Defense Standardization Program

Journal

January/March 2015

Non-Government Standards

SAE's New Standard for Manufacturing Management

EIA-649-1 Configuration Management Requirements for Defense Contracts Best Practices

Extending Industry Standards to Meet the Systems Engineering Needs of Defense Programs

Defense Standardization Program Journal

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Gregory E. Saunders
Director, Defense Standardization Program Office

Tim Koczanski
Editor, Defense Standardization Program Journal

Defense Standardization Program Office
8725 John J. Kingman Road, STOP 5100
Fort Belvoir, VA 22060-6220

703-767-6888
Fax 703-767-6876

dsp.dla.mil

Director's Forum

Bringing back a few of the old "standards"…

As both a music lover and standards professional, there is a fondness in my heart for what are termed "old standards." And while the term has become most associated with the jazz and swing era (i.e., jazz standards), the fact of the matter is "old standard," or old "standard," can mean different things to different people.

What do you think about when you hear the term "old standard"? Does the term evoke a nostalgic memory such as Billie Holiday's "Good Morning Heartache" or a myriad of standards that were canceled under MilSpec Reform? Musically speaking, an old standard is a song that remains in popular currency for several decades. And though these old standards can fall in and out of popularity over time, they somehow manage—through changes made to fit the current audience—to find their way back into popular culture.

Interestingly enough, the same can be said with some of our old standards that were canceled during MilSpec Reform. During the 1990s, many of our military standards were canceled in lieu of commercial standards in response to reforms and legislation. And while at the time, DoD felt justified canceling these standards, we would later come to realize that many of the commercial standards were not developed or structured to be used in defense contracts and, as a result, were implemented inconsistently across the board. Thus, gaps emerged in our ability to require a standardized approach to ensure processes were ready for development and production by our contractors. That position was further echoed when the Government Accountability Office released findings, in various reports, stating that the loss of some of the standards had created cost overruns, schedule delays, and quality problems. And while the problems persisted, it wasn't until 2011, when, after many years of trying to work an unworkable system, did the Defense Standardization Council—under the leadership of Mr. Stephen P. Welby, Deputy Assistant Secretary of Defense for Systems Engineering—allow the services to take a look back at some of the standards canceled under MilSpec Reform and to present a business case as to why they should be brought back. This was an epic event in which the Council went back to explore some of the decisions made and revisit some of those cancellation decisions. I have always shared Mr. Welby's view that technical standards pro-

Gregory E. Saunders
Director
Defense Standardization Program Office

vide the corporate process memory needed for a disciplined systems engineering approach by helping to ensure that the government and its contractors understand the critical processes and practices necessary to take a system from design to production and sustainment. Without these standardized building blocks in place, inconsistent application can cause a myriad of problems, including cost overruns, scheduling delays, and quality problems. To accommodate this review, the Council appointed team leads from the Army, Navy, and Air Force. Each team worked tirelessly to research issues caused by a given set of canceled standards, developed a business case, briefed upper management, and, when given the okay to move forward, worked with non-government standards bodies to develop new versions of the standards for which a void had been left after the reforms of the 1990s.

This issue of the ***Defense Standardization Program Journal*** represents the culmination of some of that work. In this issue, you will learn about the work that went into bringing some of these old standards back, and although they are not in their original military-unique form, you will see how the principles and discipline of working standards issues still have relevance in today's defense environment. Kicking off this issue, Mr. David Karr, from the Air Force's Life Cycle Management Center at Wright-Patterson Air Force Base, discusses the work that went into SAE International Standard AS6500, "Manufacturing Management Program," which replaces MIL-STD-1528A, canceled under MilSpec Reform. MIL-STD-1528A's cancellation left a void for manufacturing requirements that both DoD and industry are hoping to turn around with SAE AS6500.

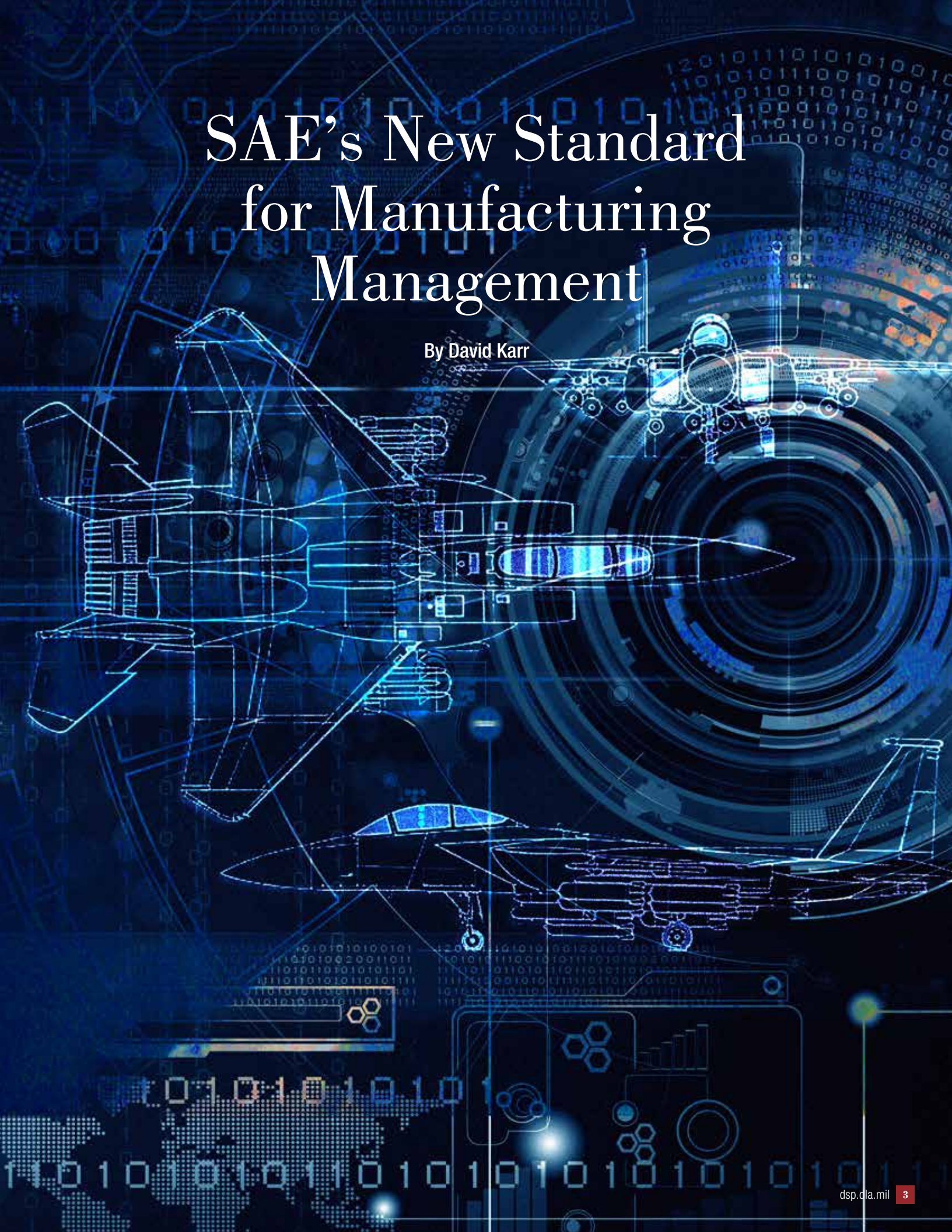
Another old standard, MIL-STD-973, "Configuration Management (CM)," was canceled and replaced with EIA-649, "National Consensus Standard for Configuration Management," in 2000. Mr. Dan Christensen and Mr. Larry Gurule discuss not only the development of EIA-649-1, but the steps the Configuration Management Standards Working Group took to bring EIA-649-1, "Configuration Management Requirements for Defense Contracts," and EIA-649-B, "Configuration Management Standard," forward.

Another gap filled by this exercise was the development of two IEEE standards, discussed in the article by Mr. Garry Roedler, Mr. Brian Shaw, and Mr. David Davis. Both IEEE 15288.1, "Standard for Application of Systems Engineering on Defense Programs," and IEEE 15288.2, "Standard for Application of Technical Reviews and Audits on Defense Programs," address the defense-specific needs for systems engineering processes and technical reviews and audits while leveraging the industry knowledge base.

While I would never recommend making a habit of second-guessing past decisions, I would say that if this exercise has taught us anything, it has taught us that the standards discipline within DoD needs to remain flexible and fluid to meet the demands of our warfighters at any given time. We do not want to go back and revisit all our past decisions, but we must always use the tools available to us when gaps in our process arise. Whether it is taking time to do a gap analysis or develop a business case, we must always stay focused on the fact that our strategy and policy need to remain as agile as our weapons. So a toast, not only to a job well done, but also for bringing back some of the old standards that are truly needed in solving today's complex issues.

SAE's New Standard for Manufacturing Management

By David Karr



SAE International recently published AS6500, "Manufacturing Management Program," a commercial standard governing the implementation of best practices for the management of manufacturing operations. In many ways, AS6500 replaces MIL-STD-1528A, "Manufacturing Management Program," which was canceled as part of DoD's acquisition reform initiative in the mid-1990s. Until then, DoD used the military standard in contracts to specify requirements, such as manufacturing feasibility assessments, producibility analyses, supplier management, and production readiness reviews.

In the absence of MIL-STD-1528A, DoD contracts were generally silent on manufacturing requirements. DoD lost its ability to require a standardized approach to ensuring manufacturing processes were ready for development and production. Companies implemented a wide range of systems with an equally wide range of effectiveness. Subsequently, the Government Accountability Office identified the lack of manufacturing maturity on many programs as a root cause that led to cost overruns, schedule delays, and quality problems. Compared with commercial industry, DoD has been willing to accept more risk when it comes to a lack of manufacturing maturity when DoD programs enter into the production phase. Commercial companies demonstrate that their manufacturing processes are stable and capable before they commit to a production decision. That has not always been the case with DoD programs, and it is a situation that DoD and industry are hoping to turn around with the publication of AS6500.

Senior defense industry leaders have told their DoD counterparts that when budgets are tight (and when aren't they?), they sacrifice manufacturing activities that are perceived to add cost in the near term because there are no specific customer requirements to perform those tasks, even though they are beneficial. This is especially true in competitive environments when offerors are reluctant to propose additional activities that are not specifically required in the request for proposals (RFP). One industry leader said that he had to lay off all of his producibility engineers in the 1990s because of the perceived added cost. Manufacturing managers have the difficult job of justifying initiatives that will have long-term benefits, but will increase costs in the short term. By including AS6500 in RFPs, industry manufacturing managers will have a customer requirement against which they can budget value-added, long-term improvement activities.

Background

DoD recognized the need for improvement and standardization in the area of manufacturing management. However, unlike the quality management area, which has commercial standards such as ISO 9001 and AS9100, no government or commercial manufacturing management standards were available. As a result, the Defense Standardization Council

approved the development of a manufacturing management standard and directed that the first priority for the development be a non-government standard. DSPO established a working group to identify potential standards developing organizations (SDOs) and select the best SDO to develop the standard. In September 2013, the working group recommended, and DSPO announced the selection of, SAE International to develop the standard.

