Standardized Documentation for Verification, Validation, and Accreditation

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ABSTRACT

Using modeling and simulation (M&S) technology that provides credible results to inform the Department of Defense (DoD) decision making process is crucial to the security and prosperity of the United States. Because the role that M&S serves in military training and training systems is critical, it is vitally important that M&S provide positive training and can be employed with confidence. Credibility and confidence in the application of M&S can be achieved only through the implementation of Verification, Validation, and Accreditation (VV&A) processes. Implementing VV&A ensures an M&S is correct, is used correctly, and can produce results that can be trusted.

The DoD Modeling and Simulation Steering Committee's Acquisition Community Lead sponsors the project, "Standardized Documentation for Verification, Validation, and Accreditation." This paper will update the Training Community on that project. It will provide information about MIL-STD-3022, which recommends standardized content and format requirements for four core VV&A documents; the DoD VV&A Documentation Tool, which is the technology that automates the production of the four VV&A documents to ensure standardization across the DoD and Military Departments; and the development of VV&A XML schemas that enable the sharing of VV&A information via the Global Information Grid enterprise anywhere in the world and at anytime.

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Curtis Blais is a Research Associate with the Naval Postgraduate School 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. Mr. Blais earned Bachelor of Science and Master of Science degrees from the University of Notre Dame. He is currently a Ph.D. candidate in the MOVES program.

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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 supports the DoD M&S Project, "Standardized Documentation for Verification, Validation and Accreditation," as an Operations Research Analyst for the Northrop Grumman Corporation. She is the Policy, Guidance, and Standards Team Lead for that project. Additionally, she provides management and technical services to the NMSO VV&A Lead as a member of the NMSO VV&A Support Team. 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 National Defense Industrial Association 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 Department of Defense, Army, and Navy since 1990. Her hobby is birding.

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INTRODUCTION

Using modeling and simulation (M&S) technology that provides credible results to inform the Department of Defense (DoD) decision making process is crucial to the security and prosperity of the United States. Because the role that M&S serves in military training and training systems is critical, it is vitally important that M&S provide positive training and can be applied with confidence. Credibility and confidence in the application of M&S results can be achieved only through the implementation of Verification, Validation, and Accreditation (VV&A) processes. Implementing VV&A ensures an M&S is correct, is used correctly, and can produce results that can be trusted and used with confidence.

The DoD Modeling and Simulation Steering Committee's (M&S SC) Acquisition Community Lead sponsors the project, "Standardized Documentation for Verification, Validation, and Accreditation." This paper will inform the Training Community of that project. It will provide information about Military Standard (MIL-STD) 3022 (Department of Defense, 2008), which recommends standardized content and format requirements for four core VV&A documents. Additionally, information about the DoD VV&A Documentation Tool (DVDT), which is the technology that automates the production of the four VV&A documents to ensure standardization across the DoD and Military Departments will be provided. Finally, the development of VV&A XML schemas that enable the sharing of VV&A information via the Global Information Grid (GIG) enterprise anywhere in the world and at anytime will be discussed.

Specifically, we will relate how implementing VV&A processes employing the project's products will allow trainers to use M&S with confidence to learn, train, and win. We will discuss how trainers can use the DoD VV&A Documentation Tool (DVDT) to document VV&A planning, implementing, and reporting completely and consistently. Additionally, we will introduce the training audience to MIL-STD-3022, which provides standardized templates for producing VV&A documents. Finally, we will connect the project products to the DoD data discovery effort and demonstrate how trainers will obtain VV&A information about reusable M&S training assets.

BACKGROUND

DoD Instruction (DoDI) 5000.61 *DoD M&S VV&A* (Department of Defense, 2003), sets policy for the accreditation of all M&S developed, used, or managed by DoD and the DoD Components. Collectively, the DoD Components comprise the Office of the Secretary of Defense, the Military Departments, the Chairman of the Joint Chiefs of Staff, the Joint Staff, the Combatant Commands, the Office of the Inspector General of the Department of Defense, the Defense Agencies, the DoD Field Activities, and all other organizational entities within the DoD.

Since 1996 when the original instruction was promulgated, organizations have been implementing VV&A processes and documenting VV&A information similarly, but differently. VV&A implementation guidance occurs as policy, recommended practices, guides, handbooks, and standards. Most organizations require the same types of information be documented, but the guidance for how to organize that information in documents varies. It became clear for VV&A information to be useful across the DoD that common

guidance was needed to ensure VV&A information was documented completely and consistently.

