Application of the M&S Community of Interest Discovery Metadata Specification to Standards Profiles for Acquisition and Air Force Training

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ABSTRACT

Technical standards are important enablers for compatibility and interoperability. Because many standards exist, when starting to develop a product, or to use multiple products together, one needs to discover applicable standards efficiently. Standards "profiles" have emerged to reduce the number of standards that a specific effort should consider. From 2007-2012, the U.S. DoD M&S Community of Interest developed a Discovery Metadata Specification, the MSC-DMS. It defines sets of metadata, called "metacards," to describe M&S data or services, a key one of which is the Resource Metacard. Because a standard is a resource, the MSC-DMS is a good starting point for a standards profile.

Recently, two standards profile efforts have applied the MSC-DMS, either directly or indirectly. For both, the Resource Metacard can be used as a starting point to define pertinent metadata. The Acquisition M&S Standards Profile has been developed by the Simulation Interoperability Standards Organization (SISO) to aid discovery of M&S standards useful for systems acquisition and engineering efforts. It provides a living reference document to remain current with standards revisions, and to add new applicable standards. The Air Force Agency for Modeling and Simulation has led the development of a standards profile for the Air Force's Operational Training Infrastructure (OTI). It provides extensive metadata on standards useful to OTI participants. To help keep these profiles current in a usable text format, a Microsoft Excel-based tool has been created that allows multiple selected metadata fields to be printed as a text document.

After providing an overview of MSC-DMS version 1.5, this paper will explain how different subsets of, and allowable extensions to, metadata defined in the MSC-DMS can be mapped to the metadata in the SISO Acquisition M&S Standards Profile and the OTI Standards Profile. A description of the Excel-based tool, which may also be useful in the creation of other standards profiles, will also be provided.

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INTRODUCTION

Technical standards, whether they are formal standards approved by a Standards Development Organization (SDO), or de facto standards developed by individual organizations that have evolved into common usage, are enablers for compatibility and interoperability. There are many standards in existence, even for specific technical disciplines, such as modeling and simulation (M&S). When embarking upon the development of a product, or using multiple products in a collaborative way, a problem for a user is to be able to discover applicable standards from among the many standards in existence. To serve this need, "standards profiles" have begun to emerge that narrow down the number of applicable standards that an individual effort in a specific field should consider.

From 2007 through 2012, the U.S. Department of Defense (DoD) M&S Community of Interest (COI) worked on the development of its Discovery Metadata Specification, known as the MSC-DMS. The MSC-DMS, which built upon the foundation for discovery services initially reflected within the DoD Discovery Metadata Specification (DDMS), specifies a set of information fields that can be used to describe M&S data or service assets. It defines a number of "metacards," or sets of metadata, a key one of which is the Resource Metacard. As a document describing a standard is itself a resource, it is possible to use the MSC-DMS to provide an excellent starting point for discovery of standards described in a standards profile.

Recently, two standards profile efforts have applied the MSC-DMS, either directly or indirectly. For both, the Resource Metacard can be used as a starting point to define metadata that will aid users of the profiles to discover standards that may aid their work. The first, the Acquisition M&S Standards Profile, has been developed by a Product Development Group (PDG) within the Simulation Interoperability Standards Organization (SISO). Its purpose is to aid in discovery of M&S standards that may be useful for systems acquisition and engineering efforts. It provides for a living reference document that will stay up to date with revisions to existing standards, and add new standards that are applicable to acquisition. The second standards profile has been developed for the U.S. Air Force's Operational Training Infrastructure (OTI) under the leadership of the Air Force Agency for Modeling and Simulation (AFAMS). This profile provides extensive metadata on standards that may be useful to participants in the OTI. To aid in keeping these profiles up to date in a customizable text form, a Microsoft Excel-based tool has been created that allows multiple selected metadata fields to be transformed into a linear text document for ease of use.

After providing a brief overview of version 1.5 of the MSC-DMS, this paper details how different subsets of, and allowable extensions to, metadata defined in the MSC-DMS have been applied to both the SISO Acquisition M&S Standards Profile and the standards profile for the Air Force's OTI. A description of the Excel-based tool, which may also be useful in the creation of standards profiles beyond these two by members of the community, will also be provided.

