were included in 2006 editions of the codes and standards, which facilitated the development of preliminary approval documents for the dispensing system at DDSP. However, the 2006 editions did not adequately cover safety requirements for indoor dispensing, especially ventilation and cutoff room requirements for conventional hydrogen storage systems. At the time, there was little pressure to develop codes for indoor dispensing, because hydrogen was used primarily as a process gas and because industry focus was on outdoor fueling for road vehicles not industrial MHE. The code development community did not anticipate the near-term demand for indoor fueling that occurred with the growing interest in MHE fleets while the codes were under revision between 2004 and 2006. Instead, the code development process was moving at a pace to match the anticipated deployment of fuel cell-powered road vehicles in the longer term. The near-term commercial opportunities for industrial vehicles, such as MHE, gained momentum through DLA's decision to forge ahead with these cutting-edge pilot projects and prompted revisions in the codes.

Air Products and Chemicals, Inc., the contractor in charge of the fueling infrastructure and overall integration at DDSP, responded to this challenge by initiating safety reviews using alternate rule provisions, recognized within the consensus codes. Further, Air Products developed reports that drew analogies with comparable fuels. The safety and design review team for the project included personnel from DDSP, DLA, and Air Products. Air Products personnel had experience in the design, installation, and operation of similar hydrogen fueling systems. Further expertise was drawn from other industrial sites that require indoor usage of hydrogen for processes. To assess the ventilation requirements for indoor dispensing, the team conducted a dispersion analysis, modeling hydrogen clouds and concentrations with computer simulations and worst-case leak scenarios.

In addition to the hazard and process safety analysis completed by the project safety review team, a professional fire safety engineer was engaged through DOE and NREL to complete an independent fire safety review. The review focused on the provisions incorporated by the project safety team and the extent to which they met or exceeded the objectives of the codes and standards published in 2006. The design and safety review for the DDSP project resulted in a number of recommendations for code revisions, which were published in the 2010 editions of National Fire Protection Association 52, *Vehicular Gaseous Fuel Systems Code*, and 55, *Standard for the Compressed Gases and Cryogenic Fluid Code*, as well as in the 2009 edition of *International Fire Code®*. Specifically, the results from dispersion analysis and leak modeling were used to define, within these codes, ventilation requirements and electrical classification for dispensing systems.

This structured review and permitting process generated valuable design and safety documentation for the industry. Although the DDSP permitting effort took months for review and approval, DoD and industry projects that follow it will benefit. A number of templates and communication tools were developed for sharing safety review data with permitting authorities. The hydrogen industry is already seeing the benefits of these tools at various project sites that are currently in different stages of execution through new codes and industry experience. The independent review report on indoor dispensing and hydrogen dispersion models was made available to other interested parties considering the adoption of this technology at their sites. As of September 2009, industry installations at Joliet, IL, Dallas, TX, Houston, TX, and Springfield, MO, were permitted based on documents generated from this project.

Business Case Analysis

As part of the four MHE pilot projects, DLA is sponsoring an economic study that will compare the costs and benefits of fuel cells to assess whether they make good economic sense. The study will consider the various operational conditions and the range of hydrogen supply techniques being used at the installations. NREL and LMI are gathering and harmonizing data from an array of sources for an apples-to-apples comparison. Ultimately, the results of the analysis will improve the state of knowledge regarding fuel cell technologies to the benefit of a range of stakeholders.

The business case analysis will include a comparison of baseline data for the incumbent technology with data for fuel cells and hydrogen infrastructure. This comparison requires detailed cost-related information, ranging from the salvage value of lead-acid batteries to the queuing time for hydrogen refueling. NREL is collecting operating data for the fuel cell forklifts and hydrogen infrastructure. LMI is collecting cost information for the various power sources from government personnel who manage contracting, operations, maintenance, and acquisition activities, in addition to data from the manufacturers of fuel cells, hydrogen, and batteries.

To illustrate the complexity of the analysis, consider the data being gathered to compare infrastructure, fueling and recharging, and real estate. Both batteries and fuel cells require specialized infrastructure to support their use. In the case of batteries, equipment is needed to change them out after they lose their charge, to recharge them, and to periodically wash off acid residue. Fuel cells powered by hydrogen require a hydrogen infrastructure, including storage tanks, pumps, compressors, and fuel lines. Cost information must be analyzed for the various components of these infrastructures, including initial capital costs and the ongoing costs of operating, maintaining, and repairing them.