In 2007, DoD Directive (DoDD) 5000.59, *DoD M&S Management* (Department of Defense, 2007), established the M&S SC, an executive-level DoD committee comprising Senior Executive Service, flag or general officers of the military, or officials of equivalent rank and precedence. The initial membership includes the Under Secretary of Defense for Acquisition, Technology & Logistics; Under Secretary of Defense for Policy; the Under Secretary of Defense for Personnel and Readiness; the Director of Program Analysis and Evaluation; the Director of Operational Test and Evaluation; the Military Secretaries; the Chairman of the Joint Chiefs of Staff; and the Commander of U.S. Joint Forces Command. The membership represents six DoD Communities enabled by M&S: Acquisition, Analysis, Planning, Testing, Training, and Experimentation. The Under Secretary of Defense for Personnel and Readiness is one of the three M&S SC chairs and represents the DoD Training Community.

This DoD M&S project is sponsored by the DoD Acquisition Community, represented by the Deputy Director for Developmental Test and Evaluation in the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, who provides direct oversight.

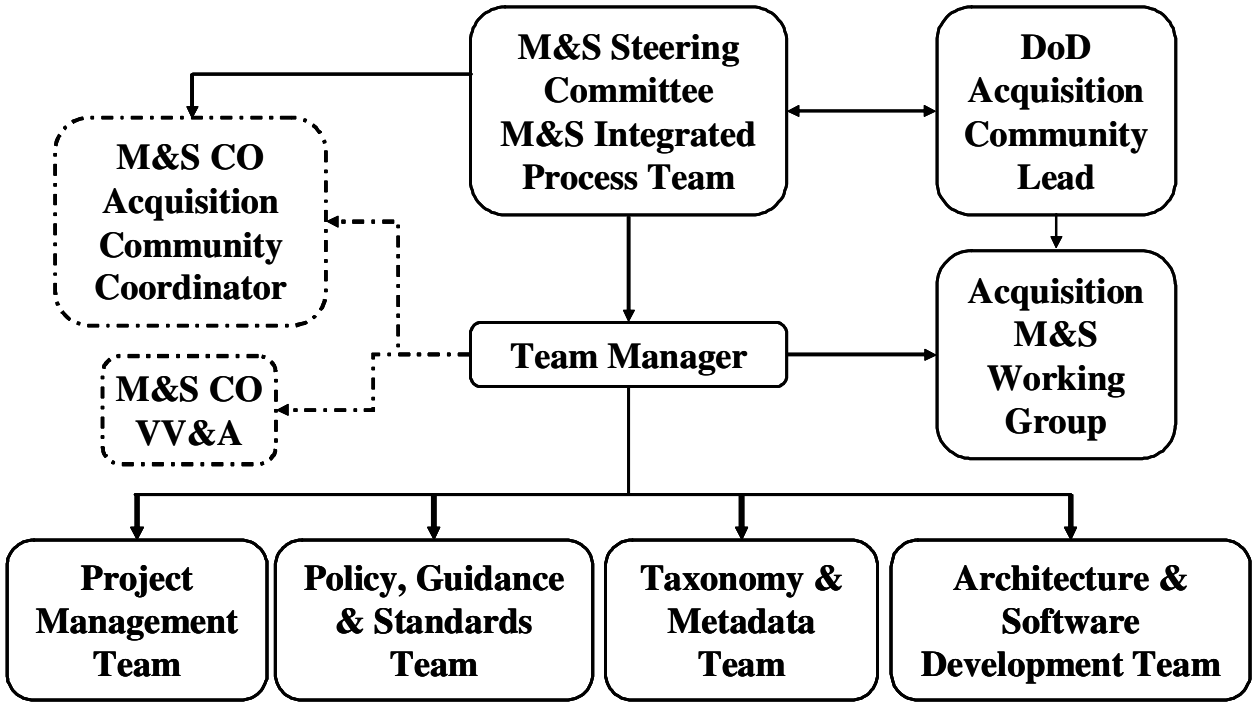


Figure 1. Project Organization

Figure 1 depicts the project's organization. The project is organized into four teams: (1) a Project Management Team led by Team Manager, Kevin Charlow; (2) a Policy, Guidance & Standards Team led by Marcy Stutzman; (3) a Taxonomy & Metadata Team led by Curtis Blais; and (4) an Architecture & Software Development Team led by David Broyles. Each team plays an important role in accomplishing the project's major tasks and producing the associated deliverables:

- recommending updates to associated policy, guidance, and standards documents
- designing, describing, and registering VV&A XML schemas
- designing, developing, testing, and deploying the DVDT

The project's concept of operations, depicted in Figure 2, starts with the consumer in the upper right hand corner. A consumer has a need to use M&S, for example to provide training or to inform a decision about a needed training capability. The consumer will employ the GIG to search for information about VV&A documents to locate resources that best meet the requirements for the use of M&S.