OVERVIEW OF THE M&S COMMUNITY OF INTEREST DISCOVERY METADATA SPECIFICATION

The *DoD Net Centric Data Strategy* (2003) defined goals and approaches for discovering and accessing a broad range of data assets throughout DoD. In response to this strategy, and in alignment with the evolving DDMS, the Defense Modeling and Simulation Coordination Office (then M&SCO; now known as DM&SCO), initiated the development of the MSC-DMS. Metadata is colloquially defined as "data about data." Discovery Metadata is focused on tagging of information assets so that an asset can be found by a potential user.

The MSC-DMS was developed over a period of years by a team of over 40 technical professionals from DoD agencies, the Services, industry, and academia. The preliminary internal review version (Version 0.8) was published in September 2007, and nine subsequent versions were developed to evolve the specification, culminating in Version 1.5 in July 2012 (M&SCO 2012). The purpose of the MSC-DMS was to standardize on the set of metadata used to describe assets in what were then called Modeling and Simulation Resource Repository (MSRR) nodes (as well as similar applications), and to ensure that the metadata template provided in the specification would align with the DDMS, as it evolved. The specification is intended for individuals and organizations in the DoD M&S community, including government, industry, and academia, who are interested in supporting the reuse and discovery of assets used for purposes related to M&S.

The MSC-DMS employs the concept of a "metacard," which is, essentially, a collection of sets of metadata that are focused on a particular aspect of an asset that will help in its discovery. Each metadata set contains several metadata components. Version 1.5 of the MSC-DMS defines four metacards:

- Resource Metacard (18 core metadata sets and six supplemental metadata sets);
- Contact Metacard (three metadata sets);
- Taxonomy Metacard (two metadata sets); and
- Workflow Metacard (two metadata sets).

In addition, "multicards" are defined that can include multiple metacards. Of the above metacards, the Resource Metacard has the most potential for general application. A graphic of the Resource Metacard is shown in Figure 1. The boxes with solid borders indicate required metadata sets; the boxes with dashed borders indicate optional metadata sets.

Figure 1. The Resource Metacard

Each metadata set provides a formal tabular description of the metadata components that it contains, including the metadata component name, a description of the component, a comment field, and perhaps most importantly, an "Occurs" field and a "Values" field. The Occurs field delineates how many instances of the component are allowed, which could include exactly 1, 0..1, 0..many, 1..many, etc. An Occurs field that includes "0" indicates that the field is optional. The Values field indicates the format of the metadata component, such as text, a Uniform Resource Identifier (URI), or a list of permitted values.
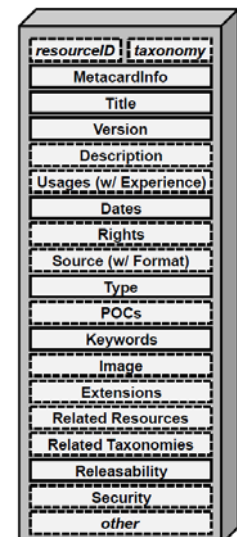
In conjunction with and following its development, the MSC-DMS has most notably been used in describing metadata for resources in the DoD M&S Catalog (DM&SCO 2019), which has supplanted the MSRRs mentioned above.

OVERVIEW OF THE SISO ACQUISITION M&S STANDARDS PROFILE EFFORT

In the early years of the 2010s, the U.S. DoD and North Atlantic Treaty Organization (NATO) material development national communities initiated movement towards more Model Based Engineering and, later, Digital Engineering. As technology and computing power improved, there was the recognition that increased use of models and simulations across the entire lifecycle, in a cohesive and continuous way, could provide an opportunity for an affordable way to gain insights and test theories on performance and operational impacts of design characteristics and/or operational concepts.

While individual enabling modeling or simulation standards were being developed, there were few resources that informed the overall implementation of large-scale M&S environments in support of acquisition activities. The pursuit of a Standards Profile for Acquisition Modeling & Simulation was to capture best practices and specifically share the ensemble or groups of standards that were employed and documented in the open literature by world-class program

support teams. The application of standards in the development and use of models and simulations increases effectiveness and efficiency while reducing risk, removing ambiguity, and lowering resource usage.

Standards for M&S enable system models to share synthetic environment representations, to interchange data within that synthetic environment, and to interoperate across simulated behaviors, tasks, and missions. They underpin and help fulfill expectations that platforms, systems, and equipment modeled for acquisition will be safe, reliable and fit-for-purpose.

