Verification, Validation, and Accreditation (VV&A)  
One Voice – Unified, Common & Cross-Cutting

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Keywords: Verification, Validation, and Accreditation (VV&A), templates, practice(s), process(es)

Abstract  
This paper establishes support for a unified Verification, Validation, and Accreditation (VV&A) approach to serve as the one "common and cross-cutting" voice for VV&A across the Department of Defense (DoD) and Military Services. Modeling and Simulation (M&S) management has been transforming for over a year. Various communities enabled by M&S have been identified at the DoD- and Service-levels. Transforming M&S management has brought about coordination amongst and between the communities to support common services, data, and tools. These common and cross-cutting areas include the standardization of processes, development of best practices, and the utility and application of M&S that together provide overarching benefits to all communities. Currently, M&S management decisions are made by committees through a process of proposals, presentations, and interviews. The VV&A leaders from the DoD, Army, Navy, Air Force, and Marine Corps have collaborated on this paper to reaffirm the need for VV&A by all communities, to identify the need for one voice to speak for VV&A to all communities, and to offer solutions for the road ahead.

1. INTRODUCTION  
This paper addresses the need for the Department of Defense (DoD), Joint Forces, and Services to move towards providing a unified voice on the need for and importance of Verification, Validation, and Accreditation (VV&A) for Modeling and Simulation (M&S). Additionally, this paper addresses the future of VV&A management in the reality of ongoing transformations in M&S management at the DoD- and Service-levels.

Flag/General Officer-level Management  

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Flag/General Officer-level Management

Acquisition | Analysis | Planning | Testing | Training | Experimentation

Communities Enabled by M&S

Common & Cross-Cutting M&S Tools

Common & Cross-Cutting M&S Data

Common & Cross-Cutting M&S Services

Component-level Organization/Coordination

Subject Matter Experts

Figure 1. Graphic of M&S Management Transformation

The new M&S management structure (Figure 1) recognizes several major (vertical) communities enabled by M&S. VV&A is a (horizontal) subject matter expert (SME)
community providing common and cross-cutting VV&A services, tools, and products that support all the major communities.

Just as the major communities have a component-level organization and coordination structure that shares leadership and responsibility, this paper advocates the same need for the SMEs that identify and implement solutions for common and cross-cutting M&S tools, data, and services.

Section 2 establishes the need for VV&A and examines why VV&A is important. Section 3 addresses the need for all communities to be able to access and share VV&A information. In Section 4, the standardization and automation of VV&A to support reuse, data collection, and data sharing is examined. Section 5 provides the advocacy for creating "one voice" for VV&A. Finally, the road ahead for VV&A is looked at in Section 6.

2. NEED FOR VV&A

"In order to establish confidence and select the most effective tool, a potential user needs to understand what a model or simulation is capable of representing and how well it represents it. The processes of verification, validation, and accreditation help to build that confidence for a model or simulation by establishing whether a model or simulation is capable of supporting the application."

Modeling & Simulation Steering Committee
Common and Cross-Cutting Business Plan [1]

Someone once pointed out that the acronym "C4ISR" stands for seven different things! Similarly, VV&A is an acronym for three distinct and integrated processes that are implemented to establish the credibility of M&S:

- **Verification**: The process of determining that an M&S implementation and its associated data accurately represent the developer's conceptual description and specifications. An informal question often asked is, "Was the M&S built right?"
- **Validation**: The process of determining the degree to which an M&S and its associated data are an accurate representation of the real world from the perspective of the intended use of the M&S. The informal question often asked is, "Was the right M&S built?"
- **Accreditation**: The official determination that an M&S application and its associated data are acceptable for use for a specific purpose. Accreditation seeks to answer the question, "Is this the right M&S to use?"

The M&S developer and user communities have struggled to come together to formalize the VV&A processes that are mutually acceptable, but consensus seems to have been achieved.