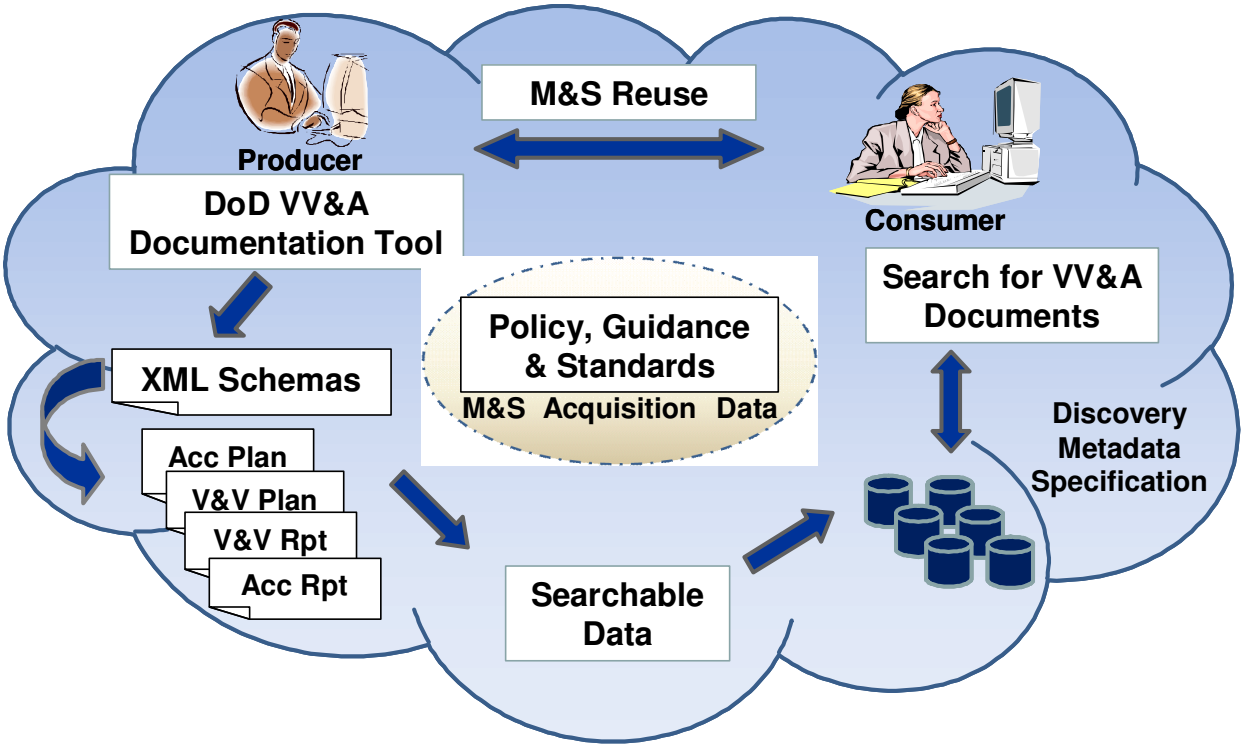


Figure 2. Project Concept of Operations

VV&A metadata generated by the DVDT and conforming to the M&S Community of Interest Discovery Metadata Specification (MSC DMS) (Department of Defense, 2008) will be discoverable via the GIG. Based upon the information retrieved from a search, the consumer will be exposed to VV&A information that can inform the training decision to reuse a legacy M&S "as is," to modify a legacy M&S, or to build a new M&S.

Starting in the upper left hand corner of Figure 2, the producer uses the DVDT to document VV&A planning, implementation, and reporting, e.g., of M&S used to train a specific task or tasks from the Universal Joint Task List. Upon registering and accessing the DVDT, the producer downloads five interrelated XML-based files that are stored by the producer at the location of choice (e.g., on the producer's computer). Four of the five files represent the templates formalized in MIL-STD-3022 (Department of Defense, 2008); the fifth file provides help in using the DVDT. When the producer initiates a VV&A documentation project in the DVDT, certain VV&A metadata is made available for search and discovery (e.g., contact information and project information). When a VV&A document is finalized and formally approved (i.e., signed), additional VV&A metadata can be made available to the GIG enterprise for search and discovery.

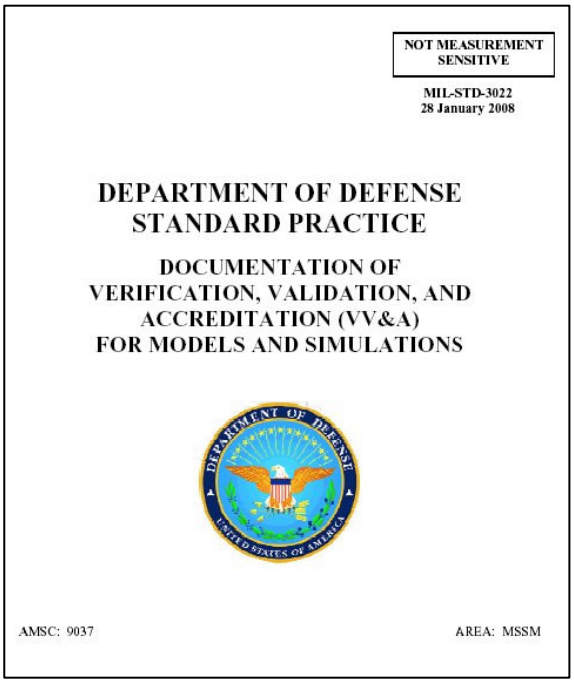
The center circle shows the three areas — M&S, Acquisition, and Data — of relevant policy, guidance, or standards, on which the project:

- Formulates recommendations for updates
- Coordinates those recommendations with the DoD Communities, and then
- Recommends that DoD M&S SC members advocate for the needed changes.