SAE was ideally suited for this effort, because it already publishes and maintains several standards in related fields, such as AS9100, "Quality Management Systems–Requirements for Aviation, Space and Defense Organizations"; AS9102, "Aerospace First Article Inspection Requirement"; and AS9103, "Aerospace Series–Quality Management Systems–Variation Management of Key Characteristics." SAE provides flexibility to its committees to proceed in a way that best meets its needs in terms of the committee membership, operations, and the format and content of the final document. It also has a recognized, structured approach for document review and balloting that ensures all voices are heard and the resulting standard is technically sound.

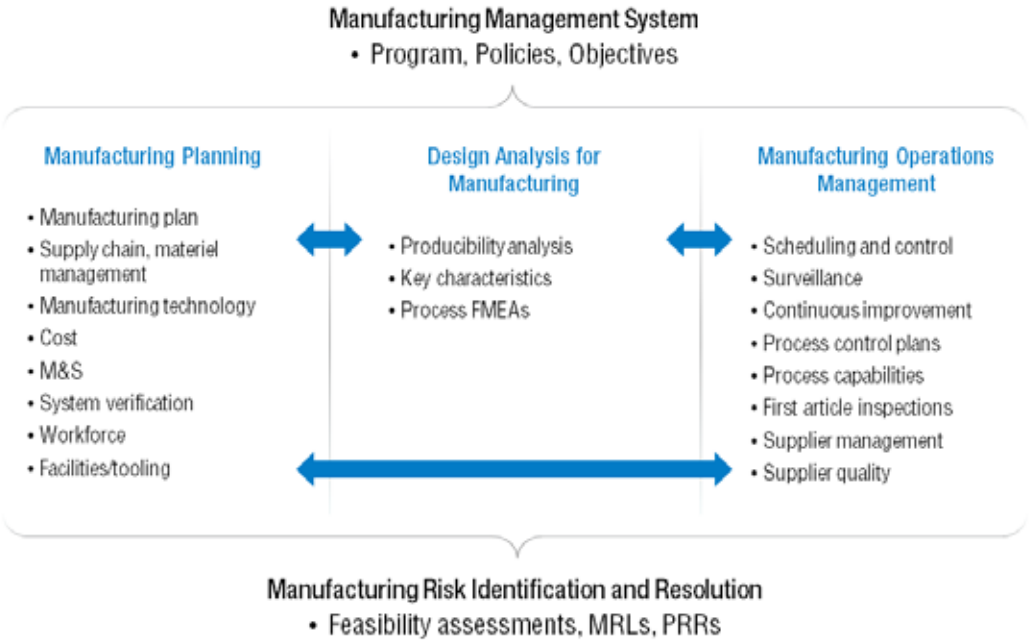
SAE established a new committee, the G-23 Manufacturing Management Committee, in November 2013 to develop the standard. The committee's charter states it is "responsible for the development, coordination, publication, and maintenance of a standard that documents best manufacturing practices aimed at promoting the timely development, production, modification, fielding, and sustainment of affordable products."

The G-23 Committee, which is balanced between DoD and defense industry subject matter experts, invited industry associations to review the document and provide feedback. Two rounds of detailed reviews of the document were conducted over a span of 8 months, and the committee addressed nearly 350 comments. In November 2014, the Aerospace Council approved the standard for publication.

Content of the Standard

AS6500 applies to all phases of the system acquisition life cycle and is intended for use on all programs with manufacturing content. It describes both the tools to measure manufacturing maturity and the activities that should be conducted to successfully mature the manufacturing processes. As shown in Figure 1, the standard covers manufacturing planning, design analysis, operations management (including supplier management), and manufacturing risk identification. It includes specific practices, such as producibility analyses, identification of key characteristics, and process failure modes and effects analyses.

Figure 1. Overview of AS6500 Content



Notes: FMEA = failure modes and effects analysis, M&S = modeling and simulation, MRL = manufacturing readiness level, and PRR = production readiness review.

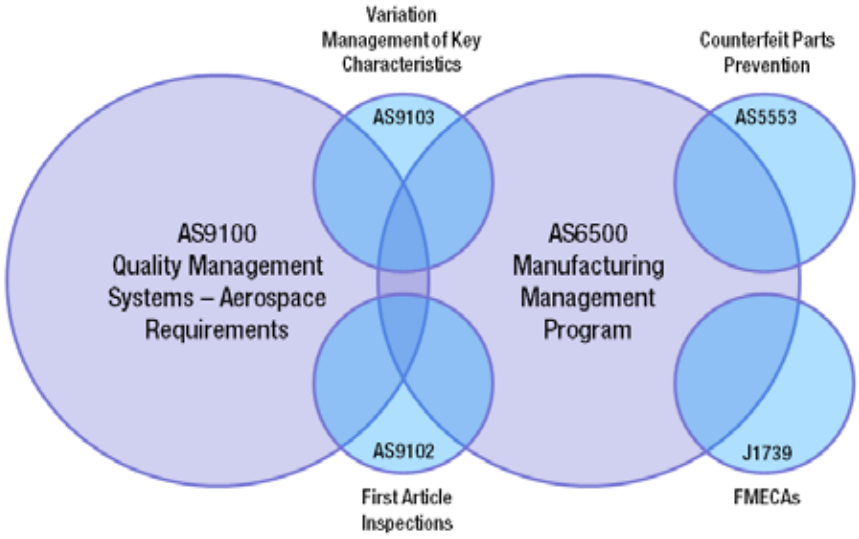
A key element of AS6500 is the use of manufacturing readiness levels (MRLs) to assess the maturity of manufacturing processes and components. MRLs have become the generally accepted approach among the services and many defense companies to determine manufacturing readiness and identify manufacturing risks. MRL determinations are made through the evaluation of nine topic areas or "threads," arranged in a matrix of objective criteria that reflects the growing expectation for product maturity as a program progresses through its life cycle. The threads, criteria, and matrix were developed by an MRL Working Group consisting of members of the Office of the Secretary of Defense, military services, Defense Acquisition University, and industry. AS6500's adoption of this approach will further ingrain MRLs into the defense industrial base.

Because suppliers perform a significant amount of development and production, many delivery and quality problems begin at lower-tier vendors before they become apparent to the prime contractor. AS6500 not only addresses in-house manufacturing management at prime contractors, but also their management of suppliers.

The standard requires organizations to establish and maintain supplier management systems to evaluate the capabilities of suppliers, track and report supplier performance, and identify and manage supplier risks. The standard also focuses on ensuring the quality of parts delivered by suppliers by flowing down quality requirements, verifying suppliers' procedures for controlling quality, and using predictive indicators to provide early detection of potential quality problems at suppliers.

As illustrated in Figure 2, AS6500 goes hand-in-hand with AS9100, as well as with several other commercial standards: AS9102; AS9103; AS5553, "Fraudulent/Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition"; and J1739, "Potential Failure Mode and Effects Analysis in Design (Design FMEA), Potential Failure Mode and Effects Analysis in Manufacturing and Assembly Processes (Process FMEA)." AS6500 complements AS9100 by providing more detailed application requirements for manufacturing and supplier management. It also incorporates key elements of AS9102, AS9103, AS5553, and J1739 and refers the users to those standards for more detailed guidance.

Figure 2. AS6500 and Related Commercial Standards



Note: FMECA = failure mode, effects, and criticality analysis.

Implementation

AS6500 must be included in statements of work to be contractually binding. The standard may be tailored to meet the needs of each program's unique situation. Requirements within the standard are designed to reduce program life-cycle costs. Those that are not specifically applicable may be eliminated or adapted to fit the program. For example, the requirements for design analysis may not be appropriate when applying the standard in a mature production program.

Although the standard is primarily aimed at the defense industrial base, the G-23 Committee made every effort to write the requirements as generically as possible so that other industries may use the standard. The G-23 Committee also designed the standard to be applicable to companies of nearly any size, allowing adaptation of the requirements appropriate to the level of effort, the complexity of the product, and the size of the supplier. The standard's requirements are intended to be top level, providing each company the flexibility to implement its own processes to meet the requirements.

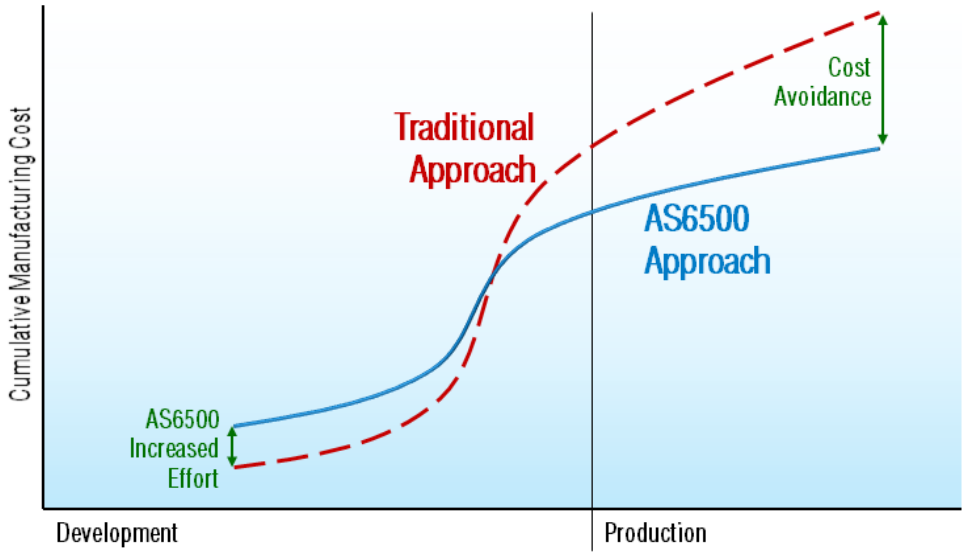
Benefits

AS6500 will directly contribute to the success of DoD's Better Buying Power (BBP) initiative. Key tenets of BBP include achieving affordable programs, controlling costs throughout the life cycle, incentivizing productivity, and eliminating unproductive processes. AS6500 supports the BBP tenets through the application of producibility techniques, early focus on production costs, and the implementation of continuous improvement and lean manufacturing processes. Since a significant portion of a program's life-cycle cost is driven by manufacturing activities, increased effectiveness in manufacturing management will lead to overall program affordability.

Application of AS6500 in the early phases of development and production may require additional resources. However, this investment will pay off in the long term by driving down the cost of development and production through improved quality, higher schedule confidence, and more producible products. As Figure 3 depicts, the savings during development and production will far outweigh the investments required in early phases, resulting in an overall reduced program life-cycle cost.