**Why VV&A is Important**

M&S are directly connected to our National Defense. While today's reader might think this statement is obviously true, it was not always the case. As the technology rolled out in different areas of endeavor, there was serious and founded concern and distrust. M&S, modelers, and simulationists have had a checkered past supporting decisions, providing training environments, or facilitating analyses.

There is tremendous diversity of perspective and expectation among those who conceive, build, and use M&S. This diversity can create friction amongst and between developers and users and can result in failure if not recognized, identified and addressed. Speaking in general terms, M&S users seek tools that provide insights into what is real (not virtual), on-demand and without error. The scientists creating the mathematical underpinnings of M&S look for elegant abstractions, trying to maximize the ratio of relevant dynamics exposed to M&S input required. But losing significant portions of a system's properties is what modeling is all about.

Then there is data. All data, be it measurements of physical properties or parameters feeding abstract models of human behavior, is fraught with error. Compounding the distortion that mathematical models create, the data used in an application can generate huge biases in M&S outcomes. The nature of this error is very different depending on whether the data are used to input measurements into an M&S based on the laws of physics, or whether to inject parameters into an M&S of social dynamics.

In the face of all of this potential discredit to an M&S, all parties must be fully informed. The ultimate user must understand the abstraction of the M&S he is using as well as the nature of his data, and must accept these shortcomings in terms of accuracy. This information has not always been available. There are stories handed down through the community concerning:

- Invulnerable artillery in a staff training simulation;
- Experiments involving the value of satellite imagery supported by simulations with inappropriately near-flat terrain data;
- Casualty predictions orders of magnitude too high, generated by a simulation where ground armies collide instead of maneuver.
What is really interesting about these particular stories is that each was revealed through a formal VV&A process. In fact, that is why we know what we know.

VV&A does not fix these potential problems, but it exposes them so that they may be debated in the open and potential solutions found. VV&A is the formalization of the collective judgment of a diverse set of subject matter experts, analysts, developers and users, all focused on the same goal. With pre-knowledge of the process, developers are encouraged to develop M&S that are based on accepted theory, engineers and programmers can build M&S that facilitate testing, and users can systematically examine their true M&S requirements and make informed selections that match those requirements.

Warfighters increasingly rely on accredited M&S to support military operations. The proper VV&A documentation for the M&S use is critical. Just like the actual M&S, the VV&A information must be visible, accessible, understandable, trusted, and responsive to the user's needs. It is expected that current M&S will have to meet the net-centric requirements to be part of the Global Information Grid (GIG). VV&A will play a role in meeting those requirements.

3. NEED TO SHARE VV&A INFORMATION FOR NET-CENTRIC OPERATIONS

"The globally interconnected, end-to-end set of information capabilities, associated processes, and personnel for collecting, processing, storing, disseminating and managing information on demand to warfighters, policy makers, and support personnel."


It is Joint Staff policy to assure that information technology (including M&S) and systems provided to warfighters to support DoD, Joint, combined, and coalition operations meet interoperability requirements and are supportable over the GIG [3]. The worlds of global information access and net-centric operations require almost instant visibility and access to discover and share information, systems, and tools as enablers and force multipliers.

DoD is using the GIG architecture to create a worldwide net-centric information technology and systems network of which M&S is a critical part. Before becoming part of the network, VV&A will be required of all live, virtual, and constructive M&S. GIG users will be reluctant to use non-accredited M&S, especially for high risk operations, training, and course of action analyses. With VV&A properly implemented and documented, M&S can be used to meet needs in a rapid manner leveraging the input from participants across the GIG.

VV&A evaluates the fitness of an M&S for an intended use whether it is used for operations, mission rehearsal, training, research, analysis, or test and evaluation. The worldwide network will depend on the M&S and need 24-hour access to the M&S and the VV&A documentation. VV&A documentation includes the M&S assumptions, capabilities, and limitations and will help identify the risk associated with using the M&S for a proposed purpose. Understanding the M&S input data, results of the M&S, standards used, and the information resulting from the application of the results will increase the utility and credibility of the M&S. The GIG will be able to leverage the input and innovation from the efforts of the many users on the GIG increasing the value of the M&S as well as contributing to the VV&A of new M&S.