POLICY, GUIDANCE & STANDARDS

In 2007, the M&S Technical Review Group (TRG) (led by M&S CO) for M&S Standards processed through the Defense Standardization Program conducted a review of a draft standard developed by the DoD-led Tri-Service VV&A Templates Team. That team, functional from 2005 to 2006, collected and reviewed all available VV&A documentation guidance, and then consolidated the information into common content and format guidance for the DoD.

The M&S TRG comprised members of the M&S IPT, the Service-level M&S Standards leads, and representatives of the Defense Standardization Program's DoD Standardization Management Activities for the M&S Standards and Methodologies Standardization Area. The M&S TRG was asked to review the draft standard and provide comments. A comment resolution team adjudicated all comments that were submitted. All adjudicated essential comments received approval from the individual submitters and the draft standard was updated accordingly.


NOT MEASUREMENT SENSITIVE

MIL-STD-3022
28 January 2008

DEPARTMENT OF DEFENSE
STANDARD PRACTICE

DOCUMENTATION OF
VERIFICATION, VALIDATION, AND
ACCREDITATION (VV&A)
FOR MODELS AND SIMULATIONS

AMSC: 9037 AREA: MSSM

Figure 3. MIL-STD-3022

In January 2008, MIL-STD-3022 (Department of Defense, 2008) (Figure 3) was approved providing common VV&A documentation templates for the Accreditation Plan, Verification and Validation (V&V) Plan, V&V Report, and the Accreditation Report.

Data Item Descriptions (DIDs), defining the content, preparation instructions, format, and intended use for the individual VV&A documents, also are available for each of the VV&A documents as follows:

- DI-MSSM-81750 DoD M&S Accreditation Plan (Department of Defense, 2008)
- DI-MSSM-81751 DoD M&S V&V Plan (Department of Defense, 2008)
- DI-MSSM-81752 DoD M&S V&V Report (Department of Defense, 2008)
- DI-MSSM-81753 DoD M&S Accreditation Report (Department of Defense, 2008)

As a DoD Standard Practice, MIL-STD-3022 may be cited as a solicitation requirement. The applicable DID must be listed on the Contract Data Requirements List (DD Form 1423) when it is necessary to obtain VV&A data.

MIL-STD-3022 and the DIDs are available from the Acquisition Streamlining and Standardization Information System (ASSIST), which can be accessed at http://assist.daps.dla.mil/.

TAXONOMY & METADATA

The Net-Centric Data Sharing Strategy (Department of Defense, 2003) is the guiding document for information sharing across DoD. Net-centricity is "the realization of a networked environment, including infrastructure, systems, processes, and people, that enables a completely different approach to warfighting and business operations." The network foundation 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," i.e., the GIG. Consumers can search for and "pull" data as needed, or they can receive alerts when data to which they have subscribed is updated or changed. The goals of the strategy are to make data visible, accessible, institutionalized, understandable,

trusted, interoperable, and responsive to the consumer's needs.

Data assets (e.g., VV&A documents) are described by metadata to support discovery. A standard set of metadata for discovering distributed resources is provided in the DoD Discovery Metadata Specification (DDMS) (Department of Defense, 2003).

The DDMS design reflects a combination of a core layer of metadata with an extensible layer providing Community of Interest (COI)/domain-specific metadata. The data sharing strategy is being addressed through (1) self-organized COIs for identification and maintenance of data; (2) metadata describing the data assets; and (3) GIG Enterprise Services supporting data tagging, sharing, searching, and retrieval. The DoD GIG M&S COI is actively defining metadata for discovery of M&S resources. This group recently published the MSC DMS (Department of Defense, 2008) built upon the information requirements of the DDMS.

One very important M&S resource is VV&A documentation as it provides evidence of the suitability of particular M&S for some intended use for the Training Community as well as all other communities.

As described earlier in the discussion of the concept of operations (Figure 2), the producer provides metadata when registering to use the DVDT, in turn the DVDT provides the metadata to the enterprise for discovery. The data is provided as XML documents for broad use by various applications. When a producer begins work on a VV&A documentation project, the DVDT will prompt for, store, and publish to the enterprise an initial set of metadata describing the VV&A documentation project as depicted in Figure 4.

