The Importance of Metadata for the Discovery of Digital Engineering Artifacts

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Presentation Outline

- Digital Engineering Strategy – Background, Definition, and Goals
- The Digital Engineering Collaborative Environment for a System
  - A Reference Architecture for Discussion Purposes
  - Resource Discovery Challenges
- Some Potential Discovery Metadata Repository Use Cases
- Metadata Definitions and Background on Two Discovery Metadata Specifications
  - Modeling and Simulation Community of Interest Discovery Metadata Specification (MSC-DMS), Version 1.5, 2012
  - Discovery Metadata Specification for Modeling and Simulation Resources (DMS-MSR), an in-progress product development by the Simulation Interoperability Standards Organization
- Some Potential Resource Types for Inclusion in a Discovery Metadata Repository
- An Illustration of Discovery Metadata Application Using the MSC-DMS Resource Metacard
- Summary

Digital Engineering Background

- New effort on modeling for systems engineering emerged in 2012 in ODASD(SE) under Ms. Philomena Zimmerman and the Acquisition M&S Working Group (AMSWG)
  - Initially known as the “System Model”; evolved to be called the “Digital System Model” (DSM)
- By early 2016, the DSM and engineering/modeling efforts surrounding it were re-named and expanded to be termed “Digital Engineering” by Mr. Stephen Welby [DASD(SE)]
- *Digital Engineering Strategy* issued by Dr. Michael Griffin [USD(R&E)] in June 2018

Source: *Digital Engineering Strategy*, June 2018

Digital Engineering Definition and Goals

Digital Engineering: An integrated digital approach that uses authoritative sources of systems' data and models as a continuum across disciplines to support life cycle activities from concept through disposal.

Source: "Digital Engineering Discussions", Philomena Zimmerman, NDIA Systems Engineering Division, May 2019

Digital Engineering Definition and Goals

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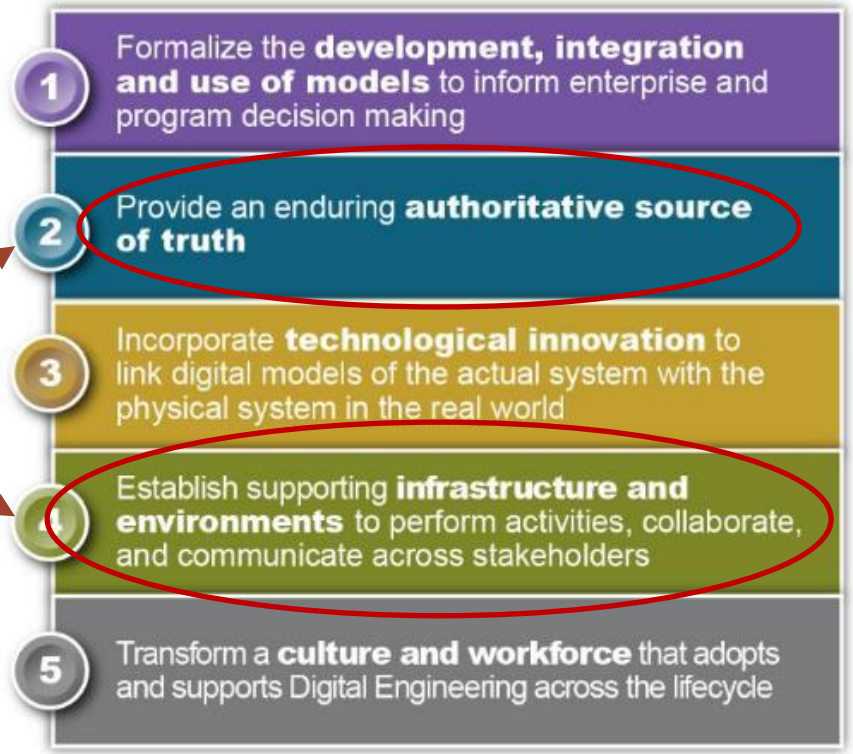
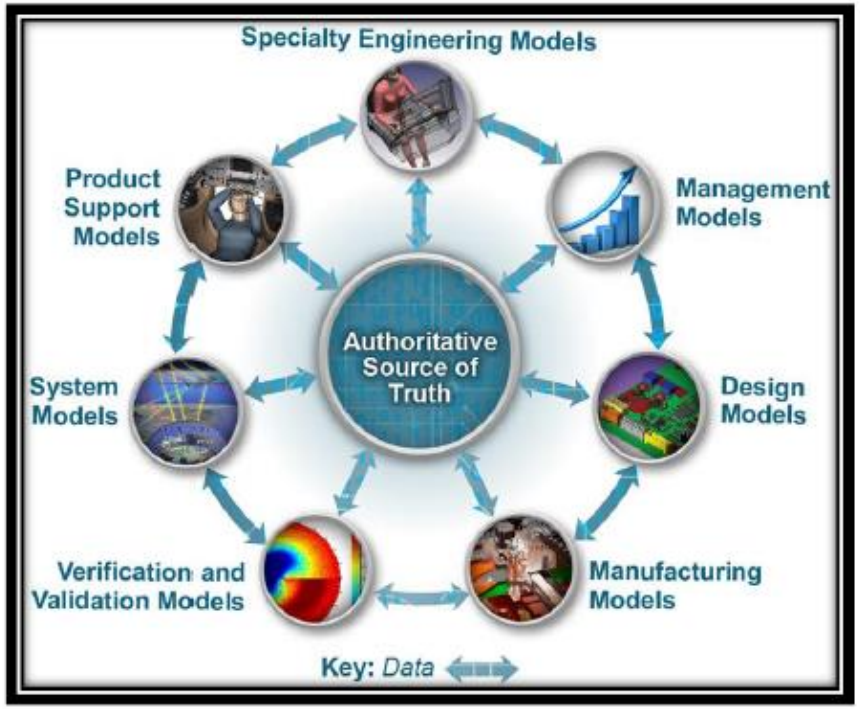
Focus areas for this presentation