Net-centricity compels a shift to a "many-to-many" use of M&S and exchange of data used and produced by M&S. This enables many users and applications to leverage the same M&S and data extending beyond the previous focus on standardized, predefined, point-to-point interfaces. VV&A is essential to facilitate this many-to-many shift by providing credible, trustable, understandable, and reliable M&S for all users on the GIG.

DoD's goal is to increase the net-centricity of warfighter, business, intelligence, enterprise management, and enterprise information operations. This will be done by enabling increased reach among the GIG users, increased richness in the information and expertise that can be applied to supporting operational decisions, increased agility in rapidly adapting information and information technology to meet changing operational needs, and increased assurance that the right information and resources to do the task will be there when and where they are required. VV&A is a vital enabler for M&S to meet these net-centric requirements. This is especially true in developing the assurance that the right M&S information and resources to do the task are available on the GIG network. To achieve that availability, a change in the VV&A infrastructure through standardization is needed.

4. NEED FOR STANDARDIZATION AND AUTOMATION

The diversity of M&S users and their expectations for M&S have increased the need for VV&A information about M&S to be shared. As the two previous sections have indicated, the primary product of the VV&A processes is information. This information facilitates assessment, selection, modification, and integration of M&S. It also serves as the basis for communication between all those
involved in the development and application of M&S, as well as the use of the M&S results. Given this emphasis on both information and communication, effective and efficient application of VV&A is predicated on a clear, consistent articulation of VV&A findings and a readily accessible, user-friendly mechanism for information capture and sharing.

The need for a structured approach for gathering, organizing, and reporting VV&A information is evident by the number of VV&A templates that have been developed to support specific organizations and programs. Since most VV&A activities take place over extended periods of time, a structured documentation approach proved necessary to help manage VV&A information throughout the M&S lifecycle. While the various templates were successful at documenting information at a local level, examination across template initiatives showed some significant differences in both terminology and information requirements. In cases where information is being gathered from multiple sources to support reuse or federation activities, such differences could lead to gaps in and difficulty locating required information as well as miscommunication and misinterpretation of existing information.

A logical solution to the variations found in ongoing template initiatives was to create a standard across DoD that would move the community to document and maintain VV&A information in a consistent form and format. This standards initiative would leverage previous work and would focus on producing consensus based products formalized through the Defense Standardization Program (DSP) and/or the DoD Information Technology Standards Registry (DISR).

Using standardized terminology to document the VV&A of M&S will make the information easier to discover and share over the GIG. Using standard formats will help users better understand if an M&S could meet their needs (i.e., they will know where to look for the information they need). Standardized VV&A documentation templates will enable program managers, Milestone Decision Authorities, and testers to determine the credibility of the M&S results used to support and influence major programmatic decisions. Additionally, analysts, operational planners, and trainers will be able to better understand the M&S representation of the real world to preclude negative training or artificial operational outcomes. Section 4.1 outlines the evolution of the standard DoD VV&A Documentation Templates.

While standardization provides an important step in the effective sharing of VV&A information, ease of information capture and access are also essential elements. For most system and software development activities, documentation is one of the first casualties of budget shortfalls, budget cuts, and constrained schedules. A commonly-supported user-friendly, web-enabled, and secure automated tool that simplifies the capture of information and exports that information in the standard format would go a long way in improving the efficiency of VV&A information capture and sharing. Such a tool would cue for required input in much the same fashion as some commercial tax tools do and then take the raw input and format it to produce standard VV&A documents. Information about the VV&A activities and resulting VV&A artifacts (i.e., metadata) would be shared through repository initiatives such as the Modeling and Simulation Resource Repository (MSRR) increasing awareness of and access to existing VV&A information. Section 4.2 describes the evolution of the Joint VV&A Documentation Tool (JVDT).