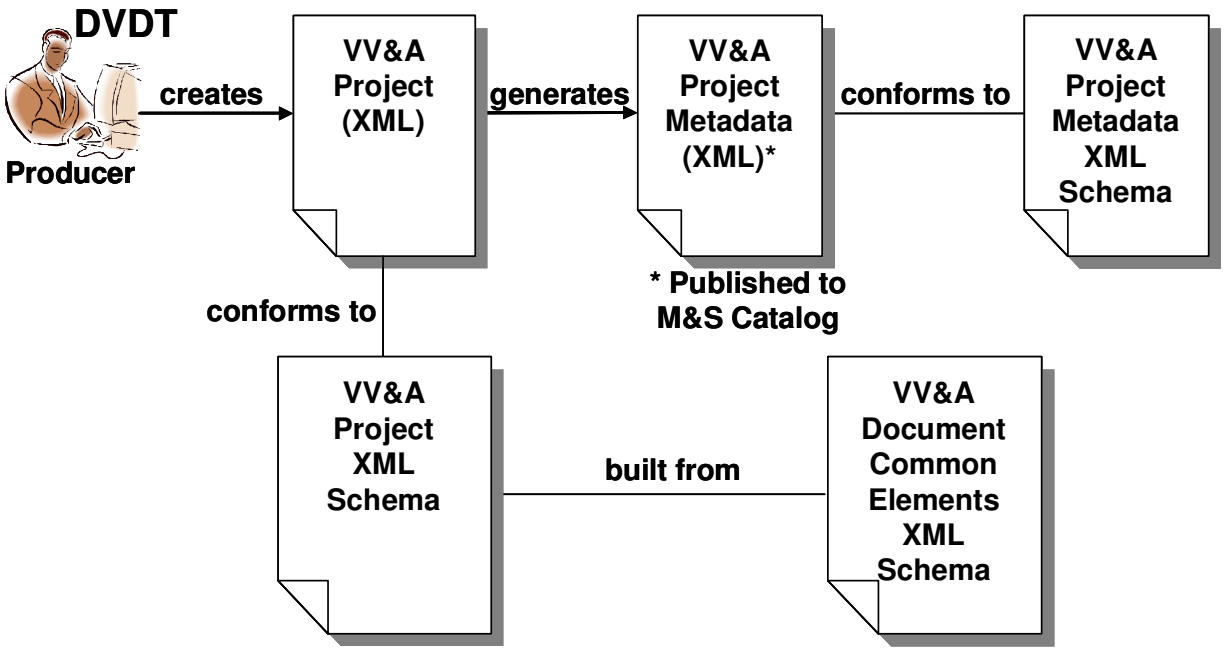


Figure 4. Project-level XML Schema Documents

As the producer develops the four standard VV&A documents (Accreditation Plan, V&V Plan, V&V Report, and Accreditation Report) in Figure 5, the producer can direct the DVDT to extract and publish document-specific metadata describing the document itself as a new M&S resource. This information can be updated as needed as the document goes through its life cycle.

The content of the VV&A documents is also stored as XML for processing by the DVDT. The producer may choose to make the document content available through various DoD-, Service-, Community-specific catalogs, registries, and/or repositories.

All standardized data about VV&A documentation that is stored to the enterprise will be stored as XML. XML schemas describing the structure and content of the various documents have been developed

specifically for project-level metadata (Figure 4), document-specific metadata (Figure 5), and document content (Figure 5). The metadata schemas employ structures defined in the MSC DMS to ensure the community-required set of discovery metadata is provided in the standardized VV&A documentation metadata files. Work is continuing to develop VV&A taxonomy and ontology descriptions to enable future semantic search and query capabilities.