The Acquisition Community has long needed insight into the "big picture" of what M&S standards are available, which lifecycle phase(s) those standards most benefit, and how standards-based products need to develop as systems mature. Standards can address challenges faced in the acquisition of complex systems and provide guidance on how to apply models and simulations in consistent meaningful ways.

Significant effort was made to characterize use of models and simulations in the language of the acquisition community, not just the M&S experts. The SISO Acquisition Modeling and Simulation Standards (AcqMSStds) Profile has been created to address this recognized need to provide and maintain a profile of model and simulation standards for use across the acquisition life cycle. The AcqMSStds profile provides common, accepted and experience-based guidance that supports the effort to discover, identify, select and document the most appropriate model and simulation standards, and recommended best practices in acquisition activities. The resulting use of these standards can better enable decision-making activities across respective international communities of practice and across complex application domains. In addition, during development, it was recognized that this need was not limited to the acquisition community, and the approach has been shown to provide value to other communities such as the training community.

The SISO AcqMSStds Profile is a pair of guidance and reference documents that provide acquisition programs guidance in the identification and selection of existing and emerging model and simulation standards. *Guide for A Standards Profile for the Use of Modeling and Simulation in Support of Acquisition Activities, Volume 1* (SISO 2018a) is the first of the two core components of the SISO AcqMSStds Profile developed by the SISO AcqMSStds Profile Product Development Group (PDG). The purpose of the first volume is to establish a framework that documents a recommended set of model and simulation standards and practices, to provide guidance to stakeholders as they execute activities within the reference acquisition lifecycle. This product entered balloting in summer 2019 and is available on the SISO web site.

The second volume, *Reference for A Standards Profile for the Use of Modeling and Simulation in Support of Acquisition Activities, Volume 2* (SISO 2018b), identifies acquisition-community-relevant model and simulation standards and recommended practices as key tools for the improvement of the international acquisition community activities across the acquisition life cycle. As a reference product, this second volume provides the descriptions and metadata for each model and simulation standard and recommended practices for maintaining their profiles. Because Volume 2 is not a balloted product, it is able to be updated and kept current as standards emerge, uses expand, and feedback gained through application is addressed.

The framework provided in volume 1, and the set of model and simulation standards and recommended practices provided in volume 2, support acquisition and development activities with models and simulations, in a manner that promotes model consistency, reuse, coherency, and efficiency across the acquisition life cycle. This focus on the full range of standards, including interoperability of models and simulations, contributes to the efficient advancement of optimal system and system of systems design solutions. The intended audience of this profile is the international acquisition community in their use and application of models and simulations.

THE AIR FORCE OPERATIONAL TRAINING INFRATRUCTURE AND THE ROLE OF STANDARDS

Overview of the Air Force Operational Training Infrastructure

The US Air Force (USAF) capabilities and the capabilities of our potential adversaries are advancing at a rate that challenges our ability to provide relevant and realistic operational training (Epstein 2018). For all domains, the USAF is only able to emulate a fraction of the existing and emerging threats to a level suitable for advanced sensors and can't provide a contested/degraded environment with the threats available. Each M&S training system environment

generator is unique and generates everything from weather and terrain to adversary and allied capabilities. This often results in distributed training participants in a virtual environment having different experiences within the same scenario, which reduces realism and can cause substantial negative training. There is also a considerable cost associated with keeping these various systems updated to the required fidelity and concurrency. These are just a few examples of the challenges that are forcing the USAF to make critical strategic changes to maintain its competitive edge.

The primary function of the USAF is to train, organize and equip its Airmen. For many years, the USAF has looked to a widely adopted concept known as Live, Virtual, Constructive-Operational Training (LVC-OT) as a solution to current challenges. However, the LVC-OT concept has proven to be insufficient in solving existing challenges. As a result, the USAF is moving beyond LVC-OT to a holistic approach to the OTI that delivers an attainable end state. The USAF OTI 2035 Flight Plan (USAF 2017), signed by the USAF Chief of Staff on 5 September 2017, moves beyond the broad concept of LVC to a detailed plan designed to connect the right participants at the right time, with the right data, to provide relevant and realistic training.

The OTI Flight Plan vision states that "It is imperative to train as we intend to fight by constructing a relevant training environment that allows a weapon system and operations to interact in a highly dynamic, realistic manner, including multi-domain command and control aspects." This requires a distributed training ecosystem that is secured at the appropriate levels, with common equipment, common architecture, common environments, common data, non-proprietary standards and a trained workforce. Integrated training requires interoperable training systems with accurate, up-to-date authoritative data and standards.