AS6500 sets the standard in manufacturing management and provides a contractual vehicle for ensuring more consistent implementation of these practices throughout the defense industrial base. The effectiveness of these practices has been demonstrated time and again, and implementing them early in the acquisition life cycle will allow both DoD and industry to benefit from reduced costs, more capable manufacturing processes, and more robust products.

Figure 3. AS6500 Costs vs. Savings

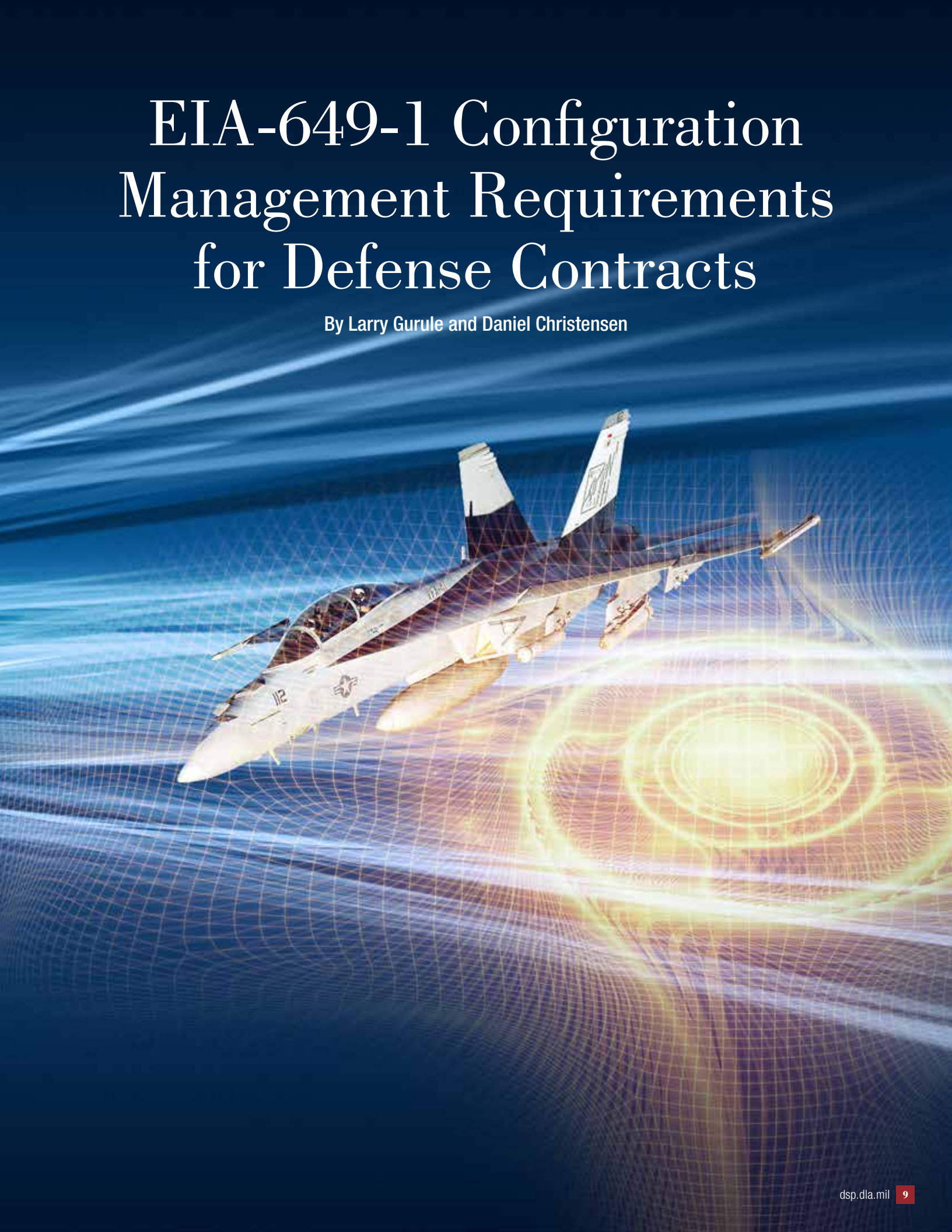


About the Author

David Karr is the technical advisor for manufacturing and quality in the Engineering Services Directorate at the Air Force's Life Cycle Management Center at Wright-Patterson Air Force Base. He is responsible for developing policies and processes in the areas of manufacturing and quality and for assisting programs.

EIA-649-1 Configuration Management Requirements for Defense Contracts

By Larry Gurule and Daniel Christensen



DoD publishes military standards to ensure defense contractors and suppliers employ consistent, efficient, and effective processes and conform to government policy. Section 12(d) of the National Technology Transfer and Advancement Act of 1996, Public Law 104-113, directed the federal government to use technical standards developed or adopted by voluntary consensus standards bodies as a means to carry out policy objectives or activities determined by the agencies and departments.

During acquisition reform in the late 1990s and early 2000s, and in response to Public Law 104-113, DoD canceled many of the military standards and adopted commercial standards in their place as a cost-saving measure. For example, the Department adopted EIA-649, "National Consensus Standard for Configuration Management," then canceled MIL-STD-973, "Configuration Management (CM)," in 2000.

However, some of the commercial process standards were not developed or structured for use on defense contracts. The foreword of the current version of SAE International's ANSI/EIA-649-B, "Configuration Management Standard," states that "because of the broad scope of its applicability, this standard is not written as a requirements document, per se, but as the foundation document upon which requirements may be structured." The foreword goes on to address the "per se":

> In the acquirer/supplier context there are several methodologies to conformance by a supplier: …
>
> - Acquirer uses 649 as the basis for developing either, or both, an enterprise CM requirements document or a specific project CM requirements document to impose on suppliers.
> - The requirements documents may state 649 principles as requirements and reference 649 paragraphs. Compliance with the contractual requirements constitutes conformance with 649.

Because ANSI/EIA-649-B contains the text "this standard is not written as a requirements document, per se," it has been applied inconsistently in DoD contracts.

Gap Analyses and Development of EIA-649-1

In 2010, the Air Force briefed the Defense Standardization Council (DSC) regarding the need to reinstate several military standards, including the canceled MIL-STD-973 for CM. The DSC, which champions standardization throughout DoD to reduce costs and improve operational effectiveness, agreed that having some select standards applicable across DoD acquisition programs could improve program execution. The DSC directed DSPO to work with the services to form a CM gap analysis working group to confirm

the need for an enterprise-wide approach to certain process standards, including CM. In 2011, the CM gap analysis working group submitted its findings indicating that suitable standards do not exist to meet DoD's requirements. The DSC agreed with the findings.

In March 2012, the Defense Standardization Executive directed that the first course of action should be to engage organizations that develop non-government standards (NGSs) to determine whether existing NGSs could be modified or whether the organizations may be interested in developing new standards to meet DoD's requirements. This direction complies with Public Law 104-113, which states that

> Federal agencies and departments shall consult with voluntary, private sector, consensus standards bodies and shall, when such participation is in the public interest and is compatible with agency and departmental missions, authorities, priorities, and budget resources, participate with such bodies in the development of technical standards.

Understanding the length of time it takes to develop a standard, the Army requested and received DSC approval to release MIL-STD-3046, "Interim Standard Practice for Configuration Management," for use on contracts while the CM NGS was developed. Released on March 6, 2013, MIL-STD-3046 will be canceled when the CM NGS is published, or after 2 years.

The Navy stood up and led the chartered Configuration Management Standards Working Group (CMSWG) to develop the CM NGS. The CMSWG comprises participants from the uniformed services, including the U.S. Coast Guard, and from other DoD agencies, such as the Defense Contract Management Agency, National Security Agency, and Defense Logistics Agency. The CMSWG generated an initial draft standard, which was presented to the SAE G-33 Committee on Configuration Management in October 2013. The SAE G-33 Committee initiated a formal project in November 2013 to develop the EIA-649-B addendum, referred to as EIA-649-1, "Configuration Management Requirements for Defense Contracts."

The CMSWG distributed multiple drafts of the EIA 649-1 for review across DoD and industry. To date, this group has adjudicated more than 3,750 comments to provide a standard compliant with DoD policy and supported by both DoD and industry. In addition to writing the EIA-649-1, the CMSWG modified 19 CM-related data item descriptions (DIDs) to prescribe deliverables compliant with EIA-649-1. In addition, the CMSWG reviewed and updated five CM-related DoD forms—DD Form 1692, Engineering Change Proposal (ECP); DD Form 1694, Request for Variance (RFV); DD Form 1695, Notice of Revision (NOR); DD Form 1696, Specification Change Notice (SCN); and DD Form 2617, Engineering Release Record (ERR)—and added detailed instructions to support consistent implementation and use in support of EIA-649-1.

Configuration Management Requirements for Defense Contracts

ANSI/EIA-649-B and other standards, including MIL-STD-3046 and DoD addenda to ISO/IEC/IEEE 15288, "Systems and Software Engineering–System Life Cycle Processes," influenced the development of EIA-649-1. Other key sources of information guiding EIA-649-1 development include current DoD policy (in particular, the interim DoD Instruction 5000.02, "Operation of the Defense Acquisition System") and related DoD guidance, such as the *Defense Acquisition Guidebook*, Chapter 4, "Systems Engineering" (in particular, Section 4.3.7 on configuration management) and the military handbook MIL-HDBK-61A, *Configuration Management Guidance*.

Consistent with ANSI/EIA-649-B, EIA-649-1 makes use of the acquirer and supplier roles to define requirements. The SAE G-33 website contains the following information describing the scope of EIA-649-1:

> This document defines configuration management requirements which are to be applied, based on program needs, in contracts with suppliers for products and/or their designs during the contract period of any Configuration Item (CI) which meets the following criteria:
>
> a. Developed wholly or in part with Acquirer funds, including non-developmental items when the development of technical data is required to support the products or services being acquired or
>
> b. Designated for configuration management for reason of integration, logistics support or interface controls.

By defining how CM requirements are to be applied in contracts with suppliers, EIA-649-1 drives the program to understand and quantify the requirements as accurately and as early as possible to support effective CM and control of the system baseline.

The foreword to the EIA-649-1 further emphasizes the standard's purpose and inherent linkage to EIA-649-B:

> This document defines requirements for a Defense enterprise implementation of the American National Standards Institute/Electronics Industry Association, ANSI/EIA-649 in an Acquirer/Supplier contractual relationship.
>
> The requirements are intended to be tailored by the Acquirer and cited in contracts or similar agreements with Suppliers to establish requirements for Configuration Management tasks consistent with ANSI/EIA-649 and each of its functions and principles.
>
> Unless otherwise indicated, the requirements described herein apply to both hardware and software systems.

It is the responsibility of the Acquirer to determine the specific needs for their respective programs and ensure that their contracts or agreements sufficiently communicate those requirements.

This standard also applies when other types of agreements exist, such as agreements between government organizations who play the roles of acquirer and supplier.

Finally, this document is intended to be used as a stand-alone reference, invoked on a contract where the acquirer intends to be consistent with ANSI/EIA-649 Principles, and may be used for Department of Defense (DoD) programs in all phases of the acquisition life cycle.