Digital Engineering Strategy Goal 2: Providing an Enduring Authoritative Source of Truth

- The Digital System Model has evolved to become the "Authoritative Source of Truth"
  - Need to capture the current state and history of the technical baseline
  - Need a central reference point for models and data across the lifecycle
  - Need to facilitate a sharing process across engineering disciplines
  - Need authorized users to have access to the right information at the right time
  - Need to enable teams to work collaboratively, with access to up-to-date models, data, and information



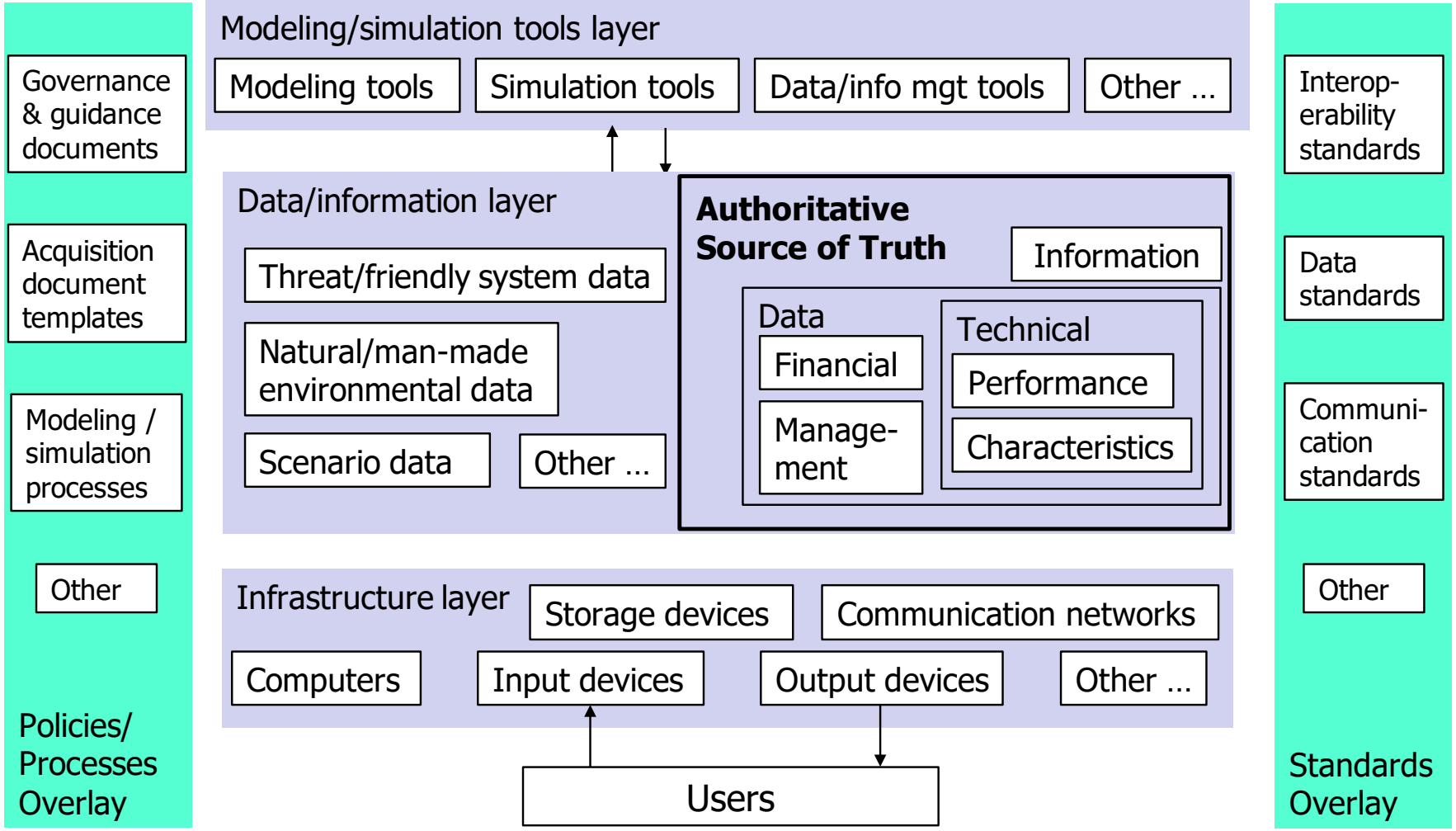
Source: *Digital Engineering Strategy,* June 2018

Digital Engineering Strategy Goal 4: Develop a Supporting Infrastructure and Environments …

Goal 4.1: Digital engineering IT infrastructures include a collection of hardware, software, networks, and related equipment. They span geographical locations and organizations, and they must satisfy security requirements. …

Source: *Digital Engineering Strategy*, June 2018

So What Might a Digital Engineering Collaborative Environment Centered on the Authoritative Source of Truth Look Like?



Adapted from: "A System-Model-Centric Collaborative Environment for the Acquisition Lifecycle," J.E. Coolahan and J.J. Bergenthal, 2015 Interservice/Industry Training, Simulation & Education Conference, Nov.-Dec. 2015.