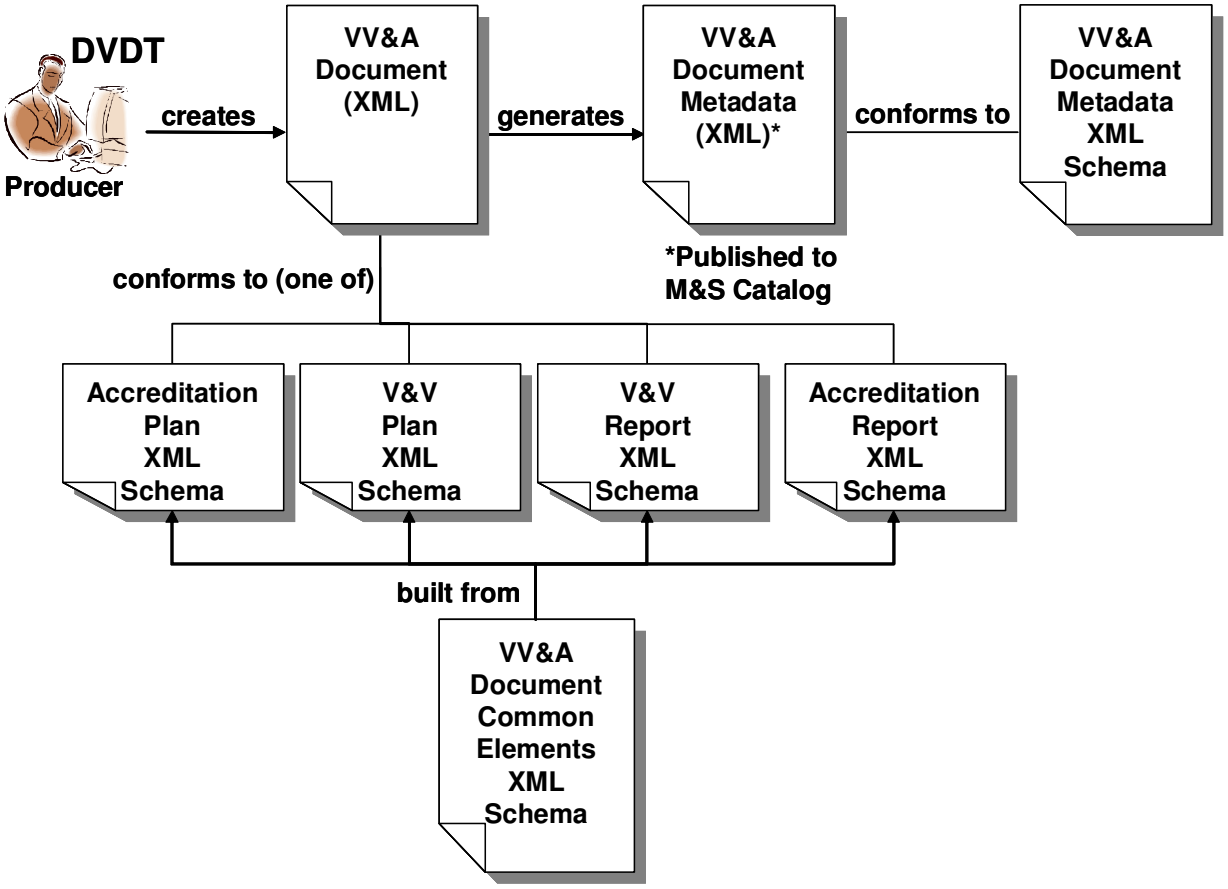


Figure 5. Document-level XML Schema Documents

ARCHITECTURE & SOFTWARE DEVELOPMENT

The DVDT is a technology development effort to automate the standard DoD VV&A templates captured in MIL-STD-3022 (Department of Defense, 2008) and to make information about the VV&A documents produced using the DVDT available via the GIG enterprise. 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. Because the DVDT is a tool for use by all DoD Components, requirements for the tool reflect the needs of a broad population that cuts across all communities enabled by M&S.

The DVDT codifies VV&A business rules in XML and executes those rules for the production of VV&A documentation. As stated previously, the DVDT also enables the search and discovery of VV&A document information via the GIG enterprise. These capabilities enable the Training Community to produce consistent VV&A information and to discover VV&A information about M&S needed to support training decisions and to conduct training.

The DVDT's architecture provides a service to capture consistent information about the implementation of VV&A processes to determine confidence in the credibility of M&S results for an intended use. Using the DVDT will be easy for everyone engaged in VV&A activities since there are just four basic actions

— register, download, produce, and update — as shown in Figure 6.

The producer registers the first time visiting the DVDT website. The registration process solicits a minimal set of information (e.g., contact information Certification Authority Public Key Infrastructure certificate.

Once registered, the producer initiates a VV&A documentation project and downloads the XML VV&A schema documents. These schema documents are used by the organizations implementing the accreditation process and the verification and validation processes to record VV&A information.

and project information) and assigns a username and password. When a registered producer returns to the website, access is achieved by username and password and/or a government Common Access Card or an External

The DVDT automatically populates the four VV&A documents with the common information identified in MIL-STD-3022 when those documents are stored together. This capability can save producers time and money in the production of the subsequent documents. Since the organization that produces the accreditation plan and report probably will be different from the organization that produces the V&V plan and report, automatically sharing the common information across documents will depend on where the documents are stored.