Even though EIA-649-1 is intended to satisfy DoD contracting requirements, this CM standard applies to any commercial or government enterprise engaged in acquirer/supplier CM activities.

Appropriate CM, the "Goldilocks Factor"

EIA-649-1 is intended to help the government and industry in the acquirer role place CM requirements on DoD contracts by supplying the "shall" statements for implementing the EIA-649-B CM functions and principles.

The standard is intended to be tailored to fit the unique needs of a defense acquisition or sustainment program. To help facilitate this, EIA-649-1 contains a tailoring worksheet listing all the CM requirements, or "shall" statements, by paragraph number. Figure 1 is an example. CM practitioners may use the worksheet to help tailor the requirements of this standard to fit their program's phase, acquisition strategy, and system development approach. This worksheet is not intended to be part of the contract but to help determine which requirements, i.e., activities and deliverables, are needed for placement on contract.

Status

EIA-649-1 successfully completed two rounds of formal voting at the SAE G-33 Committee level in September 2014. The SAE Aerospace Council formally approved EIA-649-1 in October, and the DSC CMSWG officially issued the standard in November.

The standard will be synchronized with the cancellation of the interim MIL-STD-3046 and associated DIDs.

Figure 1. EIA-649-1 Tailoring Worksheet

ANNEX B Tailoring Worksheet

B.1 General
This Annex is a tool for practitioners to use to aid them in tailoring requirements of this standard and is not intended to be part of the contract.

B.2 Matrix Description
A check mark in the column entitled "Applies" indicates where the Acquirer has determined the applicability of the SAE Configuration Management Requirements for Defense Contracts, EIA-649-1.

Paragraph	Requirement	Sub requirement	Applies Y/N	Change or Clarification	SOW Paragraph	DID No.	CDRL Number	CDRL Tailoring
3.0 Configuration Management Requirements	(1)							
	(2)							
	(3)							
	(4)							
3.1 Planning and Management	(1)	a.				DI-SESS-80858 Supplier's Configuration Management Plan		
		b.						
		c.						
		d.						
		e.						
		f.						
		g.						
		h.						
		i.						

Complementary Coordinated Family of CM Principles and Processes

The acquirer should use EIA-649-1 in concert with EIA-649-B and leverage the guidance provided in associated handbooks, such as EIA-HB-649 and MIL-HDBK-61A. With this arsenal of collaborative and standardized CM requirements, processes, principles, and guiding information, the CM professional should have a strategic advantage in implementing and executing acquirer/supplier (i.e., government/contractor) CM more efficiently and effectively.

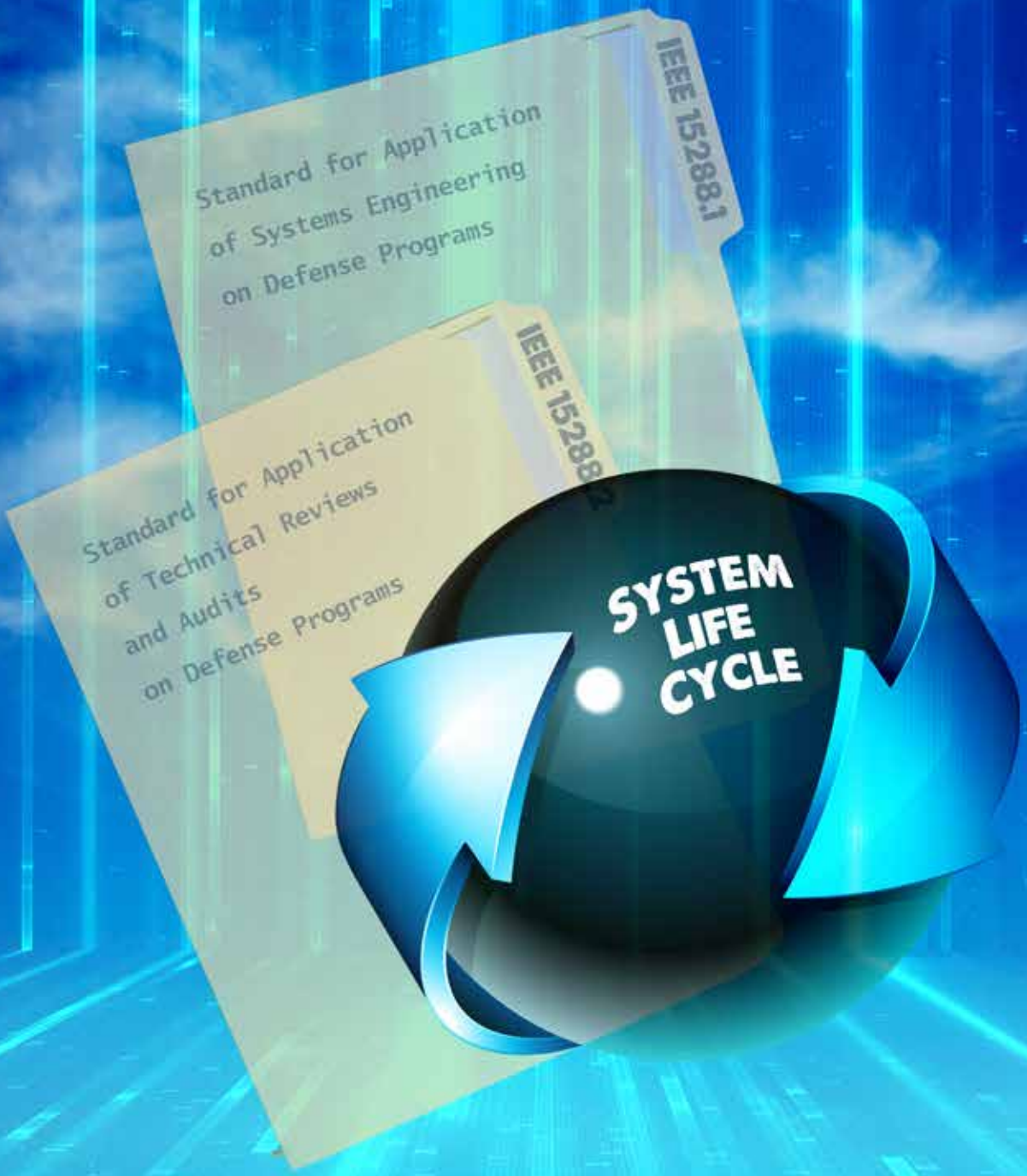
About the Authors

Larry Gurule is president of i-Infusion, Inc., a CMPIC® associate instructor, and an active SAE G-33 Configuration Management committee member. An experienced consultant, he specializes in process- and knowledge-driven environments, including product development, engineering, manufacturing, supply chain, retail, distribution, and service/process industries. Mr. Gurule has also owned and/or held senior-level positions in manufacturing, software, and service-based businesses, and he has lectured to and consulted with hundreds of individuals from Fortune 500 companies and various government agencies on process improvement and enterprise IT implementation initiatives.

Daniel Christensen is the configuration/data manager for the Naval Air Systems Command and chairman of the DSC CMSWG. He holds numerous certifications, including Enterprise CM Professional, CMII Professional from the Institute of Configuration Management, CMPIC Masters Certification of Enterprise Configuration Management and Configuration Management Subject Matter Expert from the University of Houston, and Certified Configuration and Data Manager from National Defense Industrial Association (NDIA). Mr. Christensen is a member of the International Society of Configuration Management and of SAE International. For the latter, he is the government liaison to the G-33 committee and to the NDIA Technical Information Division committee. Mr. Christensen is a 2012 recipient of the TechAmerica Associate Technical Fellowship award.

Extending Industry Standards to Meet the Systems Engineering Needs of Defense Programs

By Garry Roedler, Brian Shaw, and David Davis



Acquisition reform in the 1990s left gaps in the standardization of systems engineering (SE) for defense programs. However, over the past few years, DoD has defined the gaps and taken action to work collaboratively with industry, academia, and the standards development organizations (SDOs) to deal with the gaps. As a result, two new industry consensus standards—IEEE 15288.1, "Standard for Application of Systems Engineering on Defense Programs," and IEEE 15288.2, "Standard for Application of Technical Reviews and Audits on Defense Programs"—have been developed to address the defense-specific needs for SE processes and technical reviews and audits (TR&As), while leveraging the industry knowledge base.

Background and Objectives

Engineering standards can be used for bringing consistency to processes and the life-cycle management of systems or products. Processes are standardized to implement standard practices that facilitate engineering effectiveness based on best practices derived from academic/applied research and lessons learned. Stephen Welby, Deputy Assistant Secretary of Defense for Systems Engineering, DASD(SE), and chairman of the Defense Standardization Council (DSC), clearly expressed the current DoD position when he wrote, "Technical standards provide the corporate process memory needed for a disciplined systems engineering approach and help ensure that the government and its contractors understand the critical processes and practices necessary to take a system from design to production, and through sustainment."[1]

The 1994 acquisition reform drove the reduction of military standards to a fraction of what was in place in the 1980s.[2] As acquisition reform was implemented, many gaps were identified that needed to be addressed. The gaps include the absence of requirements and the conversion of previous standards into handbooks whose format prohibits use as contractual compliance documents. Industry responded to acquisition reform by establishing internal practices, often based on the military standards that have been in use for years. The non-governmental standards organizations also reacted by either converting canceled military standards into non-governmental standards or by developing new industry consensus standards to fill critical voids. These newer types of documents became part of the basis for contractors' "total system performance" responsibility in this new era of government contracting where buzzwords like "faster, better, cheaper" became the mantra for other buzzwords like "doing more for less." Whatever the mantra or buzzword, this new era of acquisition was characterized by tight budgets and high levels of competition yet a continued need for industry to meet the government's requirements.

In the military space sector, the 1990s brought several dramatic launch failures (including Titan IV[3] and Delta III[4]) that resulted in an unanticipated waste of millions of dollars. One of the attributes of a launch failure is that not only is the launch vehicle lost in such a mishap, but so too is the payload comprising a very expensive and potentially mission-critical satellite. Even when the launch goes well, there are great risks for the space vehicle. Once a satellite is off the ground, it is largely unmaintainable. On-orbit failures can transform a satellite performing a critical mission into a useless piece of space junk, and preventing that is quite a feat considering that a satellite operational life may be 15 years in a rather hostile environment.

When space system failures happen, extensive investigations are undertaken to determine the root cause of the failure and identify countermeasures to ensure future success. These investigations addressed failure to implement critical engineering standards as contributory to the launch mishaps.

The Air Force Space and Missile Systems Center (SMC), the primary military space acqusition agency, bucked the trend and, in 2003, reinstituted a collection of high-value standards as a routine part of space system acquisitions. The back-to-basics approach at SMC included not just reviving a formal standards program but focusing on effective implementation of basic SE practices that can contribute to mission assurance and mission success. Ultimately, SMC put into place a set of 68 standards and the infrastructure associated with maintaining and implementing the standards. These standards were selected considering prior failures and known best practices to ensure achievement of system/mission needs. SMC included all types of standards: interfaces, design criteria, manufacturing processes, standard practices, and test methods. It also used the best available source of standard: military, industry consensus, and locally written standards when justified.

