

Rediscover the Defense Modeling & Simulation Catalog

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ABSTRACT

During the past year the Defense Modeling & Simulation Coordination Office (DMSCO) has implemented major hardware, software and process upgrades to the discovery and reuse capabilities of the new Defense M&S Catalog. Key enablers for the improved capabilities are the Enterprise Metacard Builder Resource (EMBR) Portal and the M&S Community of Interest Discovery Metadata Specification (MSC-DMS), both DMSCO-developed, GOTS products that have evolved to complement and enhance the Defense M&S Catalog's search and discovery features.

This paper will demonstrate recent enhancements, describe a relevant case study and outline plans for future development.

ABOUT THE AUTHORS

Hart Rutherford is the Modeling & Simulation Program Manager at SimVentions where he leads a team with broad experience in developing tools and strategies for M&S resource management. Mr. Rutherford has over 20 years of professional experience as a combat systems engineer and program manager including technical leadership of software development and M&S for U.S. Navy surface ship programs. Over the last 5 years in support of the Department of Defense Modeling & Simulation Coordination Office (DMSCO), he and his team have developed new operational concepts and deployed new M&S metadata standards and tools to increase the efficiency of M&S reuse throughout the DoD. His team is the co-developer of the new Defense M&S Catalog and provides ongoing technical support. Mr. Rutherford's military background includes active duty service in the United States Navy. He holds a Master's degree in Systems Engineering from Old Dominion University and B.S. in Computer Information Systems from Chapman University.

Frank Mullen is a senior scientist at SimVentions and was previously an associate director at the Defense Modeling & Simulation Coordination Office where he contributed to development of the Defense M&S Catalog. He gained over twenty-five years of defense-related engineering and management experience at the Charles Stark Draper Laboratory in Cambridge, Massachusetts, where he specialized in integrated circuits and microwave devices, and contributed to development of tactical and strategic guidance systems. On active duty and as a reservist he served afloat and ashore, deployed to the Mideast, and spent four years on the Pentagon's Joint Staff. He retired as a captain after thirty years of service. Mullen is an alumnus of the US Coast Guard Academy, the US Naval War College, Defense Acquisition University, and the California Institute of Technology. He holds degrees in electrical engineering and physics.

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INTRODUCTION

The new Defense Modeling & Simulation (M&S) Catalog, which achieved full operational capability in November 2014, represents a complete hardware, software, and conceptual upgrade from its predecessor. Based on operational and maintenance experience with the previous version of the Catalog, combined with considerable input from users, the Defense Modeling & Simulation Coordination Office (DMSCO) initiated the upgrade in 2013. The result is a far more capable and user-oriented system designed to advance DMSCO's aim of achieving the goals of the Department of Defense (DoD) Net-Centric Data Strategy [1]. These include making data products visible, understandable, trusted, and accessible by "authorized but unanticipated users." The design of the new Defense M&S Catalog makes these goals achievable.

The previous version of the M&S Catalog was a proof-of-concept system that, because of its initial success, was adopted as an interim operational product. It continued in regular use for nearly three years, but it was apparent that long-term sustainment would require system upgrades and capability enhancements. Maintenance of the Catalog had become problematic. Support for the commercial software at the heart of the system began to decline and eventually became unavailable after the original vendor was acquired by a competitor. Of equal concern was that the server on which the Catalog was hosted in the Pentagon had reached the end of its service life and was to be retired without replacement.

Feedback from Catalog users indicated other necessary changes. Users wanted a less complicated search interface, one that was more intuitive and required no special knowledge of the organizational plan (the "schema") of the metadata. (Metadata is descriptive information concerning, in this context, an M&S data product such as a computer model.) Because of limitations in the Catalog software, support personnel were unable to make the desired interface modifications.

In addition, organizations that regularly contributed or updated metadata records to the Catalog wanted to have full control of those records—to publish them to the Catalog when they were ready, to retract them when obsolete—without requiring intervention from the Catalog support staff. As the previous Catalog was configured, it was necessary for the support staff to perform manual transformations on all incoming metadata before it could be published. Retracting metadata records from the Catalog could also be done only by the support staff. Commercial online transactions today are routinely conducted without humans other than the user involved. Defense M&S Catalog users wanted similar levels of automation and convenience.

Finally, for DoD organizations to place full confidence in the Defense M&S Catalog, it had to comply with expanded information assurance (IA) requirements. The previous version of the Catalog did not fully comply, and while this defect was not entirely a consequence of the hardware and software deficiencies described above, it made sense to remedy the IA problem while implementing the necessary hardware and software upgrades.