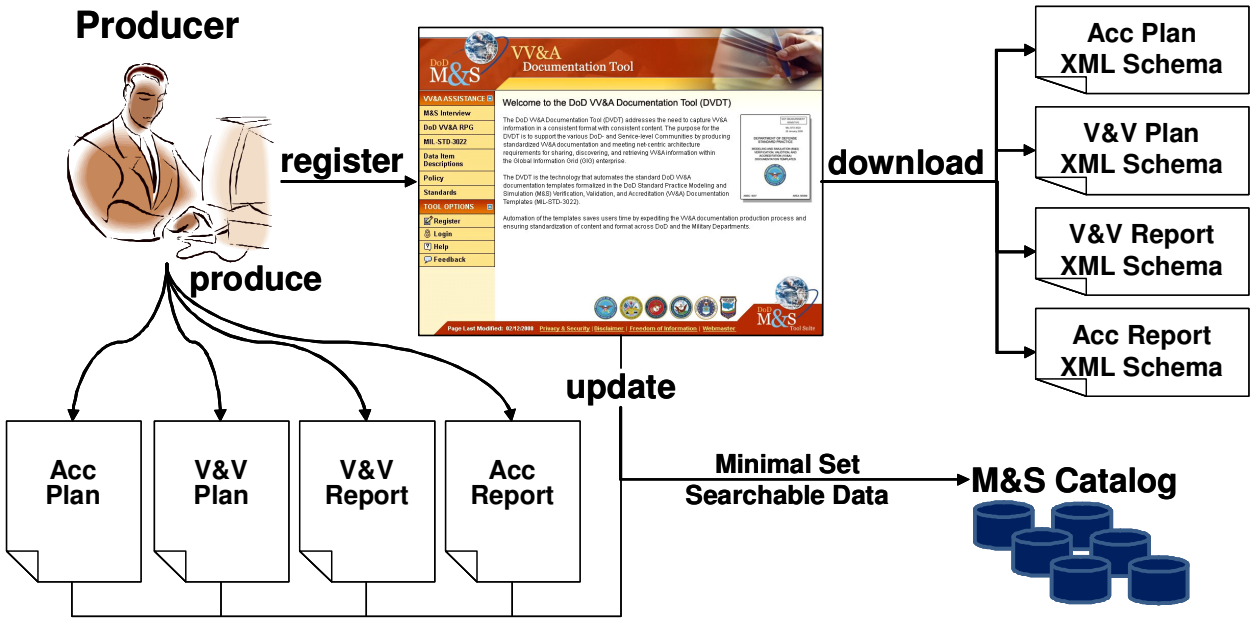


Figure 6. DVDT Architecture

Coordination on the production of each of the individual documents by the different organizations involved in implementing the individual verification, validation, and accreditation processes will occur through the means used by the organizations involved, (e.g., integrated digital environment, engineering environment, knowledge sharing environment, or sharing files through email). The decision where to retain the documents under control is left to the producers of the documents.

After a plan or report is finalized, approved, and signed, the producer can update the information in the M&S Catalog. This update adds information to the existing record in the M&S Catalog that was not available at the initiation of the VV&A documentation project.

Why is updating information about VV&A documents in the M&S Catalog important to the Training Community consumer? Leveraging services is the answer. The M&S Catalog provides the capability to

search and discover information about M&S that have undergone VV&A when there is a need to use (or reuse) M&S to address a training problem. Using the M&S Catalog, consumers will (1) find information about M&S that could meet their needs; (2) identify who "owns" the M&S and the VV&A documents; and (3) determine how to contact the owners.

DATA DISCOVERY

The DVDT and XML VV&A Schemas are being developed with the GIG in mind. Figure 7 depicts the process for making VV&A information available to the GIG enterprise.

On the one hand, the tool assists the producer by extracting and publishing discovery metadata to the DoD Discovery Catalogs. As presented earlier, the discovery metadata initially describes the conduct of a VV&A documentation effort (project-level metadata) and later describes specific VV&A documents (document-level metadata). The former metadata is published when the producer first begins a VV&A documentation project with the DVDT and anytime thereafter at the producer's discretion. The latter metadata (document-level) is extracted and published at the producer's discretion as VV&A documents are completed and the metadata about those documents is made available via the GIG.