The business case analysis also requires a comparison of the time it takes to change out a battery in a forklift and the time required to refuel a fuel cell. Battery change-outs may take as long as 15 minutes; however, this time can be reduced to 3 or 4 minutes with a good battery management system. Similarly, basic hydrogen fueling stations can take 5 or 6 minutes per fill, while newer systems that allow communication between the pump and the tank can reduce fueling time by half. The equipment costs and time requirements for the various battery change-out and hydrogen refueling systems will significantly affect the results of the study.

Another important factor is the amount of space needed for infrastructure. The battery infrastructure may require several thousand square feet of space located within the warehouse. Hydrogen infrastructure requires less space within the warehouse, but the sizable tanks must be located nearby on the outside. The costs of this space depend on the costs of real estate at each particular site.

To compare the costs of infrastructure, fueling and recharging, and real estate, the program's data collection efforts require extensive coordination with the full spectrum of stakeholders responsible for managing the data.

Another consideration is access to the data. One limitation of projects conducted by commercial entities is that data are generally not released to the public so that a competitive advantage can be maintained. For these DLA projects, data will be made available to the public to improve the market's state of knowledge. However, DLA recognizes the proprietary nature of the innovations being introduced in these projects. Accordingly, DLA is working with NREL and LMI to mask results so they cannot be attributed to any one company. As a result, participating companies are open to sharing key data for the business case analysis.

Finally, to determine the full range of benefits associated with hydrogen and fuel cell technologies, DLA is considering environmental impacts. In general, fuel cells are more efficient than internal combustion engines at converting fuel to power, but hydrogen is usually created from fossil-based natural gas. Batteries, although relatively efficient at using electricity from the grid, often rely on environmentally damaging coal. The best way for fuel cells to avoid most environmental concerns is to use renewable sources of energy. Through this series of projects, DLA will compare the environmental implications of incumbent fuel sources to an increasingly "green" set of hydrogen production technologies.

Because the DDSP project is still in its early stages and because the use of fuel cells to power forklifts is still fairly new, much is being learned as time passes. For this reason, initial cost estimates pertaining to fuel cell forklifts may not fully reflect what the costs will be going forward. In effect, a portion of project costs is in the nature of R&D. The fuel cell manufacturers are learning through this effort how manufacturing and operating methods can be improved to reduce costs.

The initial results of the business case analysis of DLA's pilot projects are providing useful information to DLA. Moreover, they are giving manufacturers of fuel cells and hydrogen an opportunity to learn and improve the technologies' economic viability. The DDSP experiment already is indicating that fuel cell operations can be improved as the manufacturers understand how better to deliver this technology. It will be some time before the complete results are in, but so far, these various improvements appear to be giving DLA an early return on its investment.

Summary

The DLA Hydrogen and Fuel Cell R&D Program is off to a strong start. The program has developed a series of complex research and demonstration projects, and it has developed an extensive array of subject matter experts to support project implementation and analysis. The program's work will serve to guide DoD's future investment decisions, industry plans, and consumer knowledge for the benefit of energy security and environmental sustainability.

About the Authors

Leo Plonsky is a program manager at DLA where he is responsible for managing a variety of programs, including the Hydrogen and Fuel Cells R&D Program and the Tent Network for Technology Implementation.

Rob Hardison and Mike Canes are technology management consultants at LMI. Mr. Hardison leads initiatives on the environmental implications of energy use. Dr. Canes leads research on the economic aspects of power management and strategic energy planning for government systems.

Tom Joseph is an independent consultant for the hydrogen technologies industry. He was an 18-year employee of Air Products and Chemicals, Inc., where he managed business development and technology production.

Defense Parts Management Portal–DPMP

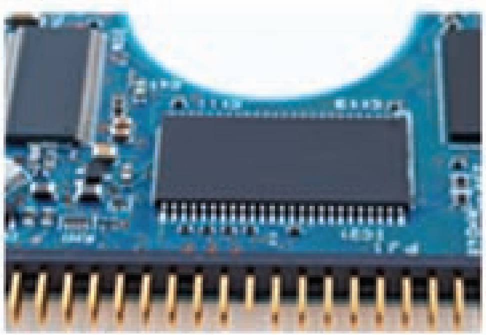
The DPMP is a new public website brought to you by the Parts Standardization and Management Committee (PSMC) to serve the defense parts management community.

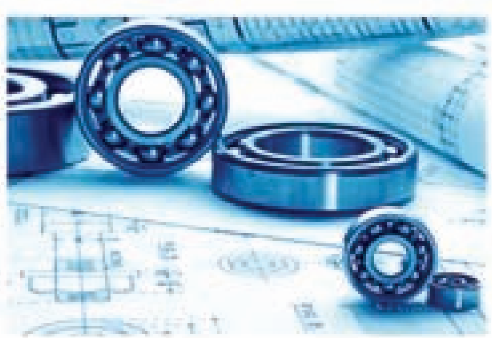
The DPMP is a new resource, a new marketplace, and a "one-stop shop" for parts management resources. It is a navigation tool, a communication and collaboration resource, and an information exchange. It gives you quick and easy access to the resources you need, saves you time and money, connects you to new customers or suppliers, and assists you with finding the answers you need.