Digital Engineering Collaborative Environment Resource Discovery Challenges

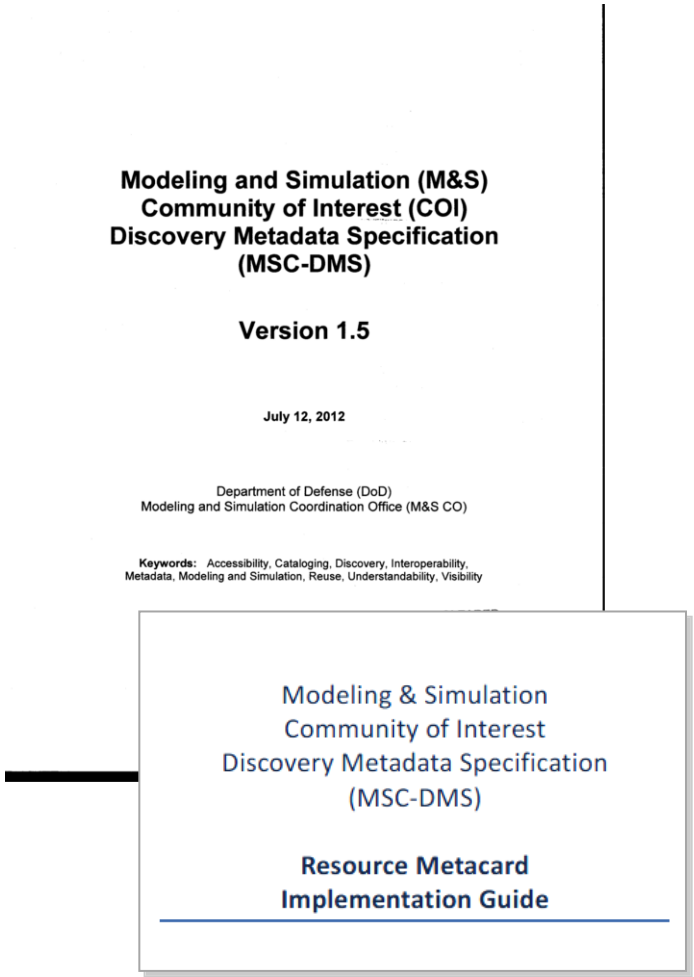
- Stakeholders in a Digital Engineering Collaborative Environment (DECE) for a major system need to be able to discover and access:
  - A wide range of resources in the Data/Information Layer that are stored in a large variety of locations.
  - Applicable policies and processes for the digital engineering of the system in the Policies/Processes Overlay
  - Standards relevant to the digital engineering of the system in the Standards Overlay
- DECE stakeholders need to be able to discover the degree to which system data and information stored in the Authoritative Source of Truth is authoritative, from both technical and management perspectives.
- An aid in meeting the above challenges is the formulation of a Discovery Metadata Repository for the system's digital engineering artifacts.

Some Potential Use Cases for a Discovery Metadata Repository for a Digital Engineering Collaborative Environment

- How can one find a particular information or data resource in the Authoritative Source of Truth?
- What organization is the owning authority for a resource asset?
- What person is the technical authority for a dataset's contents?
- When was a resource asset last updated?
- What is the security classification for a dataset's contents?
- To whom is a resource asset's contents releasable?
- … Others

Discovery Metadata
Definitions and Example Specifications

- Metadata: Data about data; specification of the content, meaning, structure, and use of the data.
- Discovery Metadata: Metadata that is focused on tagging of information assets so that an asset can be discovered.
- Example metadata specifications (focused on M&S assets):
  - Modeling and Simulation (M&S) Community of Interest (COI) Discovery Metadata Specification (MSC-DMS) Version 1.5, 2012 (and its associated implementation guide)
  - Discovery Metadata Specification for Modeling and Simulation Resources (DMS-MSR), in-progress



Background on the MSC-DMS

- Purpose: To standardize on the set of metadata used to describe assets in the then Modeling and Simulation Resource Repository (MSRR) nodes and similar applications, and to align with the (no longer supported) DoD Discovery Metadata Specification (DDMS)
- Sponsor: Defense Modeling and Simulation Coordination Office (DM&SCO)
- Contributors: Approximately two dozen individuals from the Office of the Secretary of Defense (OSD), the Services, and industry
- Development History: 5 September 2007 - Version 0.8 (Preliminary Internal Review Version) thru 12 July 2012 – Version 1.5 (last update)
- Key Constructs: “Metacards” (32) defining sets of metadata fields

