Acquisition M&S Community Sponsored M&S Project: Standardized Documentation for Verification, Validation, and Accreditation - A Status Report to the Systems Engineering Community

Kevin Charlow
David H. Broyles
Space and Naval Warfare Systems Center Charleston
P.O. Box 190022
North Charleston, SC 29419
843-218-5372, 843-218-4834
kevin.charlow@navy.mil, david.h.broyles@navy.mil

Curtis Blais
MOVES Institute, Naval Postgraduate School
700 Dyer Road
Monterey, CA 93943-5001
831-656-3215, DSN 756-3215
clblais@nps.edu

Marcy Stutzman
Northrop Grumman Space & Mission Systems Corporation
Defense Mission Systems
3422 Londonleaf Lane
Laurel, MD 20724
301-317-9698
marcy.stutzman@ngc.com

ABSTRACT: *Using models and simulations that provide credible results in the systems engineering process is crucial to fielding defense weapon systems more effectively to the warfighter. Employing distributed, live-virtual-constructive synthetic environments that produce results that can be used with confidence is essential to support development and testing of interoperable systems for joint capabilities. Credibility and confidence in the use of modeling and simulation (M&S) results can be achieved only through the implementation of standard Verification, Validation, and Accreditation (VV&A) processes. M&S is a key enabler for systems engineers throughout the acquisition process. VV&A is critical for ensuring an M&S is correct, is used correctly, and can produce results a systems engineer can trust.*

The Department of Defense (DoD) Modeling and Simulation Steering Committee (M&S SC) Acquisition M&S Community Lead, Mr. Chris DiPetto, Deputy Director for Developmental Test and Evaluation, is sponsoring several Acquisition M&S Projects. One of those projects is titled, "Standardized Documentation for Verification, Validation, and Accreditation." This paper will update the Systems Engineering Community on what the project is about and progress that has been made. It will provide information on the development of standardized content and format requirements for four core VV&A documents, the technology development efforts to automate those templates to ensure standardization across the DoD and Military Departments, and the work underway to identify VV&A metadata that will enable the sharing of information across all M&S Communities via the Global Information Grid anywhere in the world and at anytime. Additionally, the paper will identify gaps from the M&S SC Common and Cross-Cutting Business Plan and objectives from the DoD Acquisition M&S Master Plan that are being addressed by this project. Finally, the paper will provide an overview of the project including scope, schedule, and deliverables.

1. Introduction

The Department of Defense (DoD) Modeling and Simulation Steering Committee (M&S SC) Acquisition M&S Community Lead, Mr. Chris DiPetto, Deputy Director for Developmental Test and Evaluation, is sponsoring several Acquisition Modeling and Simulation (M&S) Projects. One of those projects is titled, "Standardized Documentation for Verification, Validation, and Accreditation (VV&A)." This paper updates the Systems Engineering Community on what the project is about and progress that has been made. It provides information on the development of standardized content and format requirements (i.e., templates) for four core VV&A documents, the technology development efforts to automate those templates to ensure standardization across the DoD and Military Departments, and the work underway to identify VV&A metadata that will enable the sharing of information across all Communities enabled by M&S via the Global Information Grid (GIG) anywhere in the world and at anytime. Additionally, the paper identifies gaps from the M&S SC Common and Cross-Cutting Business Plan and objectives from the DoD Acquisition M&S Master Plan that are being addressed by this project. Finally, it provides an overview of the project including scope, schedule, and deliverables.

Using models and simulations that provide credible results in the systems engineering process is crucial to fielding defense weapon systems more effectively to the warfighter. Employing distributed, live-virtual-constructive synthetic environments that produce results that can be used with confidence is essential to support development and testing of interoperable systems for joint capabilities. Confidence in the use of M&S results can be achieved only through the implementation of standard VV&A processes that are understood and employed by the M&S communities. M&S is a key enabler for systems engineers throughout the acquisition process. VV&A is critical for ensuring an M&S is correct, is used correctly, and can produce results a systems engineer can trust.

2. Background

DoD Instruction (DoDI) 5000.61 [1] sets policy requiring accreditation of all models and simulations "used to support major DoD decision-making organizations and processes" and all models and simulations "used to support joint training and joint exercises." The Instruction requires DoD components to "establish VV&A policies and procedures for models and simulations they develop, use, or manage." Moreover, the Instruction requires Principal Staff Assistants and heads of the DoD Components to hold M&S proponents accountable and

responsible for "verification and validation of their assigned M&S, as well as the documentation of those activities," and to hold individual data producers accountable and responsible for "the quality of their data or data products provided for M&S use."