UPGRADING THE DEFENSE M&S CATALOG

Objectives for the current Defense M&S Catalog were to provide users updated, intuitive interfaces for searching and publishing metadata on upgraded and sustainable hardware and software, compliant with DoD IA requirements, and available via the DoD's Nonsecure Internet Protocol Router Network (NIPRNet) in the "dot-mil" domain.

New commercial servers were acquired as part of a routine hardware refresh for DMSCO's M&S Core Tools Suite [2] in early 2013. Requirements gathering for the software components of the current version of the M&S Catalog began during the autumn of 2012. This was followed during the subsequent winter and spring of 2013 by an analysis of alternatives (AoA). This consisted of an expert panel of government and government contractor technical personnel conducting interviews with prospective software vendors and comparing capabilities against a matrix of requirements. Numerical grades were assigned based on compliance with the various requirements, and these were aggregated to determine the most suitable solution.

In May 2013 the selection panel presented its findings and recommendation to the DMSCO Director, who concurred and ordered that development begin immediately.

SYSTEM DESCRIPTION

The Defense M&S Catalog constitutes a key component of the data management concept envisioned in the DoD Net-Centric Data Strategy within the DoD M&S communities. It serves as a repository of metadata about M&S products—models, initialization data, output data, user notes, etc.—sufficiently detailed that users other than the originators can discover the existence of, evaluate the utility of, gain access to, and reuse those products. The objective is to enable authorized but unanticipated users of M&S data products to leverage investments of time and funds made elsewhere in the Department—a process termed “discovery and reuse”—in order to accelerate decision cycles, increase efficiency, avoid unnecessary costs, and improve interoperability.

Users

The intended users of the M&S Catalog are organizations and individuals whose duties involve the creation, maintenance, or use of M&S data products for DoD missions. Because M&S is used throughout the DoD in support of operations, training, program and system analysis, acquisition, and other activities, no specific bounds are placed on the organizations or individuals within the Department who may gain access.

Access is controlled differently depending on the user's role—whether the user merely searches the Catalog's records or, in addition, is a registered user, or is a member of a source-contributor organization. Various levels of access are controlled as part of the Catalog's information assurance regimen.

Information Assurance

The Catalog system complies with the Defense Information Assurance Certification and Accreditation Process (DIACAP). In addition to DIACAP activities, tasks, and management practices, the Catalog has additional business rules designed to enhance its IA posture. Access to the Catalog is controlled by Common Access Card (CAC) or equivalent certificates obtained from an External Certification Authority (ECA) [3]. All CAC or ECA certificate holders may access the Catalog for the purpose of searching its holdings. Publishing to the Catalog is more restricted, however. To publish M&S metadata records to the Catalog, the user's organization must be registered with the Catalog system administrator as a source contributor, and the user must be indicated by the source contributor organization as an authorized publisher.

To make its holdings as broadly available as possible within an IA-compliant environment, the Defense M&S Catalog is available via NIPRNet (<https://mscatalog.msco.mil/>). All metadata in the Catalog is unclassified (though it may describe classified M&S products as long as the description remains unclassified).

System Components

Major system components of the Defense M&S Catalog are shown in Figure 1.

- The DoD M&S Catalog block contains the commercial cataloguing software providing metadata indexing, storage, search, and retrieval capabilities. It also manages the web-services that enable data and metadata transfer among system elements.

- The Enterprise Metacard Builder Resource (EMBR) block is an integrated user toolkit that enables local management of user-controlled M&S metadata. Tools include a menu-driven metadata record (“metacard”) builder, a locally-controlled database to store metacards and associated M&S data products, and a locally-controlled publishing option to send metacards from the originator to the M&S Catalog for department-wide visibility by authorized but unanticipated users.
- The Federated Search blocks represent other DoD catalogs and data repositories that the Defense M&S Catalog can search at a user’s option. Shown here as currently working examples are the DISA Enterprise Catalog and the Defense Technical Information Center (DTIC) publicly available holdings.
- The User Systems block represents repositories of M&S metadata created and stored locally by M&S Catalog user organizations. Data transformations make it possible for such systems to publish their metadata holdings to the M&S Catalog. This is an option available to user organizations and is not mandatory.
- The Catalog Users block represents individual users and user organizations in several modes of interaction. These include conducting searches of existing M&S metadata in the M&S Catalog; conducting broader federated searches of other catalogs and repositories; creating M&S metacards using the EMBR toolkit; and managing user-controlled M&S metadata or data products in the user-controlled partition of the EMBR database.