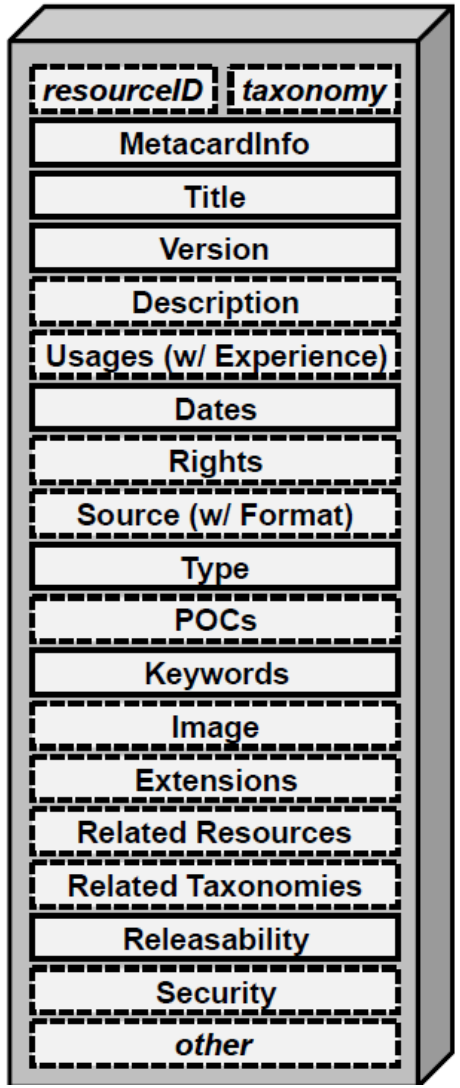
Background on the DMS-MSR

- Purpose: To develop a metadata standard to describe modeling and simulation (M&S) resources in a manner that will be useful to the international M&S community in discovering various types of M&S-related resources
- Sponsor: Simulation Interoperability Standards Organization (SISO)
- Contributors: Approximately two dozen (to date) SISO members from government, industry, and academia, from the U.S. and several other countries
- Development History: Product Development Group began in February 2020, standard still in early-to-mid development stage; new members welcome
- Key Constructs: Metadata sets for several resource types, drawing significantly, but not exclusively, from the MSC-DMS

Some Potential Resource Types (Preliminary) from SISO DMS-MSR Product Development Group Discussions

- **Models**, e.g., Computer Aided Design (CAD) models, data models, cost models
- **Simulations**, e.g., system stimulators, simulations of system effectiveness, cockpit simulators
- **Simulation Environments**, e.g., High Level Architecture (HLA) federations, Test and Training Enabling Architecture (TENA) logical ranges
- **Datasets**, e.g., terrain elevation data files for specific geographic regions, CAD data files for systems, sound velocity profiles for specific maritime regions
- **Services**, e.g., measurement unit conversion services, geodetic coordinate conversion services, cloud-based data storage services
- **Tools**, e.g., CAD modeling tools, process modeling tools, system modeling tools
- **Facilities**, e.g., hydrodynamic tow tanks, crash-test facilities, test ranges
- **Documents**, e.g., model/simulation development plans, user guides, Verification, Validation, and Accreditation (VV&A) artifacts, standards for M&S tools and processes

Two Key "Metacards" from MSC-DMS v1.5



Resource Metacard

M&S Resource Assets Supported

1. M&S Software (models / simulations)
2. M&S Adjunct Tools (data loggers, visual)
3. Federations of Simulations
4. M&S Software Components
5. M&S Services
6. M&S Data
7. M&S Data Models
8. Interface Specifications
9. Documents