4.1. Achieving a DoD VV&A Documentation Standard

Following is an example showing the cooperation and coordination amongst DoD- and Service-level VV&A stakeholders that have proven effective in working toward standardization.

The need for standard templates for VV&A documentation to enable the sharing of VV&A information over the GIG was identified initially in 2005. The standard templates' common vocabulary would identify the metadata needed for describing VV&A in the context of the GIG. By standardizing documentation, the quality and consistency of M&S information (to include VV&A) documented by one organization could be used as the basis for M&S reuse decisions by another organization. The goal was to find a standardized way to communicate the information at an appropriate level of detail in templates.

A DoD-led Templates Tiger Team worked together to produce templates that any organization could use to document VV&A thoroughly and adequately. The participants defined the objective as "Enabling expanded M&S reuse by building the foundation for consistent V&V information to support accreditation decisions." Over the course of several months, four core document templates (i.e., Accreditation Plan, V&V Plan, V&V Report, and Accreditation Report) that captured a wide range of known requirements for document formats were produced. In 2006, the effort began to process the templates through the Defense Standardization Program.

The DoD M&S Steering Committee (M&S SC) approved continued work on standardizing the templates in FY07. Once the templates are approved as a Defense Standard Practice, they may be referenced in contracts for VV&A products and services. The draft templates are
available to download from the Modeling and Simulation Coordination Office (M&S CO) webpage [4].

Achieving standard VV&A documentation will benefit all communities. By documenting the information contained in the templates, a complete, concise, and consistent snapshot-in-time describing the fitness of an M&S for a particular intended use is captured. When standard VV&A information is shared across the GIG, communities will be able to quickly determine if additional verification or validation (V&V) is needed to support a different or related intended use. Communities will no longer duplicate V&V already accomplished because that information was not readily available, but will use scarce resources to perform only the V&V that is still needed.

4.2. Achieving a Common and Cross-Cutting VV&A Documentation Tool

In 2006, the M&S SC approved the implementation of the DoD standard templates in the JVDT. The same Templates Tiger Team identified requirements previously implemented in the Navy’s precursor tool, added new requirements, and documented the deltas for the JVDT.

The web-enabled engine incorporates an open architecture and employs open source applications to enable various data functions and runs under a secure socket layer. The tool is designed to eliminate the need for any unique client applications to be installed by the user. The goal is for someone to use the tool from a common web browser. Accessing the tool requires use of a unique user identification and password. Access to a project is granted by the project owner to project team members and project data is protected and secure.

Another important feature of the JVDT is to capture traceability of requirements from one document to the next. This capability transforms the JVDT from simply a word processor to a database linking information together. There is an order of events in the VV&A process that when followed reduces and contains the costs of doing VV&A. Initially, accreditation is planned based on the requirements for using the M&S, and then the V&V necessary to address the criteria for acceptability is planned. Following that the plans are implemented, and finally the information documented during implementation is assessed for acceptability to use the M&S for a specific intended use. VV&A implemented in any other order means that superfluous V&V tasks performed could consume scarce VV&A resources and result in information collected that does not support a decision to use the M&S.

The M&S SC approved funding in FY07 to complete JVDT development based on a proposal by the Acquisition Community. Once available online, the JVDT will facilitate M&S reuse and cross-community data sharing of VV&A information. Achieving a common tool for documenting VV&A is a giant step towards sharing relevant VV&A information across all communities enabled by M&S.