SMC used four core principles of standards development, selection, and use. Specifically, the standards needed to (1) be the right size, not a gold standard but what is really needed to accomplish the objective; (2) be tailorable for scalability to individual acquisitions and to better describe the government's intent; (3) be clearly written, with requirements balanced against associated cost and schedule issues; and (4) use technical practices that have been optimized based on data and proven experience. Unlike some of the prior generation of standards, these newer standards focused on what needs to be done rather than specific how-to mandates. This addressed interest expressed by industry to be allowed to propose cost-effective alternatives that may be more efficient and lower cost yet meet the same mission need and design criteria.

In the SMC collection of standards were two locally developed standards: SMC-S-001, "Systems Engineering Requirements and Products," and SMC-S-021, "Technical Reviews and Audits for Systems, Equipment and Computer Software." These were initially released in 2008 and 2009 and used on SMC contracts.

Concurrent with SMC's standards revival was industry's recognition that SE capabilities had been lost in the cancellation of key standards such as MIL-STD-499, "System Engineering Management," and MIL-STD-1521, "Technical Reviews and Audits for Systems, Equipments, and Computer Software."

Notable in the effort to address SE needs was the National Defense Industrial Association's (NDIA's) Systems Engineering Division, which hosts an annual conference to foster government-industry technical interchange on this topic. These meetings crystalized several thoughts: all DoD services share the same SE need and have experienced similar degradation of SE capabilities/services, and both government and industry see value in standardization. Government benefits from having clearly stated requirements in a contractually compliant form, and industry benefits from having clearly stated requirements that they can bid against to ensure bidding sufficient resources to fulfill those requirements.

In 2011, DSC initiated a joint services activity, led by DASD(SE), to revive several key canceled standards, including SE, TR&As, manufacturing management, and configuration management. The goal of the gap analysis phase was fourfold:

- Identify need. Collect service inputs on problems resulting from the lack of specifications and standards.
- Determine gaps, for example, existence of industry SE standards that are not amenable for use on contracts and lack of industry technical review standards.
- Analyze alternative approaches.
- Recommend a way ahead to the DSC. The way-ahead recommendation was to revive and reinstate standards for SE and TR&As using the SMC standards as a starting point.

DSC's direction was to collaborate with industry and work toward industry consensus standards that would be suitable for use by DoD on contracts in these areas.

In 2012, a source selection phase was initiated for the joint service team to clarify its specific requirements for such a standard and to explore potential non-governmental SDOs for partnership. To support the government's assessment of capability and approach to developing standards suitable for use by DoD on contracts in these specific technical areas, the team held informal discussions and issued a formal request for information to the SDOs, NDIA, and Aerospace Industries Association. Key factors discussed included current involvement in the technical domain area, ability to coordinate a well-rounded and representative govern-

ment-industry team, internal SDO process continuity from standards development through distribution and maintenance, and proven experience in developing effective standards whose use can be contractually compliant. For the SE and TR&A effort, the IEEE Computer Society (IEEE-CS) was selected on the basis of its proven history with the development and maintenance of ISO/IEC/IEEE 15288, "Systems and Software Engineering—System Life Cycle Processes," and harmonization of the SE document suite with related standards and DoD guidance.

Approach and Scope of the Standardization

In 2013, IEEE formed the Joint Working Group for DoD Systems Engineering Standardization under the IEEE-CS. The working group was chartered to address two separate, but related projects, the SE standard, IEEE 15288.1, and the TR&A standard, IEEE 15288.2. The specific goals of these standards were to meet both the government and industry needs by being

- tailorable for different domains and contracting environments,
- consistent with the DoD technical and contracting approach, and
- conformant with established, overarching industry process standards and practices.

The working group's leadership comprised an industry chairperson, a government vice-chair, a secretary, and editors for each of the documents. Membership comprised members of DoD (7 organizations, including each service branch), defense contractors (15 organizations representing about 80 percent of U.S. defense spending), industry associations (6 organizations), and academia from the DoD Systems Engineering Research Center. As the projects progressed, the representatives from each organization reached back to their respective organizations to capitalize on the breadth of requirements needs and experience during document development and formal balloting. Initially, it was conceived that each project would be developed separately, but in practice, the members of each project overlapped almost entirely, so the working group worked both projects simultaneously.

Since SE has interfaces with other standards being developed under DSC's auspices, specific efforts were made to establish relationships with the working groups chartered under other SDOs, like SAE International's G-33, which is responsible for EIA-649-1, "Configuration Management Requirements for Defense Contracts," and SAE G-23, which is responsible for SAE AS6500, "Manufacturing Management."

The working group operated in accordance with the American National Standards Institute–accredited IEEE standards development process. The standards development process

ensures an open consensus process in which all interested stakeholders can participate. This facilitates open discussion and resolution of concerns, issues, and varied approaches with documented decision making. The balloting process was formally conducted by IEEE at both the working group and IEEE sponsor levels. IEEE also provided editorial and legal review prior to publication.

IEEE 15288.1 provides a standard with the defense-specific language and terminology to ensure the correct application of acquirer-supplier requirements for defense programs. The scope of the standard is focused on the system life-cycle processes, activities, and tasks of ISO/IEC/IEEE 15288 for use on any defense system and across the entire system life cycle. This standard was authored as an addendum that implements ISO/IEC/IEEE 15288 for use by DoD organizations and other defense agencies in acquiring systems or SE support. As an addendum rather than a standalone standard, IEEE 15288.1 does not repeat processes and information in 15288. IEEE 15288.1 used SMC-S-001 as a government requirements basis and incorporated best practices from the leading government and industry sources, including the *Defense Acquisition Guidebook*, International Council on Systems Engineering (INCOSE) *Systems Engineering Handbook* (SEH), *Guide to the Systems Engineering Body of Knowledge* (SEBoK), and others.

IEEE 15288.2 establishes the requirements for TR&As to be performed throughout the acquisition life cycle for DoD and other defense agencies. Since no current military or industry standard exists for TR&As, this standard amplifies ISO/IEC/IEEE 15288, Clause 6.3.2.3.a for selection, negotiation, agreement, and performance of the necessary TR&As, while allowing tailoring flexibility for the variety of acquisition situations and environments when the technical reviews or audits are conducted. IEEE 15288.2 elaborates on the activities and tasks related to TR&As, including defense-specific language and terminology, the criteria for reviews and audits, expected/required outcomes and products of reviews and audits, as well as a limited amount of essential explanation and guidance.

The development of the two standards spanned approximately 1 year of effort, including the authoring/review and balloting in preparation for final approval and release. Both projects executed by the IEEE Joint Working Group for DoD Systems Engineering Standardization resulted in standards that express a government-industry consensus and are suitable for use on DoD contracts, as did the related SAE efforts.

Summary of the Content

The base document used for this standardization effort is ISO/IEC/IEEE 15288, which provides a common, comprehensive, and integrated framework for describing and managing the full life cycle of systems. It is applicable to all size organizations, most domains,

and any life-cycle model. This standard defines a set of processes, concepts, and associated terminology that can be applied at any level in the structure of a system across its life cycle. The processes are organized into four groups: technical processes, technical management processes, agreement processes, and organizational project-enabling processes. Figure 1 identifies the processes within each group.

Figure 1. Process Structure in ISO/IEC/IEEE 15288:2015

Adopted from ISO/IEC/IEEE 15288: 2015.

Processes in 15288 cover the full life cycle and are intended to be applied as needed and tailored for the specific program characteristics and needs. They are not intended to applied in a one-size-fits-all, sequential, and linear approach. They focus on "what" is expected, not "how" to achieve it, thus allowing for a variety of methods, techniques, and tools. The expectation for appropriate tailoring is reinforced by the processes in each of the four process groups:

- *Technical processes*. The 14 processes in this group "are used to define the requirements for a system, to transform the requirements into an effective product, to permit consistent reproduction of the product where necessary, to use the product to provide the required services, to sustain the provision of those services and to dispose of the product" and any waste during its life cycle or when it is retired from service.
- *Technical management processes*. The 8 processes in this group "are used to establish and evolve plans, to execute the plans, to assess actual achievement and progress against the plans and to control execution" throughout the life cycle.

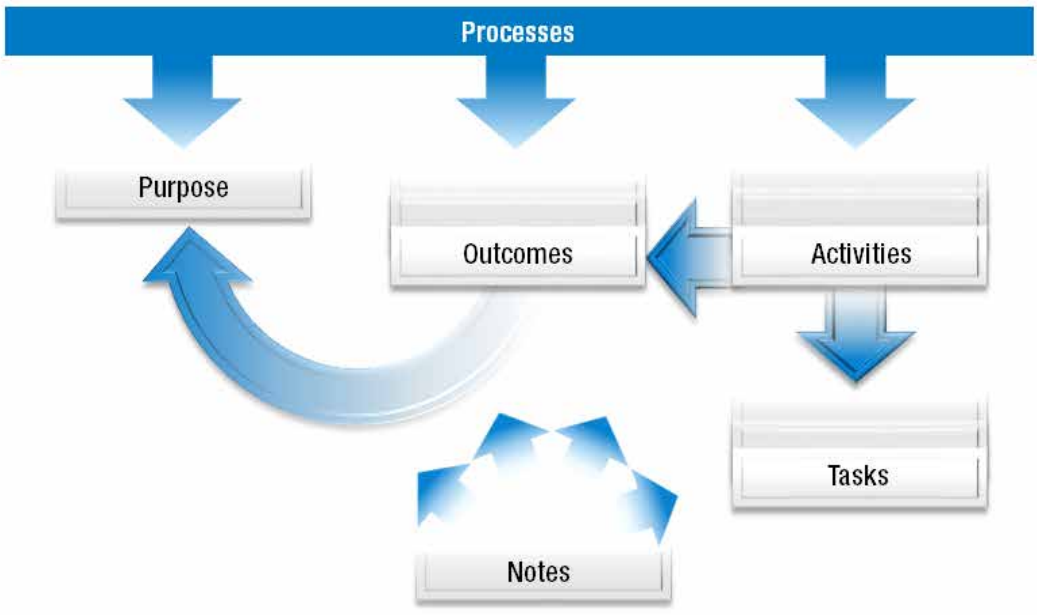
- *Agreement processes*. The 2 processes in this group define the expected interactions and parameters of an acquisition and supply relationship and "the activities necessary to establish an agreement between two organizations."
- *Organizational project-enabling processes*. The 6 processes in this group "ensure the organization's capability to acquire and supply products or services through the initiation, support and control of projects. They provide resources and infrastructure necessary to support projects." These processes focus on the interfaces with the organization that are necessary to enable to successful execution of projects.