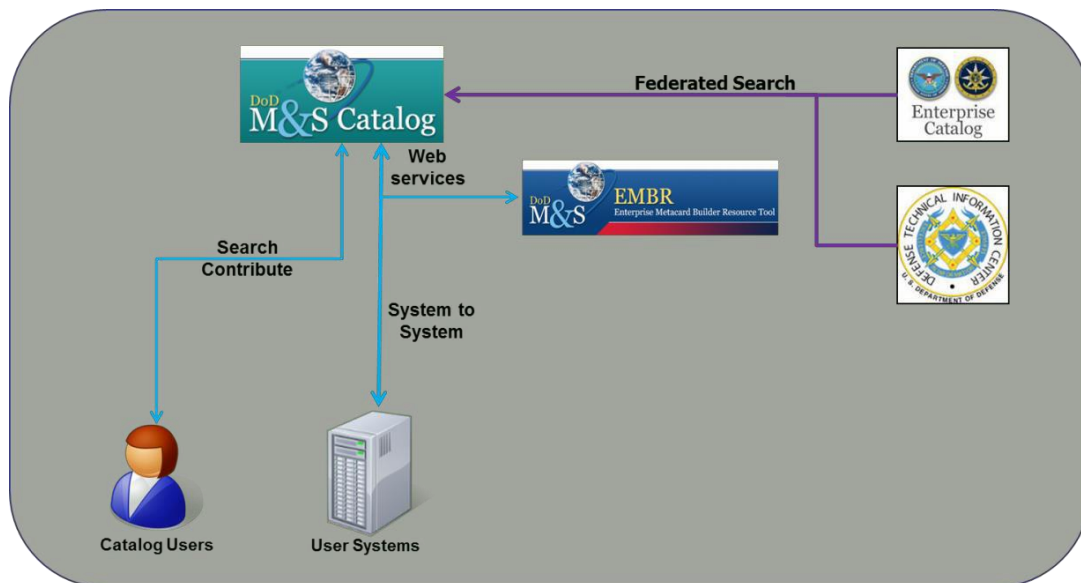


Figure 1. Defense M&S Catalog System Components

The M&S Catalog re-indexes its metacard holdings hourly. New metacards submitted by users for publication in the M&S Catalog will be discoverable by all other authorized users generally within an hour.

Metadata records created using the EMBR toolkit conform to the Modeling & Simulation Community of Interest Discovery Metadata Specification (MSC-DMS) [4], an extension of the Defense Discovery Metadata Specification (DDMS). While conforming to DDMS, MSC-DMS includes additional descriptive elements particular to the M&S Community of Interest, such as fields to describe the Verification, Validation, and Accreditation (VV&A) status of a product. This provides more relevant information for M&S practitioners than is available from DDMS alone.

DEPLOYMENT CONCEPT

The Defense M&S Catalog and its integrated EMBR capabilities are hosted at a central computer facility. User organizations who become contributors to the M&S Catalog are assigned a logical partition of the EMBR database,

and this partition remains under their local control. With the integrated tools, this partition becomes the contributing organization's work area for the purpose of managing M&S metadata and data products and collaborating among the organization's M&S practitioners. At the option of the local organization, metacards can be published to the M&S Catalog, becoming discoverable from there throughout the DoD.

Experience has shown that where the anticipated benefits of discovery and reuse have been best realized is among M&S practitioners who share a common understanding of a related family of systems or who share common technical methodologies. These conditions are most commonly found within organizations whose M&S activities are focused either on related systems, related technical methodologies, or both. Examples include Program Executive Offices, Defense laboratories, training centers, and so on.

For this reason the M&S Catalog deployment concept is designed to deliver value to local user organizations such as these. The EMBR toolkit integrated with the M&S Catalog was originally designed for, and was initially used by, just such organizations for the purposes of creating, modifying, and storing metacards, managing M&S data products, and collaborating among M&S practitioners within those organizations. These are the elements of successful discovery and reuse.

Integration of EMBR as a component of the M&S Catalog enables a two-component concept of operations known as "local management, enterprise discovery." The EMBR toolkit delivers intrinsic value to local user organizations in the form of information management tools to immediately enable local discovery and reuse. The intrinsic value of the tools is alone incentive for organizations to adopt them. At the same time the M&S Catalog provides free, redundant, and fully IA-compliant backup for the local organization's metadata records. The marginal cost for an organization to publish its holdings to the M&S Catalog, and thus make them discoverable enterprise-wide, is near zero: it is a matter of a few mouse clicks.