Benefits in Using Standards
There are many benefits of standards to OTI. Standards can improve operational capabilities by supporting higher reliability and facilitating new technology insertion. Further, standards reduce costs that include development, lifecycle, and implementer training costs. Finally, standards can reduce complexity and produce more modular and reconfigurable implementations thus reducing development risk.

The reasons to use OTI standards include:
- To share investments and access the best of technology;
- To build consensus and promote transparency;
- To optimize efficiency and protect investment;
- To close interoperability gaps between systems; and
- To facilitate cooperation among industry competitors.

According to Gen David Goldfein, USAF Chief of Staff, "It's time to think big, start small, and scale fast because we find ourselves in a revolution driven by two key features: a stark change in the geopolitical landscape coupled with dramatic technological accelerations" (Goldfein, 2018).

Purpose of the Air Force Operational Training Infrastructure Standards Profile

The USAF OTI Standards Profile promotes and supports the use and reuse of models, simulations, and authoritative data, as well as supporting protocols, techniques and processes. The desired end state is a fully resourced and unified effort to manage OTI in a cross-cutting manner at an enterprise level. Technical standards, data, and models need to be managed holistically to enhance training capabilities in all spectrums to increase the realism, fidelity, responsiveness, and interoperability of our operational training systems. The USAF OTI Standards Profile, with the Distributed Mission Operations standards submitted to the DoD Information Technology Standards Registry will ensure that USAF standards that support USAF operational training can be identified, tracked and made available to USAF programs.

The objective includes establishing a common framework for OTI technical standards evaluation and approval, and to provide a common approach for M&S activities to track and record the processing of proposed standardization documents as they are vetted to the AF OTI community. Although there are several applicable and authoritative DoD, USAF, and Industry standards evaluation processes, a common standards evaluation process ensures a common understanding.

APPLICATION OF THE MSC-DMS TO STANDARDS PROFILE METADATA

Application of the MSC-DMS to the SISO Acquisition M&S Standards Profile

The AcqMSStds Profile effort is an example of how the MSC-DMS has been applied indirectly. As noted in the draft SISO document, *Reference for A Standards Profile for the Use of Modeling and Simulation in Support of Acquisition Activities, Volume 2* (SISO 2018b), several M&S standards profile efforts were leveraged to assist in the development of a suitable metadata structure for the AcqMSStds Profile, including the NATO M&S Standards Profile (NATO 2018), The Technical Cooperation Program (TTCP) Standards Guideline (TTCP 2011), and the Department of Defense (DoD) Modeling and Simulation Related Standards and Best Practices Guide (M&SCO 2010). An analysis of metadata elements shared across these profiles formed the basis of the metadata template employed by the SISO product.

The MSC-DMS was applied indirectly in the development of the AcqMSStds Profile in that the standards on which it was based were being developed concurrently with the MSC-DMS, and were in a position to be informed by the MSC-DMS development. Furthermore, M&S professionals who were significantly involved in the development of the MSC-DMS were also significantly involved in the development of the AcqMSStds Profile, and ensured that the metadata in that profile were consistent with the MSC-DMS, although specific names are different, and allowable extensions to the MSC-DMS were employed. Table 1 provides a mapping of selected metadata components in the MSC-DMS to the metadata names used in the AcqMSStds Profile. Note that the AcqMSStds Profile makes fairly extensive use of the extensibility of the MSC-DMS by use of the "other" categories of metadata that are permitted to be defined in the MSC-DMS. Table 2 provides an example of the metadata for one standard that is included in the AcqMSStds Profile.

Table 1. Mapping of MSC-DMS Metadata to Acquisition M&S Standards Profile Metadata.