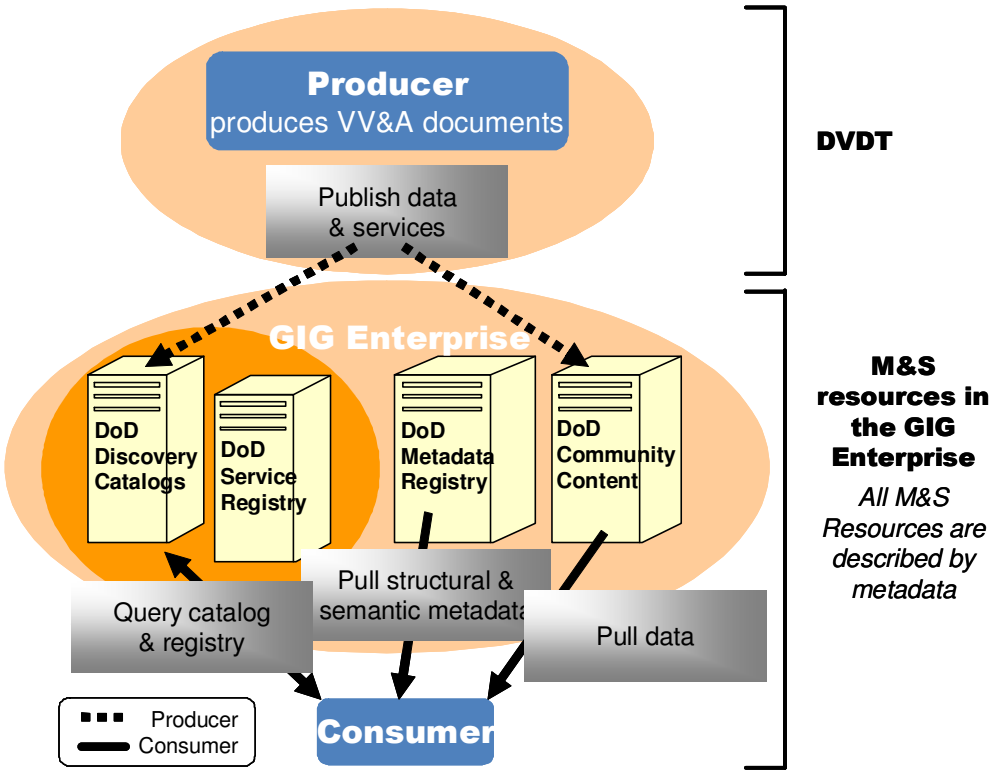


Figure 7. VV&A Document Data Discoverable through M&S Catalog

On the other hand, the producer publishes data (i.e., the VV&A documents themselves) and services as DoD Community Content for discovery and possible reuse by consumers. The VV&A documents may be made available in a variety of formats, such as XML or several commercially available word processing applications. Posting of XML formats offers consumers a variety of options for rendering or processing the VV&A document content; for example, the use of Extensible Stylesheet Language Transformations (XSLT) to extract information from the XML documents to create or update webpages in Hyper-Text Markup Language (HTML).

Department of Defense Directive 8320.02, *Data Sharing in a Net-Centric Department of Defense*, (Department of Defense, 2007) establishes policies and

responsibilities to implement data sharing and provides the definitions for data and metadata as follows:

- Data. A representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or by automatic means. (Data and information are equivalent terms for the purposes of the policy.)
- Metadata. Information describing the characteristics of data; data or information about data; or descriptive information about an entity's data, data activities, systems, and holdings. For example, discovery metadata is a type of metadata that allows data assets to be found using enterprise search capabilities.
- Semantic Metadata. Information about a data asset that describes or identifies characteristics about that asset that convey meaning or context (e.g., descriptions, vocabularies, taxonomies).
- Structural Metadata. Information provided about a data asset that describes the internal structure or representation of a data asset (e.g., database field names, schemas, web service tags).

Discovery services enable search activities within the M&S Catalog. The Training Community consumer seeking VV&A information queries the M&S Catalog and pulls information about VV&A documents from it. Having VV&A document information readily available enables the identification of reusable M&S training resources and the configuration of credible M&S environments to meet the needs of the Training Community consumer.

For search and discovery to be efficient and effective, the DoD Communities must provide content. By using the DVDT, that content will be provided to the M&S Catalog automatically and is shareable immediately across the Training Community via the GIG enterprise anywhere in the world and at anytime.

ADDITIONAL INFORMATION

Information about this project and its products has been briefed at various M&S VV&A venues since 2007. The reader can learn more about the project's progress by perusing those already published papers and presentations included as references.

SUMMARY AND CONCLUSIONS

This paper informed the Training Community about the DoD M&S Project titled, "Standardized Documentation for VV&A." It provided information about MIL-STD-3022 (Department of Defense, 2008), the DVDT, and the VV&A XML schemas. Additionally, the paper discussed DoD data discovery and the role the DVDT plays. Implementing VV&A by employing the project's products allows trainers and trainees to use M&S with confidence to learn, train, and win. If the reader is interested in using the DVDT to support a VV&A implementation project, please contact any of the authors to obtain more information.

ACRONYMS

ASSIST	Acquisition Streamlining and Standardization Information System (http://assist.daps.dla.mil/)
COI	Community of Interest
DDMS	DoD Discovery Metadata Specification
DID	Data Item Description
DoD	Department of Defense
DoDD	DoD Directive
DoDI	DoD Instruction
DVDT	DoD VV&A Documentation Tool
GIG	Global Information Grid
M&S	Modeling and simulation, models and simulations
M&S IPT	M&S Integrated Process Team
M&S SC	M&S Steering Committee
M&S TRG	M&S Technical Review Group
MIL-STD	Military Standard
MOVES	Modeling, Virtual Environments, and Simulation
MSC DMS	M&S COI Discovery Metadata Specification
NMSO	Navy Modeling and Simulation Office
NPS	Naval Postgraduate School
V&V	Verification and validation
VV&A	Verification, validation, and accreditation
XML	Extensible Markup Language

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