Thus the Defense M&S Catalog deployment concept is to establish and grow a constellation of M&S practitioner organizations all benefiting individually from the immediate value of the EMBR toolkit, and all selectively publishing their records to the M&S Catalog in order to gain the benefit of free, IA-compliant, redundant storage. As the number and variety of the contributing organizations in the constellation grows, it becomes more likely that individuals or groups of M&S practitioners in one organization will share an understanding of similar systems or common technical methodologies with those of other organizations. In this way it is anticipated that the benefits of discovery and reuse can be propagated from the local level to the enterprise level.

The M&S Catalog deployment concept is illustrated in Figure 2.

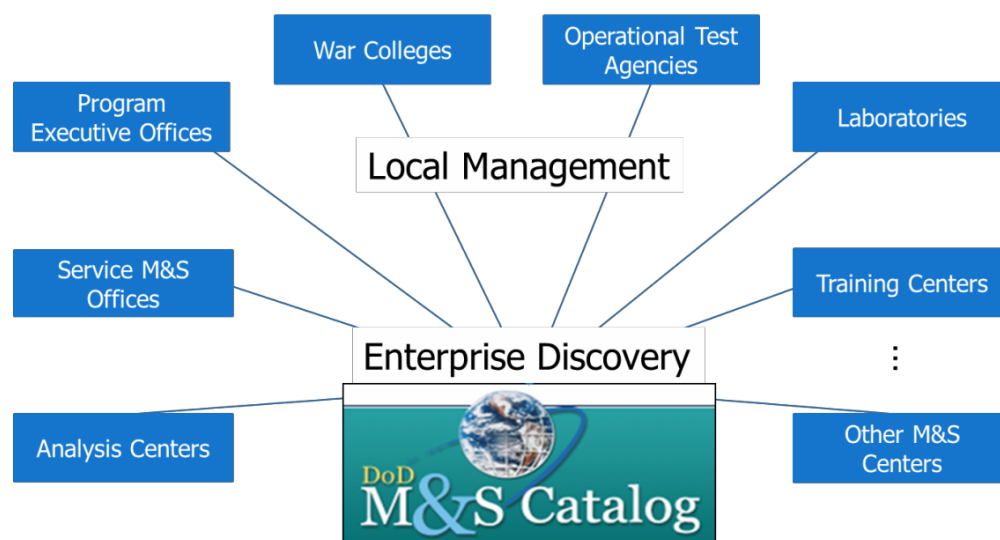


Figure 2. Deployment Concept

ORGANIZATIONAL CONSIDERATIONS

Adoption of the Defense M&S Catalog as an information management tool within an organization requires no additional personnel and no advanced training. Modeling & simulation practitioners typically have sufficient computer skills to exercise the Catalog's capabilities with only slightly more than the amount of familiarization typical for general-use software. Catalog training materials are available online, and a help desk is available for particular needs.

Adoption of the Defense M&S Catalog requires no organizational changes. However, adoption has been found to sometimes prompt organizational modifications in order to take best advantage of the benefits of local management. The particular modifications are at the discretion of the adopting organization and will vary depending on size, scope of M&S activities, and a variety of other factors. As an example, Figure 3 is a schematic of the internal establishment of an M&S integrated product team (IPT) by a Program Executive Office that was an early adopter.

The role of the IPT is coordination among the elements of the organization. It conveys the Program Executive Officer's intent to achieve internal savings through discovery and reuse, elimination of duplication of effort, and other means, so that savings in one element can be redirected to emerging needs in another. The management and collaboration tools available in the EMBR component of the M&S Catalog provide the technical means to gain visibility into how M&S assets are being used across the organization, thus giving the IPT members the ability to discover opportunities for cost savings and other improvements in efficiency.