MSC-DMS Metadata Component	Acquisition M&S Standards Profile Metadata		
	Required?	Metadata Element	Metadata Element Description
Title.title	Yes	Title	The title of the artifact.
Title.document Number	Yes	Identifier	Unique identifier of the artifact (usually provided by a Standards Development Organization).
Version.value	Yes	Version	Version information designating editions and amendments (usually provided by a Standards Development Organization).
POC.Organization. Name.value	Yes	Standards Development Organization	Name of the organization currently responsible for the content of the artifact.
Description.text	Yes	Abstract	A narrative description of the artifact.
Other.Maturity.value	Yes	Technical Maturity	Narrative description of the maturity of the artifact. Each entry should begin with a one-word assessment: "Obsolete," "Legacy," "Emerging," or "Current," followed by information substantiating that assessment, such as how long it has been in existence or significant implementations.
Other. LifeCycleStages. value	Yes	System Life Cycle Stages	Identifies which of the following ISO/IEC system life cycle stages apply to the artifact. It is permissible to characterize an artifact as supporting multiple stages. • Concept Stage • Development Stage • Production Stage • Utilization Stage • Support Stage • Retirement Stage

Table 1. Mapping of MSC-DMS Metadata to Acquisition M&S Standards Profile Metadata. (cont.)

MSC-DMS Metadata Component	Acquisition M&S Standards Profile Metadata		
	Required?	Metadata Element	Metadata Element Description
Type.Other.category	Yes	Type	Describes the nature of the artifact according to the categories below. It is permissible to characterize an artifact as multiple types. • M&S Methodology, Architecture and Processes; • Conceptual Modeling and Scenarios; • M&S Interoperability; • Information Exchange Data Models; • Software Engineering; • Representation of Natural and Human-Made Environment; • Simulation Analysis and Evaluation; • M&S Miscellaneous.
Releasability.value	Yes	Availability	Description of those eligible to access the artifact
Source.Location	Yes	Access	Location of the artifact (e.g., Uniform Resource Locator, URL) or instructions to obtain the artifact
MetacardInfo.Date. other.created.value	Yes	Input Date	Date the artifact was accepted into this Reference
MetacardInfo.Date. other.lastUpdated. value	Yes	Last Updated	Date the metadata describing the artifact was last updated
Keyword.value	Yes	Keywords	Key search words to help find this artifact
Usage.Other. applicability	Yes	Applicability	The intended uses of the artifact
Date.Other.SDO PeriodicReviewDate. value	No	SDO Periodic Review Date	The date the artifact is scheduled for periodic review by the SDO
Usage.Other. informationOn Implementation	No	Information on implementation	Specific examples of how the artifact has been used in programs and products
Usage.Other. Implementation Guidance	No	Implementation Guidance	Available implementation guidance
Usage.Other. trainingResources	No	Implementation Training Resources	List of training opportunities
Usage.Other. vendorSupport	No	Implementation Vendor Support	List of potential supporting vendors
Usage.other. literatureReferences	No	Implementation Literature References	Sources of literature references
Usage.Limitations	No	Limitations	Description of artifact's limitations, whether technical or proprietary.
Description.Other. acquisitionCost	No	Cost	The cost required to acquire the artifact

Table 2. Example Acquisition M&S Standards Profile Metadata for a Standard.

Metadata Element	Metadata Element Description
Title	IEEE Recommended Practice for the High Level Architecture (HLA) Federation Development and Execution Process (FEDEP)
Identifier	IEEE 1516.3-2003
Version	2003
SDO	SISO, acting as an IEEE (Institute of Electrical and Electronics Engineers) standards sponsor.
Abstract	This IEEE document is a part of the 1516 family on the HLA. The processes and procedures that should be followed by users of the HLA to develop and execute federations are defined in ...
Technical Maturity	Legacy; The document was published and copyrighted in 2003. This document is based upon a US Department of Defense (DoD) Defense …
System Life Cycle Stages	Development Stage
Type	M&S Methodology, Architectures and Processes
Availability	Copies of this standard may be purchased from IEEE.
Access	www.ieee.org; or www.sisostds.org for SISO members only.
Input Date	2013-04-02
Last Updated	2013-04-02
Keywords	High Level Architecture, HLA, FEDEP, federation, engineering
Applicability	The HLA has been designed to be applicable across a wide range of functional applications. The purpose of this document is to describe a high-level process by which HLA federations can be developed and executed to meet the needs of a federation user or sponsor. It is expected that the guidelines provided in this document are generally relevant to and can facilitate the development of most HLA federations.
Information on Implementation	Widely implement across NATO and Partnership for Peace (PfP) nations.
Limitations	Primarily meant for use with HLA-based federations. Distributed simulation environments constructed using other protocols would have needed to adapt this document to suit the needs to the particular environment. The new Distributed Simulation Engineering and Execution Process (DSEEP) standard is better adapted to non-HLA federations.
Review Last Updated	2013-04-02

Application of the MSC-DMS to the Air Force Operational Training Infrastructure Standards Profile

The MSC-DMS has been applied directly to the AF-OTI Standards Profile to provide a common set of metadata sets and fields (tables and data items) for a minimum set of elements. These elements support the visibility, accessibility, and understandability of M&S resources within the DoD community (DM&SCO, 2019).