Contact Metacard

M&S Contact Assets

1. Person
2. Organization

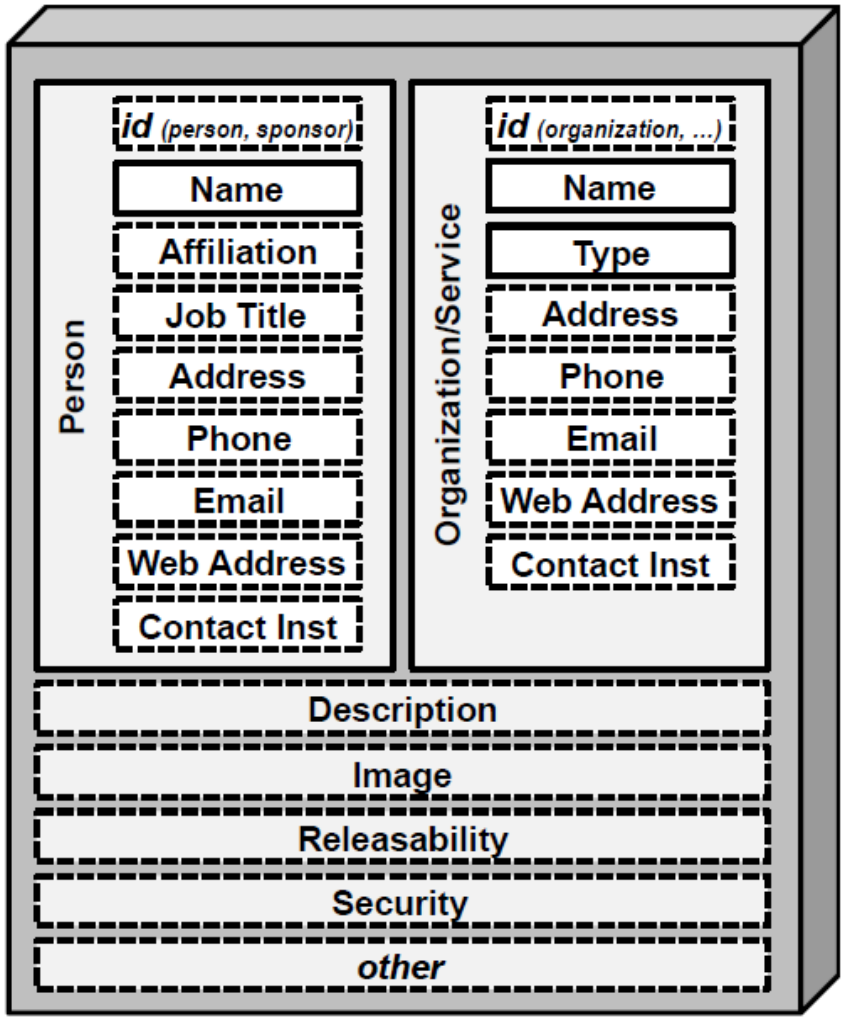


Illustration of Discovery Metadata Application Using the MSC-DMS Resource Metacard (1 of 4)

- MetacardInfo
  - e.g., dates of entry and update, POC organization/person
- Title
  - e.g., unique name for a dataset
- Version
  - e.g., version identifier for a document
- Description
  - e.g., text description of a dataset, using proper semantics
- Usages
  - e.g., intended use of a simulation and limitations on use

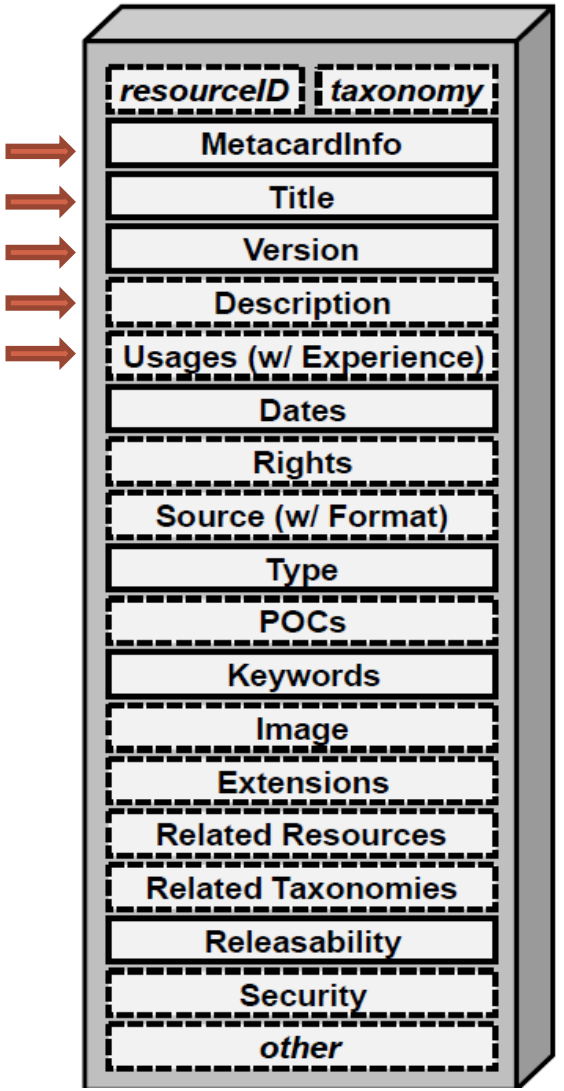


Illustration of Discovery Metadata Application Using the MSC-DMS Resource Metacard (2 of 4)