4.3. Achieving an International Standard for VV&A of Federations

Another example of VV&A stakeholder cooperation and coordination is evident in the work by the Interoperability Standards Organization (SISO) to create a standard to implement VV&A for federations being developed using the High Level Architecture (HLA) Federation Development and Execution Process (FDEP). Stakeholders representing the DoD, Services, coalition partners from around the world, industry and academia worked together in 2005 and 2006 to create the "Draft Recommended Practice for Verification, Validation, and Accreditation of a Federation, an Overlay to the High Level Architecture Federation Development and Execution Process." The overlay will be balloted by IEEE in 2007 as IEEE P1516.4TM/D1.1 [5]. Additionally, the V&V overlay will be processed by the North Atlantic Treaty Organization (NATO) M&S Group as a NATO Standardization Agreement (STANAG).

The use of an international VV&A standard for federations will provide a process understood and accepted by our country’s allies and by coalition forces. The best practices in the international standard provide a basis for accepting the federation’s usability and understandability in a net-centric environment with rapidly changing requirements. The GIG will provide for faster collaboration on VV&A of the individual federates that together comprise a federation as well as the federation itself.

4.4. Achieving a Joint M&S Standards Vetting Tool

M&S as a discipline requires the development of Standards to support the consistency of process, the ability to discover and exchange information effectively, and the ability to effectively reuse models and simulations. While existing standards processes (e.g., DSP) and standards policy bodies (e.g., OMG, SISO, IEEE, ISO, NATO) can be used to bring products to standard, a mechanism is needed to coordinate standards initiatives across the Department and to facilitate the evolution of a standard from proposed draft through balloting and lifecycle sustainment.

Modeling & Simulation Steering Committee
Common and Cross-Cutting Business Plan [1]

In 2007, the M&S SC approved funding for the Joint Vetting Tool (JVT) to support development, review, and lifecycle maintenance of DoD M&S Standards. The JVT will be an automated, web-enabled and centrally maintained
tool, similar to the JVDT, that will enable the joint collaborative execution of the common DoD M&S Standards process. The tool will be based on requirements (implemented in the Air Force's precursor tool) and specifications previously identified by the Services and DoD. The JVT will automate the online submission, storage, tracking, evaluation, and distribution of proposed M&S standards from the time of nomination, through evaluation, and finally to advocacy. When used, the tool will automate staffing processes and improve information exchange within and between the Services, Joint Forces, and other DoD components.

VV&A is a category of standards with applicability across DoD, Joint Forces, Services, and all major communities. The VV&A templates, VV&A Overlay (described in previous sections), and other potential VV&A standards are all candidates for processing using the JVT. The JVT has the potential to reduce redundancy of effort, save everyone time and money, and get standards to the warfighter faster.

5. NEED FOR ONE VV&A VOICE

Providing a common approach for VV&A is not new. Since 1995, the DoD, Services, industry, and academia have worked together to develop methodologies, standards, and procedures for the VV&A of M&S and M&S data [6]. VV&A stakeholders have met to exchange technical information, identify common implementation issues, produce roadmaps, develop recommended practices, and co-author white papers. Over the years formal technical working groups and the coalition of the willing (volunteer Tiger Team and Integrated Process Team members) have come together and attempted to institutionalize VV&A throughout DoD. There is no issue about what VV&A is and the need for it. The issue has always been how to implement it.

Again, all agree that VV&A is much needed, but the implementation of VV&A has been inherently parochial – not made here syndrome. And, no one understands our needs as we do. M&S users and developers each implement their own VV&A processes. M&S users can no longer afford to ignore opportunities to leverage existing technologies to provide M&S capabilities. Resources (e.g., funds, people, technology, etc.) are becoming scare and M&S users are being forced to do more with less. For many years, systems were purchased in isolation even though systems are not used in isolation. Systems are becoming more interdependent and are coming together to form system-of-systems (SoS). A SoS is a configuration of systems in which component systems can be added or removed during use; where each provides useful services in its own right; and each is managed for those services [7]. SoS organize and integrate the capabilities of a mix of existing and new systems into a SoS capability greater than the sum of the capabilities of the constituent parts. A service-oriented architecture (also referred to as services-oriented) (SOA) is an architecture that is built primarily with network-available services and provides a basic framework for information sharing. SOAs, like the GIG, allow a family-of-systems (FoS) to operate as a cohesive SoS, but does not create capability beyond the sum of the individual capabilities of its member systems or SoS [8].