As shown in Figure 2, each of the 15288 processes has five elements:

- *Purpose* states the overall objective of performing the process.
- *Outcomes* describe the most significant observable results of the successful achievement of the purpose.
- *Activities* provide the first level of actions to perform and generally provide a "binning" of the related lower-level elements called tasks.
- *Tasks* are performed to achieve the intent of the activities.
- *Notes* can be associated with any of the process elements to provide better understanding of expectations, relevant considerations, and other information to aid the planning and execution of the processes.

All of the processes in ISO/IEC/IEEE 15288 were determined to be relevant for application to defense programs. After gap analysis, the working group determined that additional processes were not necessary to cover the breadth of SE.

Figure 2. ISO/IEC/IEEE 15288:2015 Process Elements



IEEE 15288.1

IEEE 15288.1 is an addendum to the base standard providing tailoring and additional requirements to address defense application of the standard. Because IEEE 15288.1 was developed as an addendum to ISO/IEC/IEEE 15288, it includes only modifications, additions, or deletions to the process elements for each process. The structure of IEEE 15288.1 is the same as the structure of 15288, but does not repeat the base process information, since the two standards are intended to be used together. For each clause and process, IEEE 15288.1 identifies what information from the base standard applies, what does not apply, and what is changed or new. In addition to the changes to the process elements, IEEE 15288.1 also adds the expected outputs for each process. The outputs are stated in a way that attempts to avoid any specific structure, format, or technique. The requirements are kept to the "what" level rather than the "how" level.

IEEE 15288.2

IEEE 15288.2 is linked to the base standard through the planning process and the assessment and control process. However, the conduct of the processes also will invoke many other technical management processes, such as risk management and measurement. This standard is developed as a full content standard for TR&As. It is organized with one clause that provides an overview of TR&As and three clauses that provide the requirements and guidance for planning and executing TR&As:

- Clause 4 provides an overview of the reviews and their application in the life cycle, including the roles that are involved. Although this clause contains no requirements, it has useful information about planning the application of the reviews and audits.
- Clause 5 provides the requirements for each technical review and audit. The requirements include the purpose (why perform this technical review or audit); description (what system properties does the review or audit address); timing (when in the system life cycle or contract performance does the review or audit occur); and entry criteria, content, and exit criteria.
- Clause 6 provides the detailed criteria to be addressed in each review and audit. Specifically, for each review and audit, this clause contains four tables, which address (1) acceptability criteria, (2) preparation actions, (3) conduct elements, and (4) closure actions. These detailed criteria are expected to be tailored for the specific program.
- Clause 7 provides guidance for each TR&A for applying the detailed criteria identified in Clause 6. This clause does not contain normative (required) tasks, but does identify lessons learned or best practice information that should be considered.

IEEE 15288.2 includes the reviews and audits that the working group determined to be the most widely applicable to most defense programs. A specific type of program may find additional reviews useful and should consider them during planning. The standard's an-

nexes identify and describe a few additional reviews. The intent is for the program to tailor the reviews and audits, determining which TR&As to include to best meet the program's needs and mitigate the program's risks.

Expected Usage in Requests for Proposals and Contracts

The intent of the standards is to provide a tool for the government to use to establish the acquirer-supplier agreement in a contract.[5,6] Specifically, the government intends to cite these standards in requests for proposals (RFPs) and evaluate contractor proposals for compliance, including the proposed execution of the technical practices, planned outputs from the engineering efforts, and the resourcing for those activities.

The government intends the standards to be appropriately tailored, as indicated in the standards. Tailoring by the government as part of the RFP development process is an established best practice to ensure that the government's requirements are focused on the specific domain and system being addressed in the procurement. When standards are specified in an RFP for contractual compliance, they will be identified in the statement of work, including initial government tailoring.

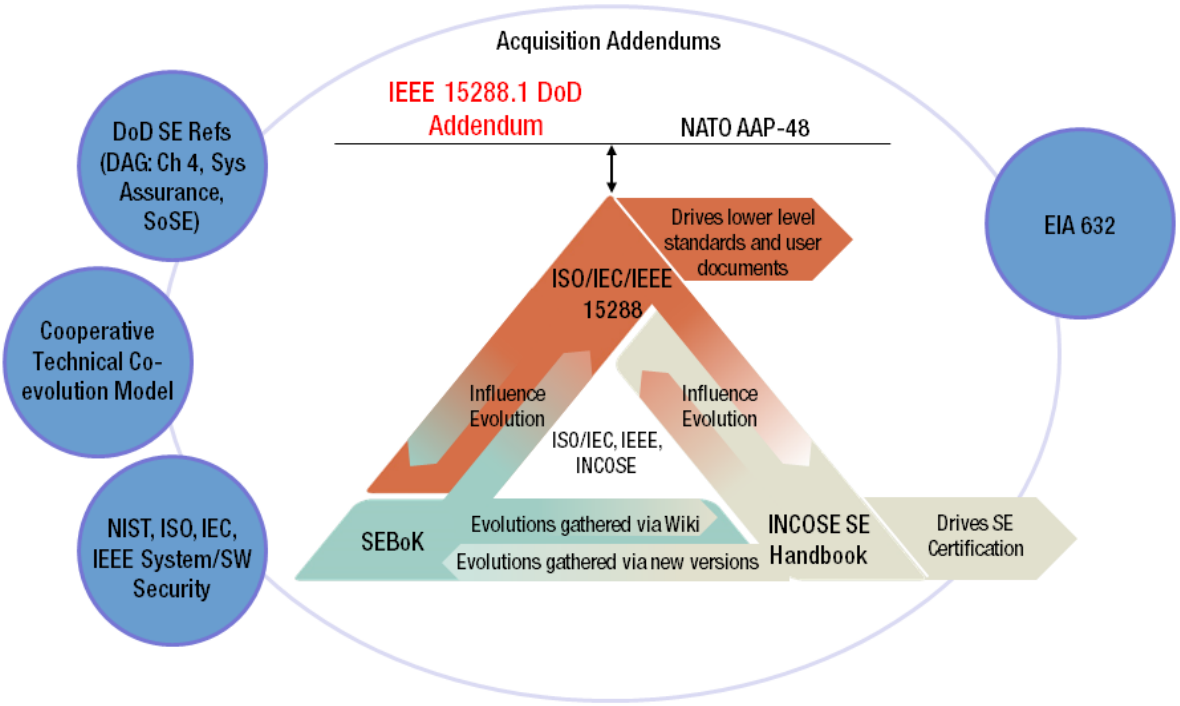
Further tailoring by industry as part of the proposal submission is also anticipated as a critical aspect of establishing an acquirer-supplier agreement.[7] All proposed tailoring will need to include the rationale and evidence that it will add value. Such tailoring may further refine the government's initial tailoring to address additional insights into the nature/needs of the specific procurement, or it may represent an alternative approach that meets the intent of the specified standard and represents a best-value alternative that will benefit the acquisition.[8]

A collaborative DoD and industry team are working on implementation guidance for the two standards. The team, led by the NDIA's Systems Engineering Division, plans to develop recommended RFP language, tailoring guidance based on program characteristics, and conformance guidance.

Relationship to Other Key SE Resources

The completion of this effort falls in line with other industry efforts to harmonize SE standards and guidance. The industry effort started with the initial publication of ISO/IEC/IEEE 15288, which quickly gained adoption and usage. Over the past several years, there has been a cooperative evolution of the key technical resources, including those shown in Figure 3.

Figure 3. Alignment of Key SE Resources—An Example for Cooperative Technical Coevolution



As this evolution has progressed, there has been voluntary cooperation by a number of industry associations and SDOs. For example, the developers of the SEBoK used ISO/IEC/IEEE 15288 and the INCOSE SEH as primary source documents. In turn, information included in the published SEBoK was later adopted in the recent revisions of ISO/IEC/IEEE 15288 and the INCOSE SEH. As these have evolved together, addendums to 15288 have been developed for application in specific domains, such as the NATO addendum AAP-48. In addition, a large number of lower level process elaboration standards have expanded on the processes in 15288 and are fully harmonized with the higher level standard. Finally, the 15288 process framework has been adopted in other engineering resources for security, system-of-systems, and testing.

IEEE 15288.1 and IEEE 15288.2 fill recognized gaps. For example, IEEE 15288.1 fills the need to have a domain-specific addendum for application of the system life-cycle processes for defense programs, similar to what the NATO addendum does for NATO programs. IEEE 15288.2 fills the need for a standard for TR&As, which has not existed for the past decade. And by ensuring it links to the system life-cycle processes, it ensures compatibility with the other standards for concurrent usage.

In developing these two new standards, the working group maintained close collaboration with the groups working on EIA-649-1 and AS6500. The chairs from both working groups were included in ongoing discussions and invited to participate as part of the SE working group to ensure consistency in concepts, terminology, and requirements. As a result, the configuration management process requirements and links to reviews and audits are consistent and aligned in EIA-649-1, IEEE 15288.1, and IEEE 15288.2. Similar consistency has been maintained with AS6500.

Conclusion

The development of IEEE 15288.1 and IEEE 15288.2 fills gaps that have been in place for nearly two decades. These standardization projects are a good example of collaboration between DoD, industry, academia, and the SDOs to fill the void, while leveraging the industry knowledge base. In doing this work, the team has continued to build toward the evolving harmonization of SE resources that has been seen in the past several years. The next step is to effectively apply the two standards.

Additional Reading

Systems Engineering

ISO/IEC/IEEE 15288:2015, "Systems and Software Engineering—System Life Cycle Processes."

ISO/IEC/IEEE 15289:2011, "Systems and Software Engineering—Content of Life-Cycle Information Products (Documentation)."

SMC-S-001, "Systems Engineering Requirements and Products," July 2013.

DoD Instruction (DoDI) 5000.02, "Operation of the Defense Acquisition System," January 2015.

NATO AAP-48, "NATO System Life Cycle Processes, July 2012 (Addendum Standard to 15288; focused on NATO Armament Systems)."

Defense Acquisition Guidebook, Chapter 4, "Systems Engineering," 2013.

INCOSE, *Systems Engineering Handbook*, V4.0.

INCOSE, *Guide to the Systems Engineering Body of Knowledge*.

EIA-632a, "Engineering of a System" (draft revision).

ISO/IEC TR 24748-1:2009, "Guide for Life Cycle Management."

ISO/IEC TR 24748-2:2011, "Guide to the Application of ISO/IEC 15288 (System Life Cycle Processes)."

ISO/IEC/IEEE 24748-4, "Systems and Software Engineering—Life Cycle Management—Part 4: Systems Engineering Planning" (draft).

Technical Reviews and Audits

Naval Sea Systems Command (NAVSEA), "Instruction and Policy 5000-009 for Systems Engineering Technical Reviews."

ISO/IEC/IEEE 15288:2015, "Systems and Software Engineering—System Life Cycle Processes."

DoDI 5000.02, "Operation of the Defense Acquisition System," January 2015.

SMC-S-021, "Technical Reviews and Audits for Systems, Equipment and Computer Software," Volume 1, September 2009.