- Dates
  - e.g., creation date and update dates for a dataset
- Rights
  - e.g., flags a document as intellectual property, with owning organization
- Source
  - e.g., a format qualifier (e.g., *data bytes*), size (e.g., *byte count*) and location of a dataset; or the file type and URL of a document
- Type
  - e.g., *model*, *dataset*, or *document*; with designation as *authoritative* (or other category)

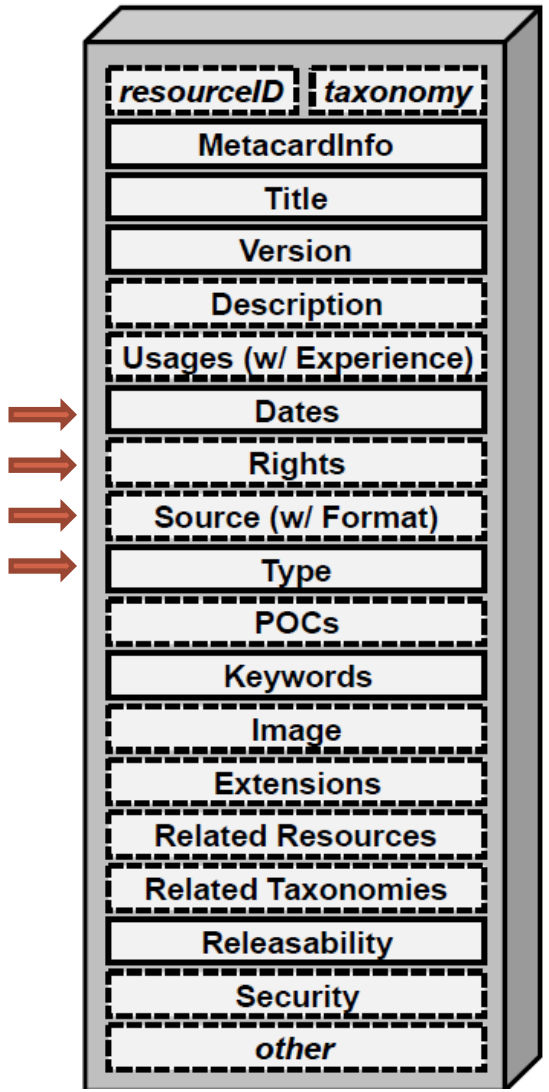


Illustration of Discovery Metadata Application Using the MSC-DMS Resource Metacard (3 of 4)

- POCs
  - Role – e.g., *owning organization*, *technical POC*
  - POC.Organization – e.g., contact info for owning organization
  - POC.Person – e.g., contact info for technical POC
- Keywords
  - e.g., *missile defense* for a capability document for an interceptor
- Related Resources
  - e.g., specifies that *length* of a component "is a part of" a CAD model dataset for that component
- Releasability
  - e.g., *Distribution D. DoD and DoD Contractors Only*