Since 1996 when DoDI 5000.61 [1] was first promulgated, organizations DoD-wide have been attempting to implement VV&A processes and capture VV&A information. Over the years, guidance for implementing VV&A was provided in the form of Service- and organizational-level instructions, recommended practices, guidebooks, handbooks, and standards. The requirements for documenting VV&A information varied from Service-to-Service, organization-to-organization, and community-to-community, but generally all required the same types of information needed to gain confidence in the application of M&S results for an intended use. Because there were common general requirements, the Service VV&A representatives came together in 2005 as part of a DoD-sponsored VV&A Templates Tiger Team to begin work on developing one set of templates for four core VV&A documents: the Accreditation Plan, V&V Plan, V&V Report, and the Accreditation Report. The purpose was to enable expanded M&S reuse by building the foundation for consistent V&V information to support accreditation decisions. The result of that effort will be a DoD Standard Practice (draft MIL-STD-XXX002) [2] that provides a common framework for the sharing of information throughout the VV&A process. The templates captured in the standard practice will be automated by the DoD VV&A Documentation Tool (DVDT). Using templates with standard format and content requirements to document VV&A information across DoD will help users better understand if an M&S can meet their needs because they will know what kind of information is available and where to look in the document for that information.

The DVDT is the latest tool to address the need to capture VV&A information in a consistent format with consistent content. Prior prototype versions used by various organizations across DoD, preceded the DVDT and provided the baseline for functional requirements [3]. The DVDT will be discussed more in Section 4.

2.1 Sharing VV&A Information

The primary product of the VV&A processes is information. [4]

Documenting VV&A information consistently across DoD will yield many returns, one of which is the capability to share that information with future users of M&S. VV&A information can tell a potential user about the M&S assumptions, capabilities, and limitations. It

provides a description of what the M&S can be used to do (capabilities) and also what it should not be used to do (limitations). This information can save time and money for potential users if they can find a match that satisfies or partially satisfies their needs to use M&S.

Using standardized terminology will make VV&A information easier to discover and share over the GIG. [5]

An ontology defines a common vocabulary and a shared understanding that enables reuse of knowledge. A common VV&A vocabulary will enable the development of a standard XML schema that will facilitate the sharing of VV&A information in GIG service-oriented and net-centric architectures.

Warfighters around the world depend on M&S and need ready access to VV&A information that can provide them the basis for using M&S results to inform decisions. It is Joint Staff policy to assure that all information technology (e.g., M&S) that is used to support operations meet interoperability requirements and are supportable over the GIG [6]. Section 5 will discuss these efforts in more detail.

2.2 Gaps, Objectives, and Actions

This DoD M&S Project (discussed more in Section 3) addresses gaps affecting the effective use of M&S throughout DoD identified in the M&S SC Common and Cross-Cutting Business Plan [7]. That business plan captures in one place corporate level M&S requirements and needed capabilities. The gaps are segregated into one of three sections — Technology, M&S Practices, and Representations.

The M&S Practices area addresses the guidance, business rules, and information exchange mechanisms that support planning, development, and use of M&S. Reuse and VV&A are identified as M&S Practices gap areas:

REUSE
Potential users find it difficult to:
— locate, access, and assess M&S resources and to identify potential reuse candidates,
— clearly understand the capabilities of candidate model and simulation resources, and
— to assess the difference between the functionality of reuse candidates and the capabilities that are needed.

VV&A
— There is no mature method for deriving VV&A costs.
— Standardized VV&A documentation templates are needed

The DoD M&S Project addresses these gaps. In addition, because the DoD M&S Project is sponsored by the Acquisition Community Lead, it also addresses the following objectives and actions identified within the DoD Acquisition M&S Master Plan [8].

OBJECTIVES
— Enhance the technical framework for M&S.
— Improve M&S use.

ACTIONS
— Establish a standard template of key characteristics (metadata) to describe reusable M&S resources.
— Enhance the means (e.g., directory service, registries, bulletin boards) to discover the existence of reusable resources required for M&S and contact information.
— Require standardized documentation of VV&A DoD-wide.

The Master Plan documents the actions needed to improve M&S support to the DoD acquisition process. The specific actions defined within the plan will foster better tools and processes to support systems engineering, acquisition decision making, development of joint capabilities, and realization of cost efficiencies [8].