Training Transformation (T2) [9] dictates that each Service, agency, and component work together to achieve the objectives outlined in DoD policy and guidance. Recently, Tri-Service VV&A meetings have addressed the need for a common VV&A voice. Those meetings have been invaluable and opened up formal and informal communications between the Army, Navy, Air Force, Marine Corps, industry, and academia representatives to exchange information and leverage VV&A resources. Outside DoD and as noted in Section 4.3, SISO brings together VV&A subject matter experts from around the country as well as our coalition partners from abroad to work together to produce viable and useful standards. Inside DoD, common and universally accepted boundaries must be clearly defined in order to facilitate innovative M&S development. The communities enabled by M&S, Services and other DoD components must identify those boundaries, while VV&A SMEs articulate smart solutions.

VV&A is a core service to ensure information can be provided to the warfighter anywhere, anytime, and in the right format. We have moved from the discreet M&S stage to that of integrated SoS. We are moving from discreet players to a net-centric environment of integrated and interoperable players. We support the need to enhance the communities' abilities to rapidly acquire, share, and reuse data while reducing the required resources. It is necessary that we have a common approach (one vision, multiple implementations), a common education and training regime (holistic), and a common data format (ease of acquiring and sharing data). Once our vision is established, management forums can decide appropriate implementation strategies (e.g., recommended practices for VV&A; electronic library, standard data formats, etc.).

6. ROAD AHEAD FOR VV&A

The recent M&S SC-sponsored assessment of M&S gaps that exist across DoD indicated that while a strong foundation of VV&A guidance documents exists at both the DoD- and Service-levels, underlying technology gaps still remain in several key areas [1]. These gaps are defined as:
• There is an insufficient understanding of how risk impacts the VV&A process and how it drives the tailoring of VV&A activities.
• There is no mature method for deriving VV&A costs.
• There is no standard method for assessing the maturity of an implemented validation effort.
• While generalized VV&A guidance exists, guidance focused on particular application areas (e.g., Non-Traditional Warfare) remains to be developed and shared.
• Standardized VV&A documentation templates need to be completed and adopted for use.

Some additional needs include:

• A VV&A XML schema that meets net-centric architecture requirements (a proposal to document the schema was approved by the M&S SC for FY07)
• A common path for processing approved VV&A standards into the DISR
• A Defense Data Management Specification to support the net-centric visibility requirement for VV&A
• Help for M&S users to make VV&A efforts more efficient and to decrease V&V complexity and difficulty

This paper underscores some of the advances that have been and are being made to address the issue of standardized documentation templates. Additional advances include the development of a Validation Process Maturity Model [4] and some preliminary groundwork that has been laid in the area of risk-based accreditation. While these initiatives are indicative of forward progress in the VV&A arena, continued efforts are needed to move the community to the efficient implementation of VV&A activities and the effective application and sharing of VV&A results and lessons learned. Sharing of VV&A results and lessons learned will be facilitated by the use of standard VV&A templates, a common VV&A language, and the implementation of common processes.

As the transition in the M&S management structure takes place and organizational structures like the former DoD VV&A Technical Working Group stand down, alternate structures need to be put into place to ensure effective cooperation, coordination, and collaboration on issues and projects across the DoD, Joint Forces, Services, and the major communities. A mechanism needs to be established to support the definition of one common, cross-cutting, and consistent vision for VV&A. The unified voice, if you will.