NAVSEAINST 5009.9, *Naval Systems Engineering Technical Review Handbook*, July 2009.

Naval Air Systems Command (NAVAIR), *Systems Engineering Technical Review Process Handbook* (initial release).

NAVAIRINST 4355.19E, "Systems Engineering Technical Review Process."

Defense Acquisition Guidebook, Chapter 4.

[1] Guest Editorial, *M&S Journal*, Vol. 8, No. 1 (Spring 2013), Modeling and Simulation Coordination Office, Alexandria, VA (http://www.dtic.mil/ndia/2013system/TH15992_Konwin.pdf, chart 3).

[2] See https://dap.dau.mil/policy/Documents/Policy/Acquistion%20Reform%20a%20Mandate%20for%20Change.pdf.

[3] See http://www.spaceflightnow.com/news/9912/02usafreport/index.html; http://www.spacedaily.com/news/titan-99a.html.

[4] See http://www.cnn.com/TECH/space/9808/27/rocket.blast2/; http://www.spacelaunchreport.com/delta3.html.

[5] Federal Acquisition Regulation, Subpart 11.1, Selecting and Developing Requirements Documents.

[6] Federal Acquisition Regulation, Subpart 11.2, Using and Maintaining Requirements Documents.

[7] Federal Acquisition Regulation, Subpart 11.103, Market Acceptance. (Section 11103 refers to "items." Items may include engineering services as specified by standards associated with hardware, software, and systems.)

[8] Federal Acquisition Regulation, Subpart 2.1, Definitions.

About the Authors

Garry Roedler is a fellow at Lockheed Martin Corporation. He is also an INCOSE fellow and has leadership roles in many technical organizations, including past chair of the INCOSE Corporate Advisory Board, member of the INCOSE Board of Directors, steering group member for NDIA's Systems Engineering Division, working group chair for the IEEE Joint Working Group for DoD Systems Engineering Standardization, project editor of ISO/IEC/IEEE 15288 and several other standards, and key editorial roles in the development of the SEBoK and the INCOSE SEH. This unique set of roles has enabled Mr. Roedler to influence the technical co-evolution and consistency of these key SE resources.

Brian Shaw is a senior project leader at The Aerospace Corporation, currently supporting the SMC Engineering Directorate. He has been involved in various aspects of standardization throughout his career, including basic/applied research and standards writing in both military and commercial settings and application of standards on government contracts.

David Davis is the chief system engineer at SMC. He is the visionary behind the reintroduction of standards as a key part of the technical baseline for space system acquisition. He is a recipient of the NDIA's Lt Gen Thomas R. Ferguson, Jr., Systems Engineering Excellence Award, recognizing his role as an acknowledged leader in both the development and application of standards.

Program News

Topical Information on Standardization Programs

DMSMS Program Updates Guidance and Develops New Training

DoD's Diminishing Manufacturing Sources and Material Shortages (DMSMS) program is pleased to announce that it released an updated version of the DMSMS guidance document—SD-22, *Diminishing Manufacturing Sources and Material Shortages: A Guidebook of Best Practices for Implementing a Robust DMSMS Management Program*—in February 2015. The organizational framework continues to parallel the five steps of the DMSMS management process: prepare, identify, assess, analyze, and implement. One of the largest additions to the content has been the introduction of best practices pertaining to the application of DMSMS management to software. Other topics that have been added or expanded upon include the concept of functional obsolescence, the importance of technology and supply chain management, DMSMS mechanisms for hardware and software, the establishment of strategic underpinnings for DMSMS management, the development of health assessments, and best practices focused on the adoption of a risk-based approach to scoping a program's monitoring efforts and funding DMSMS management. The updated SD-22 also includes several approaches for estimating DMSMS resolution costs for programming and budgeting.

The DMSMS program also has developed new training targeted at program management: "DMSMS: What Program Management Needs to Do and Why." The training has the following two objectives:

- Make the case for why DMSMS management is important to program management.
- Describe the steps that program management can take to enable successful implementation of robust DMSMS management processes.

This training content is being packaged as a Defense Acquisition University continuous learning module.

Program News

DMSMS Program Releases 2015 Cost Metrics Report

The newly released cost metrics report, *Diminishing Manufacturing Sources and Material Shortages: Cost Metrics*, features up-to-date cost metrics on DMSMS resolution costs that are crucial for ensuring that DoD uses the most cost-effective approach to resolving DMSMS issues. The updated metrics have been incorporated into the latest version of SD-22.

To update the metrics, DSPO undertook an analysis of responses to the 2014 DMSMS cost survey—Defense Industrial Base Assessment: Diminishing Manufacturing Sources and Material Shortages Cost Resolution Values Survey—conducted by the Department of Commerce's Bureau of Industry and Security in early 2014. The calculated average costs take into account all reported instances across the complexity spectrum of part type, commodity type, and operating environment and are bounded with a 95 percent confidence interval. The report provides detailed information on the data collection instrument, survey administration, and analytical steps used to calculate new DMSMS resolution costs, along with cross-tabulations that lend additional insights into the nature and characteristics of DMSMS resolutions.

The 2015 cost metrics report can be found on the DSPO website at www.dsp.dla.mil and on the Defense Technical Information Center website at www.dtic.mil.

DSP Recognizes Achievements in Standardization

Annually, the DSP recognizes individuals and teams from the military departments and defense agencies who have achieved significant improvements in interoperability, cost reduction, quality, reliability, and readiness through standardization. Since 1987, DSP has recognized these outstanding performers in a formal ceremony. This year's ceremony took place on March 27 at the Pentagon. The 2014 awards were presented on behalf of Stephen Welby, Deputy Assistant Secretary of Defense for Systems Engineering. Hosting the ceremony were Mr. Robert Gold, director of the engineering enterprise, and Mr. Greg Saunders, director of DSPO.

Taking top honors and receiving the Distinguished Achievement Award this year was an Air Force team from the Air Transportability Test Loading Activity (ATTLA) that updated MIL-STD-1791, "Designing for Internal Aerial Delivery in Fixed Wing Aircraft," to enhance support of multinational operations. The team received an engraved crystal Pentagon. The remaining awards were presented to four teams and one individual. All of the recipients have made singular improvements in technical performance, greatly enhanced safety for DoD personnel, and avoided billions of dollars in costs.

2014 Distinguished Achievement Award Winner

Design Standards Ensure Cargo Meets Air Transport Requirements

Pictured are, left to right, Mr. Gold, Mr. Jeff Stanley, Mr. Mark Kuntavanish, Mr. Eric Treadwell, Mr. Edward Durell, and Ms. Linda Titcombe.

Engineers from ATTLA at Wright-Patterson Air Force Base undertook a project to update MIL-STD-1791A, "Designing for Internal Aerial Delivery in Fixed Wing Aircraft." The standard, which was originally converted from MIL-HDBK-1791 in 2012, contains requirements that are contractually binding for systems being procured by DoD and all other U.S. government agencies that require airlift in Air Force cargo aircraft. The initial version was subject to Distribution Statement C, which made it difficult for foreign governments and vendors to obtain. Because of the need to support multinational operations, the ATTLA team took steps to make the standard publicly available (Distribution Statement A). The updated standard, MIL-STD-1791B, was approved in late 2014 and is now being used by all government agencies in procurements of airliftable material. MIL-STD-1791B has four key benefits: (1) improved safety of flight, by ensuring cargo can withstand severe flight environments such as hard landings; (2) mission time savings, by optimizing the resources needed for airlift; (3) streamlined acquisition, by providing cargo designers the key information they need in a single, publicly available document; and (4) improved multinational operations and humanitarian airlift, by ensuring domestic and foreign cargo is compatible with Air Force cargo aircraft. Total potential savings are in the millions of dollars.

2014 Achievement Award Winners

New Specification for Aluminum-Based Powders for CS Deposition Saves Millions of Dollars

Pictured are, left to right, Mr. Gold, Mr. Mark Van Landingham, Mr. Richard Squillacioti, Mr. James Dwyer, Mr. Victor Champagne, Mr. James Jobe, and Ms. Iris Labuda.

A team led by the U.S. Army Research Laboratory, with representatives from Defense Logistics Agency (DLA) Aviation, and working with the United Technologies Research Center, developed a new military specification, MIL-DTL-32495, "Aluminum-Based Powders for Cold Spray Deposition," that covers the requirements for procuring aluminum and aluminum-based alloy powders. These powders will be used to produce deposits utilizing the environmentally friendly, cost-effective materials deposition process called cold spray (CS) for parts repair, coatings, and fabrication of components and freestanding structures. CS has been approved for use by all DoD departments and agencies and by industry. Military and aerospace applications for CS specify exacting characteristics for the CS deposit. However, powder and operating parameters were not identified for optimal aluminum deposition. The new specification documents the powder characteristics needed for optimal deposition of four aluminum alloys by means of CS and ensures that CS parts or repairs meet the needs and approval of DoD and save millions in sustainment costs. Since its May 2014 publication, this specification has resulted in DoD savings of more than $10 million. The implementation of this specification will allow the procurement of non-counterfeit products in our supply chain and reduce the threat of inferior deposits that would otherwise increase the risks of failure and additional costs arising from unnecessary repair.

Biobased CLP Improves Safety without Compromising Performance

Pictured are, left to right, Mr. Gold, Mr. Mark Napolitano, and Mr. James Dwyer.

To comply with a 2012 Executive order directing federal agencies to prioritize the purchase of biobased products (those containing plant-derived ingredients), a team from the U.S. Army Armament Research, Development and Engineering Center researched the feasibility of requiring biobased materials as part of the DoD formulation for cleaner, lubricant, and preservative (CLP) used for weapons and weapons systems. Environmentally preferred biobased materials offer not only environmental benefits, but also an increased margin of safety when they are used by DoD personnel for weapons maintenance. Through coordination with the U.S. Department of Agriculture's BioPreferred program, as well as with industry, the team determined that biobased materials could, in fact, be required as part of CLP's formulation. The team documented the formulation change in an amendment to MIL-PRF-63460, "Performance Specification: Lubricant, Cleaner and Preservative for Weapons and Weapons Systems," the military performance specification used to qualify all CLP products procured by the Defense Logistics Agency for DoD use. The benefits of requiring this less-toxic formulation come without compromising any of the performance requirements identified in the specification. Standardizing the requirement for a percentage of biobased content in CLP will benefit all DoD personnel who regularly use CLP for weapons maintenance.

Advanced Robotic System Improves EOD

Pictured are, left to right, Mr. Saunders, Mr. Ashley Johnson, Mr. Gold, Mr. Adam Shaker, Mr. Michael Del Signore, RDML Lorin Selby, Mr. Andrew Czop, Mr. Juan Roman-Sanchez, CAPT Vincent Martinez, Mr. Todd Zimmerman, Mr. Christopher Paquette, Mr. Scott Steward, Mr. Kenneth Plumadore, and CAPT Aaron Peters.