3. DoD M&S Project

The M&S SC established several DoD M&S Projects in FY07 through the proposal process depicted in Figure 1 and described below.
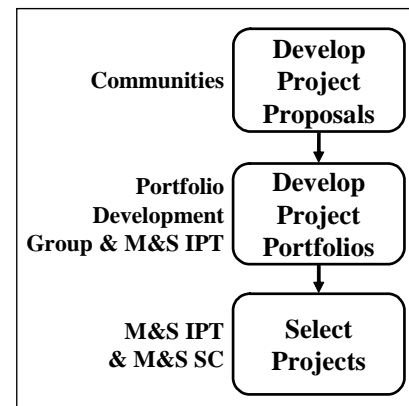
Figure 1. M&S SC Proposal Process

Develop Project Proposals — Communities led the development of and submittal of proposals for projects addressing gaps in the M&S SC Common and Cross-Cutting Business Plan [7].

Develop Project Portfolios — The M&S Integrated Product Team (IPT) and the Portfolio Development Group assessed the project proposals and identified promising proposals that addressed the gaps. These two

groups then worked with the proposal submitters to improve the proposal's ability to address gaps.

Select Projects — The M&S IPT evaluated the proposals and made selection recommendations to the M&S SC. The M&S SC decided which proposals to fund.

This project was vetted successfully through that process, found to address several gaps and acquisition objectives, and selected for funding in FY07 with a period of performance through September 2008.

3.1 Acquisition Governance

The Acquisition Community M&S SC member provides oversight of the project through the Acquisition member of the M&S IPT. Figure 2 depicts the DoD acquisition governance structure [9].
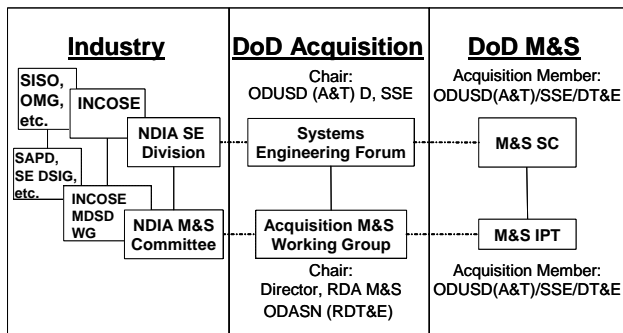

Figure 2. DoD Acquisition Governance Structure

The Acquisition M&S Working Group (AMSWG) is chartered by the DoD Systems Engineering Forum to assist program managers and acquisition professionals by improving the utility of M&S in the acquisition of defense capabilities. In this capacity, the AMSWG addresses common concerns, aligns technical initiatives, and pursues cross-cutting issue resolution [10]. Representing the interests of the acquisition M&S community, the AMSWG also acts as the sounding board for this project by providing guidance and direction with respect to requirements for the various tasks and deliverables.

3.2 Project Management

The team is led by the Space and Naval Warfare Systems Center (SPAWARSYSCEN) in Charleston, South Carolina, and its structure is depicted below in Figure 3.
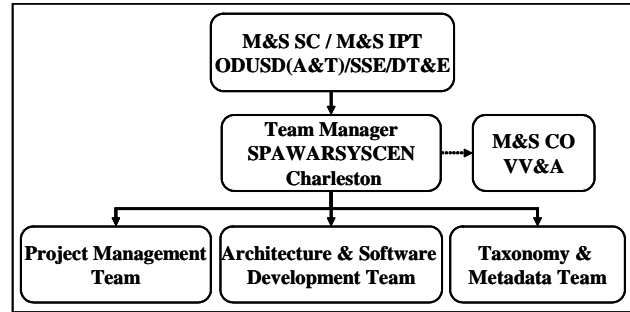
Figure 3. Project Management Structure

The Project Management Team and Architecture & Software Development Team both are led by SPAWARSYSCEN Charleston. The Taxonomy & Metadata Team is led by the Naval Postgraduate School.

3.3 Scope

The project has three major tasks and associated deliverables:
— Produce the DVDT
— Develop a VV&A XML schema and VV&A ontology for M&S
— Recommend updates to associated policy, guidance, and standards documents

The purpose of the project is to support the various DoD- and Service-level communities by delivering a tool that produces standardized VV&A documentation and a VV&A XML schema that meets net-centric architecture requirements for sharing, discovering, and retrieving VV&A information within the GIG enterprise. The project is also working towards incorporating references to the standard practice, DVDT, and VV&A metadata into the appropriate M&S, data, and acquisition policy and guidance documents.