As compared to the AcqMSStds Profile, the implementers of the AF-OTI Standards Profile have chosen to use a much broader set of the metadata components from the MSC-DMS. Similar to the AcqMSStds Profile effort, the AF-OTI Standards Profile effort has made use of the extensibility of the MSC-DMS by use of the "other" categories of metadata that are permitted to be defined in the MSC-DMS. Table 3 provides a mapping of selected metadata components in the MSC-DMS to the metadata names used in the AF-OTI Standards Profile. The listing is only a partial list of the metadata components used in the AF-OTI standards profile, and is provided for illustration. As was done in the AcqMSStds Profile effort, the AF-OTI Standards Profile effort has adopted "colloquial names" for the metadata components that will be more recognizable to users of the profile.

Table 3. Mapping of MSC-DMS Metadata Components to Selected AF-OTI Standards Profile Metadata.

MSC-DMS Metadata Name	AF-OTI Metadata Name	Metadata Component Description	Occurs	Values
Name of the metadata component from the MSC-DMS.	Informal metadata component name used by AF-OTI.	A plain text definition of the metadata component.	Number of allowed instances.	Italics for allowed type (e.g., text); normal font for potential literal enumerations.
Resource .resourceID	AF-OTI Standard ID	Unique identifier associated with the related standard being described. Used for organizing standards within the USAF OTI standards profile.	1	*Uniform Resource Identifier (URI)*
MetacardInfo .Date.other.created .value	Metadata Creation Date	Date of creation of the metacard (citation).	1	*YYYY-MM-DD*
MetacardInfo.Date .other.lastUpdated .value	Metadata Last Update Date	Date of last update of the metacard (citation).	0..1	*YYYY-MM-DD*
Title.title	Title	Full formal title of the standard; usually assigned by Owning Organization.	1	*text*
Title .documentNumber	Standard ID (by Owning Organization)	An alphanumeric identifier for the standard; usually assigned by Owning Organization.	1	*text*
Version.value	Standard Version ID	A version identifier value for the standard; usually assigned by Owning Organization.	1	*text*
Description.text	Standard Description	Reflects the narrative associated with the description; usually provided by Owning Organization.	1	*text*
Type.subtype	Standard Type	Type of standard.	1	Official, Open, De Facto, Enclave / Specific
Description.Security .classification	Standard Description Security Classification	Security classification of the description of the standard. Use US, non-US, and joint classification portion mark abbreviations from the CAPCO Register.	1	U, C, S, TS, R, CTS, CTS-B, CTS-BALK, NU, NR, NC, NS, NS-S, NS- A, CTSA, NSAT, NCA
Source.Location	URI	The location identifier address which may be used to access the standard itself.	0..1	*Uniform Resource Identifier (URI)*
Rights.copyright	Is Standard Copyrighted by Owning Organization?	An indicator identifying protection against reproduction and distribution without the express written permission of the copyright owner.	1	Yes, No
Keyword.value	Keywords	Specifies the word or concept that is addressed by the standard.	0..many	*text*

As an example of the expanded use of MSC-DMS, the AF-OTI Standards Profile effort is utilizing the Point of Contact (POC) field for organizations in the MSC-DMS to provide contact information for the owning organization for each standard. This has created the need for a "many-to-one" relationship, since multiple standards are owned by the same organization. In order to provide for a single source for organization information, the AF-OTI Standards Profile effort developed a multi-worksheet Excel workbook to link standards to organizations. The metadata components for organizations are shown in the example printout from the Excel tool in the next section.

The AF-OTI Standards Profile effort also intends to implement a number of the Usage Experience metadata components provided for in the MSC-DMS. This will require a rather extensive data collection effort from AF-OTI user organizations, but is expected to provide a significant benefit to new AF-OTI users as they attempt to determine appropriate standards for their specific use. It will also create a need to implement "one-to-many" relationships in the AF-OTI Standards Profile as different organizations document their experiences with usage instances for relevant standards.