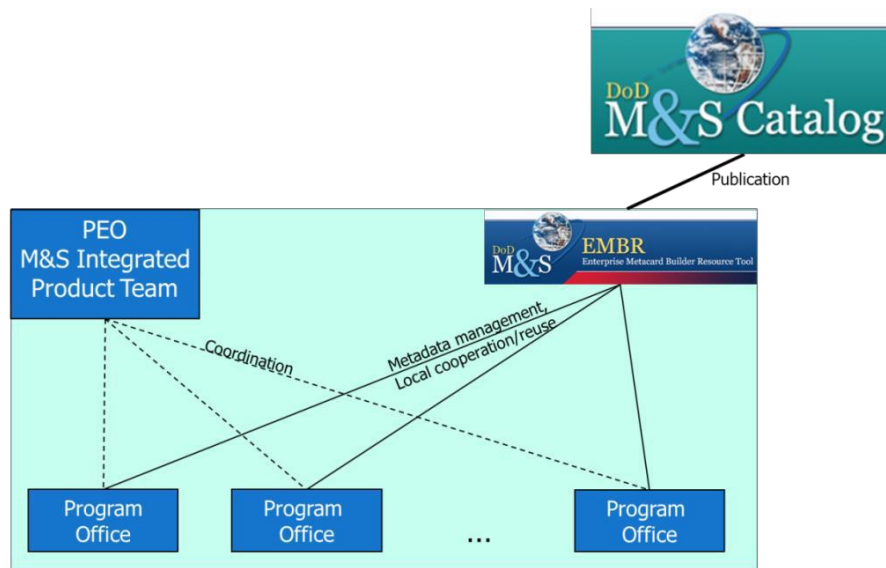


Figure 3. Organization of an M&S IPT

USER FEATURES

There are many new features that Defense M&S Catalog users will find useful and convenient. The two most apparent and perhaps consequential are the revised user interface and the capability to create and publish metacards directly from the user's desktop.

User Interface

The user interface of the previous version of the M&S Catalog was relatively complex and could not be simplified due to limitations in the software. It essentially presented the user with a menu comprising nearly the entire metadata schema, scores of terms from which the user could select. There was also a simple keyword search pane,

but the “real estate” of the screen was so dominated by the array of terms from the metadata schema that first-time users were generally overwhelmed and hesitant to proceed.

The new user interface is similar to internet search engines available online and with which everyday users are familiar. It is a simple keyword search pane. Typing one or several keywords and pressing “Enter” is all that is required. The Catalog searches its records for each instance of the keywords and returns the appropriate records, just as internet search engines do. There are additional features for more experienced users to narrow search results, but to get started using the Catalog requires no more computer expertise, no more modeling and simulation experience, and no more knowledge of metadata schema than ordinary computer users these days already possess. Figure 4 shows the home page of the new Defense M&S Catalog.

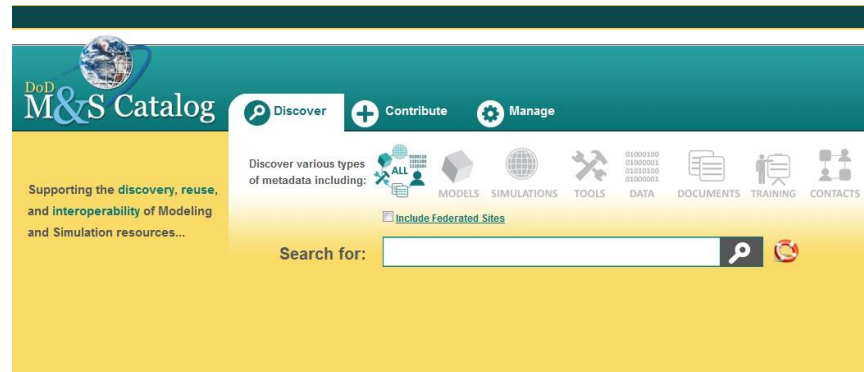


Figure 4. Defense M&S Catalog Home Page

Metacard Builder

Among the features most requested from users during the requirements gathering phase for the new Catalog was the ability to create and publish metacards without intervention of the Catalog support staff, as was previously required. This has now been achieved by integrating into the Catalog a suite of tools called the Enterprise Metacard Builder Resource (EMBR). The EMBR tools are accessed by opening the “Contribute” tab on the Catalog home page. Full instructions are included in the User Guide (see “Additional User Resources,” below), but many users find they can perform basic EMBR operations intuitively.

Among those is creation of a new metacard. The EMBR tool that facilitates this is a simple on-screen template similar to many such templates in common use today by internet businesses. Required fields are marked with an asterisk and, when appropriate, fields are equipped with drop-down menus. The number of required fields is small—only seven—so that a valid metacard can be created in just a few minutes.

When complete, simply pressing a “Save” button puts the metacard in the user’s local EMBR library. The resulting metacard is automatically created in MSC-DMS without requiring the user to know anything at all about metadata schema. Figure 5 shows the top portion of the online metacard builder form.