The beta versions of the DVDT and supporting XML schema are expected in the first quarter of FY08. The final versions of the tool, XML schema, and VV&A ontology are scheduled for fourth quarter of FY08.
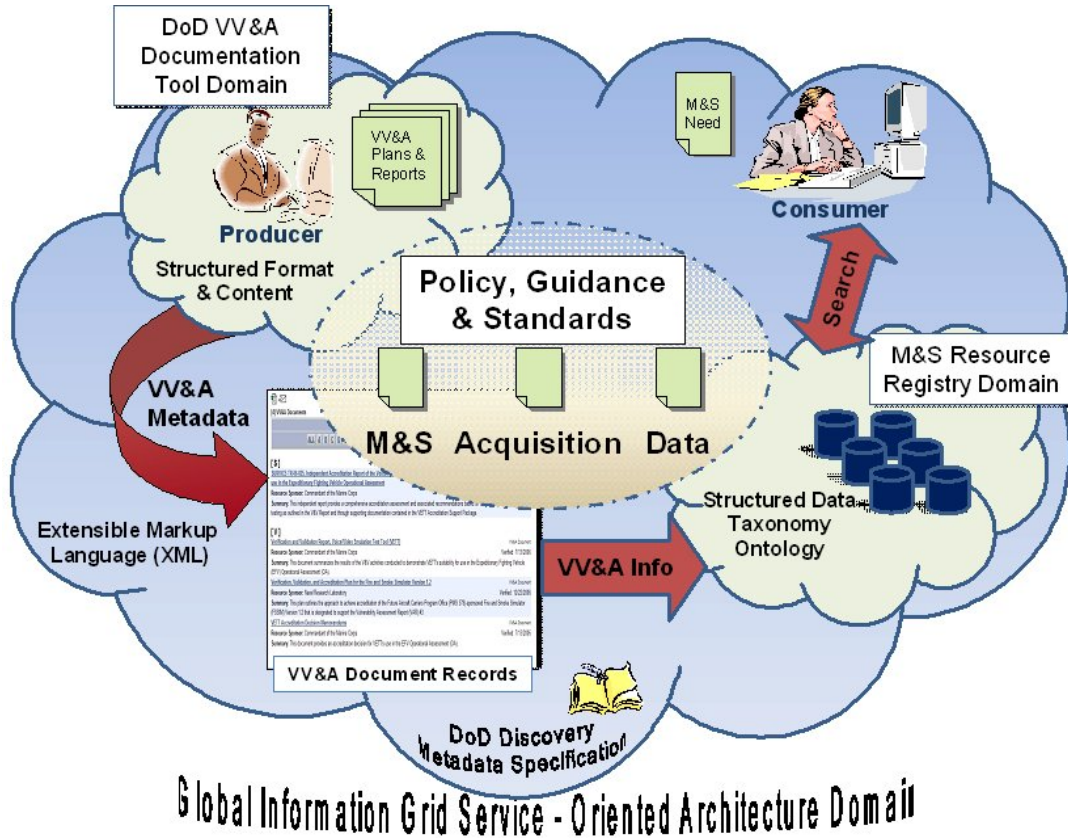
3.4 Concept of Operations

Figure 4. High Level Concept of Operations

Figure 4 presents the high-level concept of operations for how the three major deliverables support the M&S communities.

Policy, guidance, and standards in the areas of M&S, acquisition, and data (depicted in Figure 5) form the foundation for everything to work together.
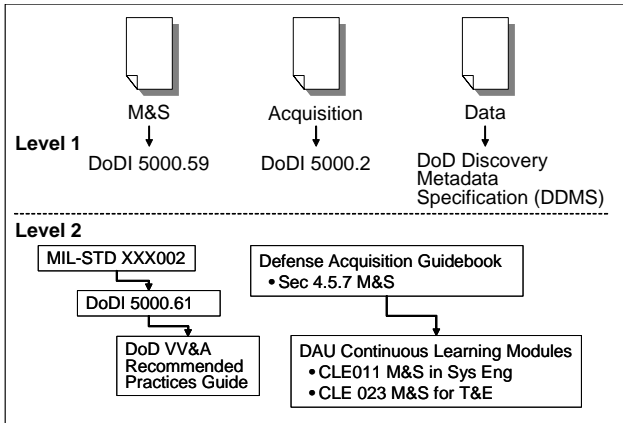

Figure 5. Policy, Guidance & Standards

Ensuring consistent use of the DVDT across the DoD and Military Departments, will enable publishing of VV&A metadata, which, in turn, will facilitate the discovery and sharing of VV&A information over the GIG. The new DoDD 5000.59 [11] was signed in August 2007 and states that "M&S management shall … pursue common and cross-cutting M&S tools, data, and services." Additionally, it provides direction to the M&S SC to "oversee … the implementation of best practices of how models and simulations are effectively acquired, developed, managed, and used by DoD Components (e.g., verification, validation, and accreditation; standards, and protocols)." Based upon the specificity of the published directive, a new instruction (DoDI 5000.59) may well be needed to implement the provisions in the directive. Along with DoDD 5000.59 [11], the new instruction will be important for all matters related to M&S across DoD. DoDI 5000.2 [12] is key to acquisition procedures for using M&S. Affecting change to these two important level-1 documents will be worked through the appropriate channels.