A team from the Naval Surface Warfare Center, Indian Head Explosive Ordnance Disposal Technology Division, made significant contributions to the standardization of explosive ordnance disposal (EOD) robotic system interfaces by developing and defining a modular open systems architecture (MOSA) for the next-generation family of EOD unmanned ground vehicles. This work culminated in the completion of 59 individual documents that completely define the Advanced Explosive Ordnance Disposal Robotic System (AEODRS) common architecture (CA). The documentation set is made up of interface and performance requirements documents for each of the defined AEODRS modules, along with overarching and implementation documentation. The documentation set represents the allocated baseline for the AEODRS CA, fully supports the AEODRS open architecture acquisition strategy, and provides critical technical data to support major program milestone decisions. Successful completion of these documents required extensive systems engineering and analysis to allocate requirements and define interfaces for all modules within the AEODRS family of systems, all while ensuring system-level requirements were maintained. The MOSA approach will enable integration of emergent technologies from multiple potential sources on fielded AEODRSs, improving the overall capability of EOD warfighters.

Updated Standard for Cargo Tie Downs Cuts Costs and Improves Safety

Pictured are, left to right, Mr. Gold, Mr. Jeff Stanley, Mr. Michael Jones, Mr. Jeff Friesner, Mr. Edward Durell, and Ms. Carol Hernandez.

A team from the Air Force Materiel Command undertook a project to update MIL-DTL-25959, "Tie Down, Tensioners, Cargo, Aircraft." Initially, the team focused on addressing logistical and weight issues raised by Headquarters Air Mobility Command (HQ/AMC). MIL-DTL-25959F covered four types of devices: two (MB-1 and CGU-4/E) rated at 10,000 (10K) pounds and two (MB-2 and CGU-3/E) rated at 25,000 (25K) pounds. HQ/AMC requested a single device for each type—one rated at 10K and the other rated at 25K pounds—with a hook that swivels and locks in two positions, 180 degrees from each other. HQ/AMC also requested that the weight of the devices be reduced to save fuel on cargo-carrying aircraft. The team developed Revision G to reflect those requirements. Shortly after MIL-DTL-25959G was published, two incidents occurred in which tie-down devices inadvertently released on an M1Al Abrams tank and a Mine-Resistant Ambush Protected vehicle while a C-5 was in flight, a great concern to the flight crew, AMC, and the Army Materiel Command. The team updated the specification, now MIL-DTL-25959H, to address the reliability of the tie downs. As a result of the team's work, the Air Force will realize logistical advantages, as well as fuel savings of approximately $167,000 per year due to the reduction in the weight of the devices. Most important, the devices are much safer; the design ensures that they hold either 10K or 25K pounds, both statically and dynamically, precluding aircraft mishaps.

Revised Performance Specification Allows Use of Faster, Lighter, and More Complex Components for Aerospace Applications

Pictured are, left to right, are Mr. Gold, Col Michael Tannehill, Mr. Muhammad Akbar, Mr. James Jobe, Mr. Thomas Hess, and Mr. Bill Lee.

Muhammad Akbar, from DLA Land and Maritime, contributed significantly to the development of a new class—Class Y—of military space-level products for nonhermetic devices for inclusion in MIL-PRF-38535, "Integrated Circuits (Microcircuits) Manufacturing, General Specification for." This 3½-year effort, undertaken at the request of NASA, resulted in the establishment of testing and qualification requirements for those devices. Gaining consensus on the requirements was the culmination of cooperation among military and space agencies, manufacturers, and DLA Land and Maritime. Development of this new class provides original equipment manufacturers access to state-of-the-art products not previously documented by MIL-PRF-38535, enabling them to push the limits of their designs to take advantage of these products, which are faster, lighter, and significantly more complex than previously defined military components. For example, Class Y devices will provide higher data rates and more sensitive circuits. The use of the devices in state-of-the-art weapons platforms are of particular interest to NASA, as well as to the Air Force Space and Missile Systems Center, National Reconnaissance Office, European Space Agency, Japanese Space Agency, and the aerospace industry in general.

Events

Upcoming Events and Information

May 30–June 2, 2015, Nashville, TN
2015 ISERC

Sponsored by the Institute of Industrial Engineers (IIE), the Industrial and Systems Engineering Research Sessions (ISERC) will be held at the Renaissance Nashville Hotel as part of the IIE Annual Conference and Expo. ISERC is a forum for exchanging knowledge and discoveries in the industrial and systems engineering research community. Its purpose is to present scholarly work by researchers in academia or industry. Submissions of preliminary research results, works in progress, and significant or final results are welcome. For more information, go to http://www.iienet2.org/Annual2/details.aspx?id=10150.

June 16–18, 2015, Edinburgh, Scotland
2015 IIOM Conference and Exhibition

The International Institute of Obsolescence Management (IIOM) is pleased to announce its inaugural conference, which is being held in Edinburgh in June 2015. This conference will position IIOM to represent obsolescence management practitioners worldwide. The conference brings together an impressive list of speakers on key issues, together with industry participants. For more information on the event, go to www.cog.org.uk.

June 22–25, 2015, Prague, Czech Republic
SAE 2015 International Conference on Icing of Aircraft, Engines, and Structures

The SAE 2015 International Conference on Icing of Aircraft, Engines, and Structures provides participants a high-quality technical program focusing on meteorology, aircraft icing systems, and ground deicing operations. Government agencies use this conference as their platform to discuss critical studies and new developments in icing and deicing standards. This conference provides a forum for the aerospace community to meet and discuss the newest regulations governing aircraft icing operations, the latest technologies and systems designed to deice and to keep ice from forming on an aircraft, current and future challenges, and upcoming opportunities within industry. For more information or to register, go to http://www.sae.org/events/icing/.

June 22–26, 2015, Dallas, TX
AIAA Complex Aerospace System Exchange

The American Institute of Aeronautics and Astronautics (AIAA) will hold its Complex Aerospace System Exchange at the Hilton Anatole in Dallas, TX. For more information, please go to http://www.aiaa.org/EventDetail.aspx?id=24069.

Events

Upcoming Events and Information

July 13–16, 2015, Seattle, WA

25th Annual INCOSE International Symposium

The INCOSE International Symposium, sponsored by the International Council on Systems Engineering (INCOSE), is the premier international forum for systems engineering. This year's symposium will be held at the Hyatt Regency Bellevue, Seattle, WA. Participants can network; share ideas, knowledge, and practices; and learn about the most recent innovations, trends, experiences, and issues in systems engineering. Papers, panels, and presentations focus on addressing how systems engineering principles and perspectives are applied today and how systems engineers will play an increasing role of influence in the future. Examples of topics are technology insertion, process improvements, and organizational governance of the systems we make, manage, operate, and maintain over their life cycle in the context of global multicultural and multidisciplinary challenges. For more information on this event or to register, go to http://www.incose.org/.

August 10–13, 2015, Baltimore, MD

64th Annual SES Conference

The Society for Standards Professionals (SES) will hold its annual conference at the Royal Sonesta Harbor Court in Baltimore, MD. SES is committed to furthering the knowledge and use of standards and standardization. It also manages the world's only certification program for standards professionals. SES provides a neutral forum where standards users and developers can come together to address mutual issues, opportunities, and interests in ways that work to the benefit of everyone involved with, or affected by, standards. SES members are primarily involved in the development, application, and use of company, government, national, regional, and international standards. For information about this year's annual conference, contact Mike Morrell by e-mail at mikemorrell@live.com or by phone at 309-716-6504.

Events

Upcoming Events and Information

August 30–September 4, 2015, Orlando, FL

2015 SISO Fall SIW

Sponsored by the Simulation Interoperability Standards Organization (SISO), the Simulation Interoperability Workshop (SIW) is a semiannual event encompassing a broad range of model and simulation issues, applications, and communities. The SIW consists of a series of forums and special sessions addressing interoperability issues and proposed solutions; tutorials on state-of-the-art methods, tools, and techniques; and exhibits displaying the latest technological advances. The fall SIW will be held at the Florida Mall Conference Center in Orlando, FL. For more information, please go to http://www.sisostds.org/Workshops/UpcomingWorkshops.aspx.

September 22–24, 2015, Seattle, WA

SAE 2015 AeroTech Congress and Exhibition

SAE International's 2015 AeroTech Congress and Exhibition will be held at the Washington State Trade and Convention Center in Seattle, WA. AeroTech provides a forum for the global aerospace community to meet and discuss current and future challenges, opportunities, and requirements of next-generation research and development, products, and systems. Technical sessions, panel discussions, and keynote presentations make up a program that provides value to industry and government engineers, scientists, designers, program managers, operators, educators, and students. The technical program will cover a broad spectrum of topics, including avionics, environment, flight sciences, operations, manufacturing, materials, structures, propulsion, safety, and systems. AeroTech also provides a venue for engineers participating on SAE committees and advisory bodies to meet and discuss industry standardization efforts and best practices. For more information, please go to http://www.sae.org/events/atc/.

People

People in the Standardization Community

Welcome

John Burrow was recently named the Navy Standardization Executive, replacing Mary Lacey, who retired April 30, 2015. Dr. Burrow also serves as Deputy Assistant Secretary of the Navy for Research, Development, Test, and Evaluation (RDT&E). In this role, he has executive oversight of all matters related to RDT&E budget activities, science and engineering, advanced research and development, prototyping and experimentation, and test and evaluation. He is also responsible for oversight and stewardship of the Department of Navy's research and development establishment, including naval laboratories, warfare centers, and systems centers.

Farewell

James Jobe, of the Defense Logistics Agency (DLA), retired after 38 years of combined military and civilian service. In his last role, Mr. Jobe served as both Standardization Executive and chief, Product Assurance. In the latter role, he managed the development and implementation of DLA policies and procedures related to engineering and technical issues, quality management, materiel standardization, value management, item unique identification, and counterfeit and technical data. Prior to that position, Mr. Jobe served in various management and support roles throughout DLA. We wish him well in retirement.

Mary Lacey retired on April 30, 2015, with 40 years of federal service. Many will remember her tenure as the Navy Standardization Executive. She also served in many high visibility positions within the Department of Navy. Among her career highlights are Deputy Assistant Secretary of the Navy for RDT&E, Deputy Program Executive for Aegis Ballistic Missile Defense, head of the National Security Personnel System Program Executive Office, and technical director of the Naval Surface Warfare Center. We wish her well in her retirement.

Sandra Leach passed away on Friday, February 20, 2015. She had retired after 30 years at the Naval Sea Systems Command (NAVSEA), Washington, DC. Ms. Leach played a key role in assisting the NAVSEA 05Q team with updating and transitioning qualified products lists (QPLs) and qualified manufacturers lists (QMLs) during a DSP-sponsored pilot program for the qualified products database. Always willing to lend a hand, Ms. Leach's persistence and drive helped the NAVSEA team finish the pilot program and successfully transition NAVSEA QPLs and QMLs into the new system.

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
April/June 2015	Standardization Stars
July/September 2015	Standards Policy
October/December 2015	Open Systems

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, STOP 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.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