A proposed paradigm is to leverage the Tri-Service VV&A meeting structure to create an active chartered VV&A focal group that is recognized DoD-wide. Leadership of the group would be shared by the Services and DoD. Secretariat duties, meeting coordination responsibilities, and agenda management would be rotated across the Services and M&S CO. The primary responsibilities of this group would be to:

• Identify VV&A gap areas
• Identify potential solutions to address the gaps
• Foster technical initiatives and standards development
• Maintain situational awareness on VV&A issues, concerns, and ongoing initiatives
• Serve as a technical exchange for emerging concepts and lessons learned
• Identify leveraging opportunities
• Support VV&A training and education initiatives
• Produce and update VV&A guidance
• Represent the one VV&A voice to communities and professional conferences

This focal group should also establish close ties to other government agencies, such as the Department of Energy and National Aeronautics and Space Administration, which face similar challenges in advancing the science of VV&A within the respective organizations.

Activities such as the VV&A templates initiative show the benefit of cooperation and coordination across DoD. The standards product that has resulted from this effort will be applicable across all communities, facilitating the exchange of information and increasing the effectiveness of VV&A results. A standing forum that facilitates the development of such standards, as well as defining emerging technical solutions that increase the effectiveness and efficiency of VV&A processes, is imperative to supporting “One Voice.”

7. SUMMARY

This paper reviewed the transformations in M&S management that are ongoing at the DoD- and Service-levels and suggested that a management structure for VV&A also is needed. We discussed the need to implement VV&A to establish and document confidence in using M&S results. The paper looked at the importance of all communities to access and share VV&A information in SOAs like the GIG. And finally, we reviewed past and ongoing efforts to standardize and automate the VV&A infrastructure and forecasted a road ahead for VV&A.
Reference List


Biography

Donald Johnson is an Engineer Systems Solutions support contractor and senior systems analyst for Air Force Agency for Modeling and Simulation (AFAMS) strategic planning, Air Force Distributed Mission Operations, M&S standards and architectures.

Frank Schwartzenburg serves as the Army Model & Simulation Office VV&A and standards coordinator. As a Senior Military Analyst, he provides policy and procedure recommendations for VV&A and standards. He is updating VV&A policy in the Army M&S regulation and guidance in the Army VV&A pamphlet. He has been working VV&A and standards since he retired from the Army in 2003, as well as some M&S in previous positions. He is an Operations Research/Systems Analyst, and has a Bachelor of Science degree in biochemistry and a Master of Business Administration with a major in finance. He works for Alion Science and Technology.

Jennifer Park is the Navy Modeling and Simulation Office (NMSO) VV&A Lead representing the Assistant Secretary of the Navy for Research, Development and Acquisition Chief Systems Engineer (ASN(RDA) CHENG) and has served in that position for more than five years. Additionally, she works with the Joint Program Executive Chemical and Biological Defense Program as the Integration and Test Lead, providing M&S and VV&A support to various Joint Project Management efforts. She graduated from the University of Missouri and the Naval Postgraduate School where she earned a Bachelor of Science and a Master of Science in Electrical Engineering, respectively.

Marcy Stutzman provides management and technical services to the NMSO VV&A Lead as an Operations Research Analyst for the Northrop Grumman Space & Mission Systems Corporation's Defense Mission Systems Division. She served in the U.S. Army as a Senior Intelligence Research Analyst, Cryptologic Language Analyst, Reporter, and Voice Interceptor with five years duty at the National Security Agency. She is an active member of the SISO's VV&A Forum, VV&A Product Development Group, and the IEEE Standards Association. Ms. Stutzman has a Bachelor's degree from Indiana University and has provided M&S and VV&A support to the DoD, Army, and Navy since 1990.

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William Oates is the chief of the Modeling and Simulation Technical Standards Branch, AFAMS, in Orlando, Florida. He chairs the Air Force Modeling and Simulation Standards Steering Group. He serves as an Air Force liaison to the Defense Standardization Program Lead Standardization Activity for M&S and the Joint National Training Capability Architectures and Technical Standards Working Group. Mr. Oates is an active member of SISO and served on its Standards Activity Committee and Communications, Framework and Infrastructure Forum.

1 The acronym "M&S" is used for both "modeling and simulation" and "model(s) and simulation(s).