Another important aspect of this task is to affect changes in level-2 policy, guidance, and standards documents. The level-2 M&S documents include, the draft DoD Standard Practice (MIL-STD-XXX002) [2], DoD 5000.61 [1], and the online VV&A Recommended Practices Guide [13]. The level-2 acquisition documents include the Defense Acquisition Guidebook (focusing particularly on Section 4.5.7 Modeling and Simulation) [14], and online Continuous Learning Modules provided by the Defense Acquisition University's Continuous Learning Center [15], focusing on these two modules in particular:

— CLE 011 M&S for Systems Engineering
— CLE 023 M&S for Test & Evaluation

The project also will recommend updating the DoD Discovery Metadata Specification (DDMS) with the VV&A metadata for general use across the enterprise.

The M&S SC members represent the driving forces behind making the necessary changes to these various policy, guidance, and standards. Together they represent a unified front for M&S management across DoD.

The concept of operations in Figure 4 starts with a consumer's need to use M&S. The consumer employs the GIG to conduct a semantic search for VV&A information to locate resources that best meet requirements for the use of M&S. VV&A metadata transferred from the DVDT will be searchable in the M&S Resource Domain. Based upon the information retrieved from the M&S Resource Registry Domain, the consumer is exposed to information that can inform the decision to reuse a legacy M&S "as is," to modify a legacy M&S, or to build a new M&S. The producer uses the DVDT to document VV&A planning, implementation, and reporting. The DVDT uses XML source data to produce printable documents. When the producer initiates a VV&A project in the DVDT, VV&A metadata will be made available to the M&S Resource Registry Domain. When a VV&A document is finalized and approved, additional VV&A metadata will be made available to the M&S Resource Registry Domain.

4. DoD VV&A Documentation Tool

The DVDT is a technology development effort to automate the standard DoD VV&A templates that are captured in the DoD Standard Practice [2]. Automation of the templates will save users time by expediting the VV&A documentation production process and will ensure standardization of content and format across

DoD and the Military Departments. Additionally, automation provides several other benefits:

— Ensure compliance with policy and guidance
— Guide users through the VV&A process
— Enable content consistency and completeness across all Communities enabled by M&S
— Facilitate and contribute to M&S reuse
— Provide quality and complete VV&A information to stakeholders faced with making decisions on the application of M&S results
— Provide standardized methods to communicate VV&A information at appropriate levels of detail

When the work to develop the standard templates was completed, efforts turned to identifying requirements for a DoD tool to automate the production of VV&A documents. Initially the requirements effort was led by the M&S Coordination Office (M&S CO) and now is part of this project.

Because the DVDT is a tool for use across DoD and the Military Departments, requirements for the tool reflect the needs of a broad population that cuts across all communities enabled by M&S. Examples of several high-level functional requirements include:

— web-enabled with Secure Socket Layer
— Common Access Card or Public Key Infrastructure certificate access to tool (for Government, Military, Civilian, and Contractors)
— private VV&A project management
— VV&A project owners grant access permission to other VV&A Team members
— log of users
— log of changes made to documents
— secure data storage
— requirements traceability across all documents
— produce four different documents
— common information update across all documents
— M&S Word-compatible, PDF and HTML formats
— automatic numbering of sections and subsections
— use of bold, italics, numbered and/or bulleted lists
— capability to insert graphics, images, and tables
— capability to send metadata about final approved documents to the M&S Resource Registry Domain.

Additionally, the DVDT offers a flexible experience. User will choose between a guided wizard interface and a "what you see is what you get" display. The tool also offers a context-sensitive help system that includes links to the appropriate policy and guidance documents.

The DVDT is being developed in conjunction with and will be compliant with the VV&A XML schema and VV&A ontology for M&S described in Section 5.

5. Structured VV&A Data

Effective data sharing requires a commonly understood representation of the data. In a web-based, network-centric architecture, data sharing through common representation is facilitated through the use of the Extensible Markup Language (XML) [16] and XML Schema language [17] standards. The XML Schema language is used to define the data structure and valid content of XML documents. Design and development of the DVDT includes design of an XML Schema description of information contained in the Defense Standard Practice for VV&A documentation [2]. The schema will describe data types and constraints suitable for ensuring the compliance of the XML documents created by the DVDT. The DVDT will be designed to read and write XML instance documents that validate[1] against this schema. Selected metadata about particular VV&A resources entered using the DVDT (resulting in XML instance documents) will be available to the M&S Resource Registry Domain.