Local Management of Metacards

Once created, metacards reside in the local user’s organizational partition of the EMBR database and are visible to other users in the local organization, but they are not yet visible throughout the DoD via the Catalog. Publication of metacards to the Catalog, allowing them to be discovered throughout the Department, is at the discretion of the user organization; the Catalog does not “crawl” the EMBR database looking for new metacards.

When the originating organization decides to publish metacards to the Catalog, this is very simply achieved from the EMBR home page by selecting a check-box next to the metacard title and clicking a “Publish Resource to Catalog” link. Within an hour the metacard will appear in the Catalog holdings and is visible by all other Catalog users.

The screenshot shows the EMBR web interface. At the top, there is a blue header with the DoD M&S logo on the left and the text 'EMBR Enterprise Metacard Builder Resource Tool' on the right. Below the header is a white area with a blue bar labeled 'Resource Info'. Underneath this bar is a form with the following fields: 'Title*' (text input), 'Resource ID*' (text input), 'Description*' (text area), 'Type*' (dropdown menu), and 'Subtype*' (dropdown menu). There are also small circular icons with question marks next to the Type* and Subtype* labels.

Figure 5. Metacard Builder

Additional User Resources

The Defense M&S Catalog is located at <https://mscatalog.msco.mil>. It is accessible by all CAC and ECA certificate holders. Becoming a registered user is not required, but some advanced Catalog search features, such as saving search parameters and subscribing to regularly updated search results, are available only by becoming a registered user. Registration is automated, easily accomplished via links on the Catalog home page, and requires no more personal information than is already contained in the CAC or ECA certificate.

An online User Guide is accessed from the Catalog home page by pressing the life ring icon to the right of the keyword search pane (see Figure 4). For particular questions or detailed help, or to register as a source contributor, send e-mail to the Catalog Help Desk (MSCatalogHelpDesk@MSCatalog.msco.mil).

Sustaining a User-Oriented M&S Catalog

While the Defense M&S Catalog has achieved full operational capability, it is not a static system. To ensure the Catalog remains responsive and valuable to its users, DMSCO will convene a Defense M&S Catalog User Group in early 2015. The User Group's role will be to recommend to the DMSCO Director capability enhancements, business rule modifications, and similar technical or procedural changes that maintain or increase the Catalog's usefulness to the M&S Community of Interest in an environment of rapid technical and organizational change.

In addition to periodic formal meetings of the User Group, an online page has been established to enable users to interact with, and provide feedback to, Catalog management, development, and administrative staff. This online forum, similar in appearance and in function to popular social media sites, is hosted on DTIC's R&E Gateway and is known as DoD TechSpace. The Defense M&S Catalog User Group's page (<https://www.dtic.mil/REGateway/groups/defense-modeling-simulation-catalog-users/>) contains useful documents, such as the Catalog User Guide and the Concept of Operations, and allows users to engage Catalog developers or other users directly through easy-to-use text panes.

With new hardware and software, new tools and the new deployment concept enabled by them, and with plentiful means for users to contribute to future development, the Defense M&S Catalog will make efficiencies through discovery and reuse possible for years to come.

ACKNOWLEDGEMENTS

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REFERENCES

- [1] Stenbit, John P., *DoD Net-Centric Data Strategy*, DoD Chief Information Officer memorandum, May 9, 2003 [2] The M&S Core Tools Suite comprises the Defense M&S Catalog, the Enterprise Metacard Builder Resource (EMBR), the Project Management Tool (PMT), the Verification, Validation, and Accreditation Documentation Tool (VDT), and the Standards Vetting Tool (SVT). The M&S Core Tools Suite is maintained by the University of Central Florida Institute for Simulation and Training (UCF-IST) under a DMSCO-funded contract.
- [3] Details on the External Certification Authority Program are available at <http://iase.disa.mil/pki/eca/>.
- [4] The Modeling & Simulation Community of Interest Discovery Metadata Specification (MSC-DMS), ver. 1.5 (<https://www.csiac.org/sites/default/files/standards/DoD%20M&S%20COI%20Discovery%20Metadata%20Spec%20%282010%29.pdf>) MSC-DMS ver. 1.5 conforms to DDMS ver. 4.1, the version currently mandated in the Defense Information Technology Standards Registry (DISR). Initial planning is in process to update MSC-DMS in the event that the recently developed DDMS ver. 5.0 is mandated in the future.