This dynamic website will grow and be shaped by its member organizations. A new and innovative feature of the DPMP is its use of "bridge pages." Organizations with interests in parts and components are invited to become DPMP members by taking control of a bridge page. Chances are good that your organization is already listed in the DPMP.

There is no cost.

Explore the DPMP at https://dpmp.lmi.org. For more information, look at the documents under "Learn more about the DPMP." Click "Contact Us" to send us your questions or comments.





Program News

Topical Information on Standardization Programs

Army Materiel Command Offers Enterprise-Wide Access to Non-Government Standards

The Army Materiel Command (AMC) has recently been successful in making a business case to overhaul its process for procuring NGSs and parts information. This business case, prepared by Timothy Edwards, AMC command librarian, uncovered redundancy and waste associated with contracts used to access standards, specifications, and parts information. Mr. Edwards was able to point out instances in which AMC activities were purchasing military documents that were freely available on the DSP ASSIST database. He also provided examples of multiple site licenses being issued to the same company due to separate contracting actions. The business case resulted in the award of a contract to a single document provider; the contract is expected to save AMC an estimated $1 million per year in procurement costs, save subordinate commands an average of 30 percent per year, and save approximately $250,000 in AMC man-hours spent in developing and managing contracts. The contract includes full text access, on a varying concurrent user limit, to documents from 24 standards developing organizations.

Building the business case and assembling the team to support this effort were both integral to ensuring contract award. Who was the AMC team that got this contracting action off the ground? Mr. Edwards relied on the Army Contracting Command to provide tracking information on individual contracting actions to access documents. He received significant support from the AMC librarians, technical information specialists, and library technicians who had extensive background in the economics of content, for example, what's free and who has the best knowledge base. And he worked very closely with the AMC Standardization Office, which proved to be instrumental in breaking down institutional barriers. In addition, a moratorium on purchasing U.S. government standards from commercial vendors was established. Once the business case was completed, money was directed from existing document access contracts to the new contracting action. It took the team many months to build the case; however, it was the pivotal document that convinced upper management to go forward on the consolidated procurement.

AMC and DSPO are not alone in recognizing the economic benefits of command-wide, if not DoD-wide, access to NGSs. In February 2009, a Defense Science Board Task Force issued *Buying Commercial: Gaining the Cost/Schedule Benefits for Defense Systems*, which recommended that DoD should negotiate and contribute to DoD-wide licenses for commercial engineering standards, rather than requiring individual offices or services to purchase separate licenses. The board based this recommendation on the fact that the costs associated with DoD purchasing site licenses or individual documents had inhibited all but the largest commands and program offices from using these documents the way DoD policy intended. The board's report went further to acknowledge that the negotiation, contracting, and oversight of hundreds of individual site licenses has meant that DoD has paid far more than was necessary for access to specific standards. The board suggested that central procurement of private-sector documents not only would equate to significant savings but also would provide access for smaller programs, testing labs, design centers, and other activities that cannot afford subscription services.

Is taking a look at how each service, agency, command, or local activity gains access to NGSs a worthwhile undertaking? Clearly, the answer is yes. Perhaps this review should begin with a librarian, perhaps with contracting personnel, perhaps at the headquarters level. No matter where the effort begins, the task needs to be undertaken. Our defense dollars are shrinking; simply put "getting more bang for the buck" is no longer a nice phrase but a way of life. If putting together a compelling business case for consolidated access to NGSs will mean ensuring DoD activities have access to NGSs, and at a lower cost, then forming the necessary strategic alliances and breaking down institutional barriers is well worth the effort.

Mr. Edwards has indicated that he is eager to share not only the actual business case but also the lessons learned from this effort with other interested DoD activities. Also, AMC is agreeable to consolidating its contracting action with other Army and DoD entities wanting enterprise-wide access to NGSs. AMC has brought on board a full-time program manager to provide an organizational structure to ensure that this effort moves forward and grows wherever feasible. For more information, please contact Mr. Edwards at 256-450-9135 (DSN 320-9135) or timothy.edwards@us.army.mil.

Gregory Saunders Receives Howard Coonley Medal

The board of directors of the American National Standards Institute (ANSI) awarded Gregory Saunders, DSPO's director, ANSI's Howard Coonley Medal. The medal honors an executive who has rendered great service to the national economy through voluntary standardization and who has given outstanding support to standardization as a management tool.