Previous work on the prototype VV&A documentation tool is being leveraged to define the XML structures and content for the current project. The DVDT XML schema will be developed in accordance with current Department of the Navy XML Naming and Design Rules [18]. To promote visibility of this structural metadata, the schema will be posted to the DoD Metadata Repository for community reference and use. To be responsive to user needs, the project will coordinate with GIG M&S Community of Interest (COI) activities defining standards and best practices for metadata, data mediation and services, relating this work to VV&A processes, data and services as applicable.

The following paragraphs provide additional information about data sharing requirements in the GIG architecture. The Standardized Documentation for VV&A project will comply with data sharing policies for widest possible dissemination and utility of VV&A information of interest to the DoD M&S community.

5.1 VV&A Information on the GIG

The GIG is 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, defense policymakers, and support personnel [19].

In the GIG, information must be discoverable and accessible across the enterprise, dismantling traditional stovepipes that have restricted information exchange in the past. The DoD Net-Centric Data Strategy describes the vision for this net-centric environment and the data goals for achieving that vision through:

— ensuring data are visible, available, and usable when needed and where needed to accelerate decision-making;
— tagging all data (intelligence, non-intelligence, raw, and processed) with metadata to enable discovery of data by users;
— posting of all data to shared spaces to provide access to all users except when limited by security, policy or regulations; and
— advancing the Department from defining interoperability through point-to-point interfaces to enabling the "many-to-many" exchanges typical of a net-centric data environment.

The GIG provides enterprise services that enable data tagging, sharing, searching, and retrieving in support of the data strategy.
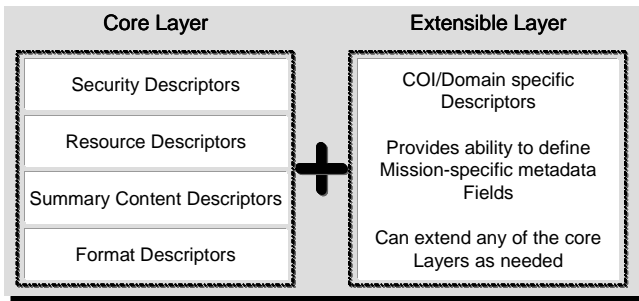
The Net-Centric Data Strategy also introduces management of data within communities of interest (COIs) or "collaborative groups of users who must exchange information in pursuit of their shared goals, interests, missions, or business processes and who therefore must have shared vocabulary for the information they exchange" [19].

COIs address organization and maintenance of data within their domains, while tagging the data in ways that make the data available for use within the COI and across COIs. COI-specific metadata structures provide an extended level of data definitions and structures. A community ontology will provide the data categorization, thesaurus, key words, and taxonomy. The COI-specific metadata structures and the community ontology will serve to increase semantic understanding and interoperability of the community data.

The goal of posting data to shared spaces uses metadata registries and metadata catalogs. A metadata registry contains information describing structure, format, and definitions of data. DoD has established the DoD Metadata Registry, containing document formats, interface definitions, exchange models used by systems, messaging formats, symbology, ontologies, and transformation services. The registry currently incorporates the DoD XML Registry, the Defense Data

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[1] "Validate" here is used in the XML sense of ensuring that the structure and content of an XML instance document conforms to the specifications given in the associated XML schema document(s).

Dictionary System, and commonly used data reference sets. A metadata catalog contains instances of metadata associated with individual data assets. In XML parlance, the metadata registry contains XML schema files and the metadata catalog contains XML instance documents conforming to the respective schema files.

To further promote data discovery, DoD created the DDMS. The DDMS "defines metadata elements for resources posted to community and organizational shared spaces…The DDMS specifies a set of information fields that are to be used to describe any data or service asset that is made known to the enterprise, and it serves as a reference for developers, architects, and engineers by laying a foundation for Discovery Services" [20]. Figure 6 provides an overview of the categories of metadata specified in the DDMS.

Core Layer	Extensible Layer
Security Descriptors	COI/Domain specific Descriptors
Resource Descriptors	Provides ability to define Mission-specific metadata Fields
Summary Content Descriptors	
Format Descriptors	Can extend any of the core Layers as needed

Figure 6. DoD Discovery Metadata Specification Overview (from [20])

This project will support the goals of the Net-Centric Data Strategy with respect to data relating to VV&A of M&S resources. Additional discussion of how the project will address the goals of data visibility, discovery, and understandability is provided in the following.

5.2 Visibility, Discovery, Understandability

To promote discovery, this project will leverage the DDMS XML vocabulary through reference to the DDMS namespace. Another effort is in progress to identify DDMS metadata applicable to DoD M&S products and resources and to identify additional metadata needed for M&S purposes that will supplement DDMS requirements (and may be proposed as extensions to DDMS). Also, that work will be leveraged to identify DDMS and M&S metadata that can be reused in the DVDT XML schema and in the document instances conforming to that schema. Finally, the project will also determine if certain metadata specific to VV&A documentation should be

proposed as extensions to the DDMS for general use across the enterprise.