Application of a Standards Profile Metadata Tool to Produce Standards Documents

The Standards Profile Metadata Tool is a macro-enabled Excel workbook that was developed to create and maintain profiles of standards and related artifacts. The tool manages a data model, the profile, which is transformed into a set of worksheet views including:
1. An index of profile entries for browsing;
2. An editor view for maintaining each entry; and
3. User-defined crosswalk views.

The tool provides a Metadata Dictionary that is used to define the profile data model as a set of metadata worksheets. For example, the main Metadata Worksheet (Metadata) defines the profile items; additional metadata sheets provide information on SDOs (Metadata SDO), and User Experiences (Metadata User Experience) that define the experiences related to the application of standards to an event or stakeholder application.

All worksheet views provide facilities to author the profile data. The Editor Worksheet view provides for editing of all profile data to include free text, dates, and enumerated lists. Table 4 shows an example of the Editor Worksheet view for a representative standard in the AF-OTI Standards Profile.

Table 4. Editor Worksheet View

Record:	28
AF-OTI Standard ID	STD-028
Metadata Creation Date	2/8/2019
Metadata Last Update Date	
Title	IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA)-Federate Interface Specification
Standard ID (by Owning Organization)	IEEE 1516.1-2010
Standard Version ID	2010
Owning Organization ID	ORG-001
Owning Organization Name	IEEE Standards Association

The profile tool supports the interchange of data using the Extensible Markup Language (XML). The XML format provides for separation of a specific profile from the tool itself. This enables organizations to manage the configuration of their profiles without being restricted to a single tool or tool version.

Report generation in Microsoft Word is supported for information exchange and publishing of profiles. Word reports include an individual profile item report, an entire profile report, and crosswalk worksheet reports. All reports are in

tabular format. The tool's Metadata Dictionary captures report-generation directives to include "Export" and the "Order" in which data are listed in the tables.

Table 5 provides an example of a partial output of the Standards Profile Metadata Tool for one standard in the AF-OTI Standards Profile. The profile tool is designed, however, to create a "linear" document that provides a complete listing for all (or a subset of) standards in a profile that is compatible for inclusion in a Word document such as those typically created to document a standards profile. Table 5 also shows how the "many to one" relationship has been implemented in the AF-OTI standards workbook. In the middle of the table, the link to the "Owning Organization" is used to pull the owning organization's metadata, as contained in the Organizations worksheet, into the linear Word document associated with the standard.

Table 5. Example Partial Printout for an AF-OTI Standard from the Standards Profile Metadata Tool.

Metadata Element	Metadata Element Description
AF-OTI Standard ID	STD-079
Metadata Creation Date	2019-02-08
Metadata Last Update Date	2019-04-27
Title	OMG Unified Modeling Language
Standard ID (by Owning Organization)	OMG formal/17-12-05
Standard Version ID	2.5.1
Owning Organization Name	Object Management Group
Owning Organization Phone Number	+1 781 444-0404
Owning Organization Type	Industry
Owning Organization State	DC
Owning Organization Country	United States of America
Standard Description	UML is a standardized specification language for object modeling. UML is a general-purpose modeling language that includes a graphical notation used to create an abstract model of a system, referred to as a UML model. UML is officially defined at the Object Management Group (OMG) by the UML metamodel, a Meta-Object Facility metamodel (MOF). Like other MOF-based specifications, the UML metamodel and UML models may be serialized in XML Metadata Interchange (XMI). UML was designed to specify, visualize, construct, and document software- intensive systems. …
Standard Type	Open
Standard Description Security Classification	U
URL to Access Standard	https://www.omg.org/spec/UML/2.5.1/PDF
Is Standard Copyrighted by Owning Organization?	Yes
Keywords	abstraction, action, sequence, action state, activity graph, architecture, association, class diagram, collaboration diagram, component diagram, control flow, data flow, deployment diagram, execution, implementation, pins, procedure

SUMMARY

This paper has shown how the MSC-DMS can be applied to two rather different applications – a standards profile for acquisition activities and a standards profile for a training initiative. Given the proliferation of standards, it is important that new users developing solutions for a different problem be able to discover standards that may help them achieve their objectives.

Based on the results of the two activities cited in the paper, we recommend that the MSC-DMS effort, which concluded with version 1.5, be considered for further evolution and adoption as an international consensus-based standard by an appropriate voluntary-membership SDO, such as SISO, so that other standards profile efforts can adapt and extend it to achieve their specific objectives.

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