The award was named for Howard Coonley, who for many years was president and chairman of the board of the Walworth Company. He served three terms as president of ANSI, then known as the American Standards Association, and 22 years on its board of directors.

Greg Saunders receives Howard Coonley Medal from Arthur E. Cote, Chairman of the Board, ANSI.

DSPO Issues Revised SD-19

Standardization Document 19 (SD-19) has been revised and renamed *Parts Management Guide*. The new version, issued in September 2009, was restructured and updated to reflect the performance-based parts management strategy described in MIL-STD-3018, "Parts Management" (October 2007) and the recent changes to the defense acquisition framework. SD-19 is available online at http://assist.daps.dla.mil/quicksearch/ident_number=119791.

Events

Upcoming Events and Information

August 15–19, 2010, Boston, MA

SES Annual Conference

The Standards Engineering Society will hold its 59th annual conference, along with two professional development courses and other events, at the Long Wharf Marriott in Boston, MA. For more information or to register, please go to the SES website: http://www.ses-standards.org/.

October 25–28, 2010, Las Vegas, NV

DMSMS Annual Conference

The Diminishing Manufacturing Sources and Material Shortages program will hold its annual conference on October 25–28, 2010, at the Rio in Las Vegas, NV. The details are still being worked out, but you can go to the DMSMS 2010 website—http://www.dmsms2010.com—to check periodically for updates.

People

People in the Standardization Community

Welcome

Maurice Womack joined the Interconnection Branch in the Document Standardization Division at Defense Supply Center Columbus (DSCC) in January 2009. He is a junior engineer, working with the Fluid Power Conveyance and Miscellaneous Mechanical Group. He brings a wealth of experience from private industry. He worked at Battelle Memorial Institute as a research mechanical engineer and at MS Consultants as a mechanical engineer on heating, ventilating, and air conditioning plumbing designs.

In April 2009, **Chris Hancock** joined the Hybrid Devices Branch in the Sourcing and Qualifications Division at DSCC. Mr. Hancock graduated with a BS in electrical and computer engineering from the Ohio State University in 2008. He has prior industry experience as a technical customer representative at Pittsburgh Plate Glass Company.

Sonya Taylor joined the Passive Devices Branch in the Sourcing and Qualifications Division at DSCC on July 20, 2009, as an electronics engineer. She will be working in the Federal Stock Class 5935–Electrical Connector arena. Ms. Taylor is specializing in radio-frequency and fiber-optics connectors. She comes to DSCC with experience she gained while working for Lucent and Nextel.

Bryant Allen, Headquarters, Army Materiel Command, Redstone Arsenal, was recently selected as the lead staff engineer on matters pertaining to the Army standardization program. He will manage the execution of the Army standardization program, including both domestic and international components, and will provide advice on standardization matters to the Army Standardization Executive, the Army Departmental Standardization Officer, and the Army acquisition and sustainment communities. Mr. Allen comes from the Logistics Support Activity, where he was an engineer in the Logistics Engineering Division, Policy and Standards Branch, preparing standards related to life-cycle logistics.

On June 21, 2009, **Charles Saffle** was promoted to chief of the Microelectronics Branch in the Document Standardization Division at DSCC. Mr. Saffle leads and manages the microelectronics standardization programs as the specification preparing activity.

Areas under his cognizance include microcircuit testing and packaging standards, the hybrid general manufacturing specification, and specifications for bipolar, interface, linear, and memory monolithic microcircuits and hybrid microcircuits. Previously, Mr. Saffle was a lead engineer in the Active Devices Branch at DSCC for the microcircuit general manufacturing specification, microprocessor specifications, and radiation hardness assurance.

Farewell

Paul McCoy retired from the Defense Supply Center Richmond on July 3, 2009, with 30 years of government service. He was the preparing activity for Federal Supply Group 31–Bearings. We wish him well in his retirement.

Kathy Lyons of the Sourcing and Qualifications Division at the Defense Supply Center Columbus retired on August 3, 2009. She specialized in the wire and cable arena. Ms. Lyons left with close to 30 years of government service. We all wish her well in her retirement.

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
October/December 2009	Warfighter Support
January/March 2010	Diminishing Manufacturing Sources and Material Shortages
April/June 2010	2009 Standardization Stars
July/September 2010	Systems Engineering

If you have ideas for articles or want more information, contact Tim Koczanski, Editor, *DSP Journal*, Defense Standardization Program Office, 8725 John J. Kingman Road, STP 5100, Fort Belvoir, VA 22060-6220 or e-mail DSP-Editor@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.