To further promote the Net-Centric Data Strategy goal of enabling the data to be understood, this project will explore application of other web-based standards for describing information. Tim Berners-Lee's vision for the World Wide Web is creation of a web of knowledge, termed the Semantic Web [21]. This is being addressed through research and development of standards that provide representation of stronger semantics in web-based information, in line with the Net-Centric Data Strategy goal of enabling data to be understandable by users and applications, both structurally and semantically. Current and emerging Semantic Web standards include the Resource Description Framework (RDF), RDF Schema, Web Ontology Language (OWL), and Semantic Web Rule Language (SWRL), among others.

5.3 Strong Semantics

For future growth in automation of VV&A processes and information, the project will develop a formal ontology that can be employed by software and humans attempting to discover M&S components/resources and to assess suitability of those components/resources for the desired purpose. We will investigate the current state of defined VV&A taxonomies, processes, and artifacts to design an initial VV&A ontology describing important concepts, properties, relationships, constraints, and business rules. The ontology will be developed using Web Ontology Language (OWL) and other Semantic Web standards as deemed appropriate.

The VV&A ontology work will establish a technical case for application of formalized semantics relating to VV&A processes and records. The formalisms will include the above metadata (XML schema) describing M&S data and products; but will extend the data modeling to provide deeper description of the concepts. The work will review prior VV&A research and development to develop an initial taxonomy of M&S artifacts and VV&A processes and artifacts (for example, see [22] and [23]). The taxonomy will then be extended to include properties that reflect interrelationships across classes or categories of concepts. For example, a taxonomy of M&S systems may classify systems by use as training or analysis systems, with possibly a third classification for systems that can be used for both purposes. However, an M&S system accredited for training may also be accredited for analysis purposes, but only under certain constraints and conditions in its employment.

The project will design and develop an ontology expressing VV&A information established in VV&A processes and M&S documentation. Previous markup language work and the Defense Standard Practice [2] provide an excellent starting point for defining classes and properties in the ontology. Concentration will be on classification schemes that will support semantic discovery of VV&A metadata describing M&S resources as well as providing an ability to perform logical inferences on the information to relate VV&A information to user or system requirements in obtaining and using needed M&S resources. In addition to the ontology itself, the work will produce a technical report on the ontology design, including design decisions and trade-offs made during the effort.

More expressive ontologies can describe not only the classes and their properties relevant to VV&A information, but relationships across classes that cannot be represented in a strict hierarchical structure as defined by XML Schema. In the literature on ontology design, the importance of determining the domain and scope of the ontology, to include identification of questions that a knowledge base built from the ontology should be able to answer, is emphasized [24]. This level of semantic sophistication will be needed to enable humans and software to better access and employ VV&A information about M&S resources as the community moves toward GIG service-oriented and net-centric architectures.

6. Summary

This paper updated the Systems Engineering Community about the DoD M&S Project titled, "Standardized Documentation for VV&A". It provided information on the development of standardized content and format requirements for four core VV&A documents, the technology development efforts to automate those templates to ensure standardization across the DoD and Military Departments, and the work underway to identify VV&A metadata that will enable the sharing of information across all M&S Communities via GIG service-oriented and net-centric architectures. Additionally, gaps, objectives, and actions from the Common and Cross-Cutting Business Plan and the DoD Acquisition M&S Master Plan were identified. Finally, a project management overview including a concept of operations was provided.

If you would like to become a DVDT beta tester or use the DVDT to support a VV&A project, you can contact any one of the authors to obtain more information.

7. References

[1] Department of Defense. 2003. DoDI 5000.61, DoD Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A), May.

[2] Modeling and Simulation Coordination Office. 2007. Department of Defense Standard Practice Modeling and Simulation Verification, Validation, and Accreditation Documentation Templates (draft), MIL-STD-XXX0002, Project MSSM-2005-002. Washington, DC, August.

[3] Park, J., Broyles, D.H., Kawabata-Hara, H. 2005. "Work Smarter Not Harder VDT v.2.1: Standardizing VV&A Documentation through User Utility." In the *Proceedings of the 2005 Spring Simulation Interoperability Workshop* (San Diego, April 3-8). SISO, Orlando, FL.

[4] Youngblood, S.Y., Bailey, M., Johnson, D., Oates, W., Park, J., Schwartzenburg, F., and Stutzman, M., 2007. "Verification, Validation, and Accreditation (VV&A) One Voice Unified, Common & Cross-Cutting." In the *Proceedings of the 2007 Summer Computer Simulation Conference* (San Diego, CA, July 15–18). SCS, San Diego, CA.

[5] Broyles, D.H., Blais, C., and Stutzman, M, 2007. "Automating Standardized Information for the Verification, Validation, and Accreditation Process: An Acquisition Community Sponsored M&S Project." In the *Proceedings of the 2007 Fall Simulation Interoperability Workshop* (Orlando, FL, Sep 16-21). SISO, Orlando, FL.

[6] Chairman, Joint Chiefs of Staff. 2006. CJCSI 6212.01D. Interoperability and Supportability of Information Technology and National Security Systems. March.

[7] Modeling and Simulation Steering Committee. 2006. Common and Cross-Cutting Business Plan Version 1.0. November.

[8] Department of Defense. 2006. Acquisition Modeling and Simulation Master Plan. April.

[9] DiPetto, C. 2007. "DoD Acquisition Modeling & Simulation Community." In the *Proceedings of the 2007 Defense M&S Conference* (Hampton, VA, May 7-11).

[10] Department of Defense. 2006. Acquisition Modeling and Simulation Working Group Charter, April.

[11] Department of Defense. 2007. DoDD 5000.59, DoD Modeling and Simulation (M&S) Management. August.

[12] Department of Defense. 2003. DoDI 5000.2. Operation of the Defense Acquisition System. May.

[13] Department of Defense. 2006. VV&A Recommended Practices Guide, Millennium Edition, RPG Build 3.0. https://www.dmso.mil. September.

[14] Department of Defense. 2006. Defense Acquisition Guidebook, Version 1.6. https://akss.dau.mil/DAG/. July.

[15] Defense Acquisition University Continuous Learning Center. 2007. http://clc.dau.mil/. July.

[16] World Wide Web Consortium. Extensible Markup Language (XML). http://www.w3.org/XML/.

[17] World Wide Web Consortium. XML Schema. http://www.w3.org/XML/Schema.

[18] Department of Navy. 2005. Department of the Navy XML Naming and Design Rules, Final Version 2.0. January.

[19] Department of Defense. 2003. DoD Net-Centric Data Strategy, May.

[20] Department of Defense. 2007. Department of Defense Discovery Metadata Specification (DDMS), Version 1.4.1. August.

[21] Berners-Lee T., Hendler, J., and Lassila, O. 2001. "The Semantic Web," *Scientific American*. May.

[22] Hartley, D.S. III. 1997. "Verification & Validation in Military Simulations," in *Proceedings of the 1997 Winter Simulation Conference*, S. Andradottir, K. J. Healy, D. H. Withers, and B. L. Nelson, eds. Institute of Electrical and Electronics Engineers. Atlanta, GA. December.

[23] Yi, C., Brade, D., and Van Emmerk, M. 2004. VV&A Global Taxonomy (TAXO), Common Validation Verification and Accreditation Framework for Simulation (REVVA), THALES JP 11.20-WE1100-TAXO-D1101. March.

[24] Noy, N.F. and McGuinness, D.L. 2002. "Ontology Development 101: A Guide to Creating Your First Ontology," http://protege.stanford.edu/publications/ontology_development/ontology101.html.

Author Biographies

KEVIN CHARLOW is the Enterprise Technologies Program Manager for the Space and Naval Warfare Systems Center Charleston, South Carolina. He is the project team lead for the Standardized Documentation for Verification, Validation and Accreditation (VV&A) Project. He has supported the Navy Modeling and Simulation Office (NMSO) for the last 6 years. He has a Bachelor of Science in Computer Engineering from Clemson University and a Master of Business Administration from Webster University.

CURTIS BLAIS is a Research Associate with the Naval Postgraduate School Modeling, Virtual Environments, and Simulation (MOVES) Institute. His primary areas of research and development include application of semantic web technologies to improve interoperability and for identifying and delivering valued information in network-centric environments such as the Global Information Grid. He is also working on his doctorate in the MOVES program.

DAVID H. BROYLES is a scientist in the Command and Control Dept. at the Space and Naval Warfare Systems Center Charleston, South Carolina. He is the Architecture and Software Development Team Lead for the Standardized Documentation for VV&A Project. He has 13 years experience in software development in the areas of geographic information, document management, and accounting systems. He has supported NMSO for 5 years and led the software development of the Navy VV&A Documentation Tool.

MARCY STUTZMAN provides management and technical services to the NMSO VV&A Lead as an Operations Research Analyst for Northrop Grumman. 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 a member of the NDIA M&S Committee, the Simulation Interoperability Standards Organization, and the IEEE Standards Association. She 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.