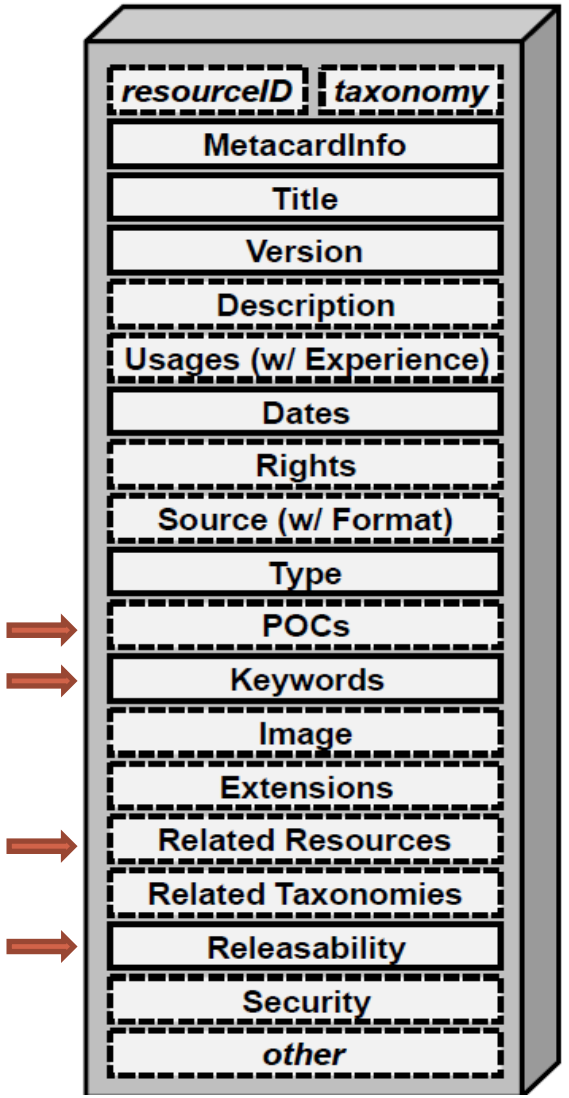
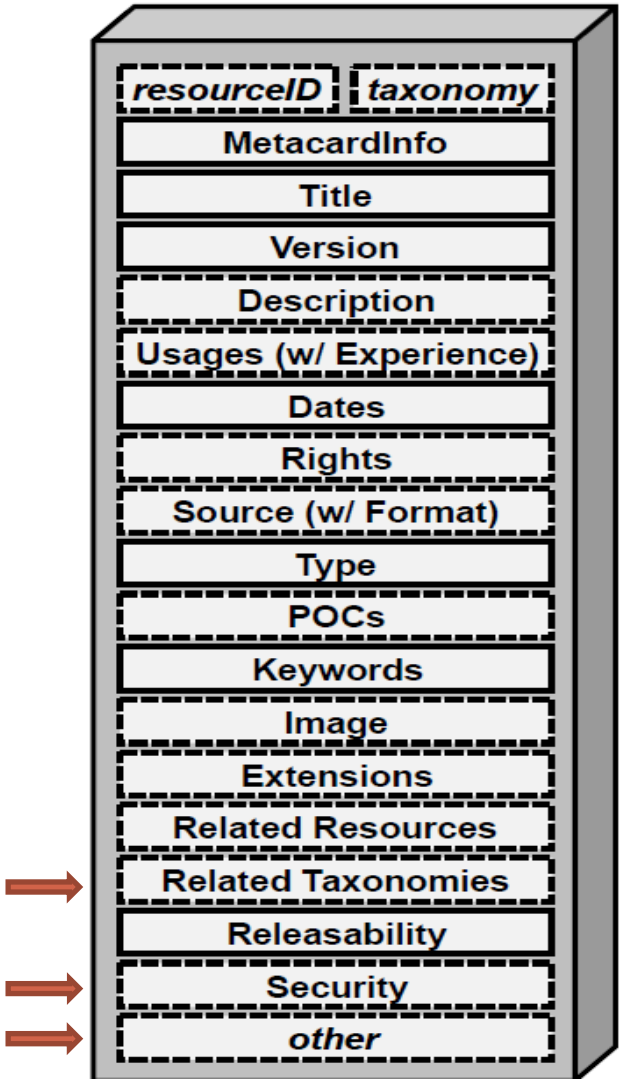


Illustration of Discovery Metadata Application Using the MSC-DMS Resource Metacard (4 of 4)

- Security
  - e.g., the security classification (e.g., *Secret*) and classification authority
- Other
  - e.g., *units of measure* for contents of a dataset
- Related Taxonomies
  - e.g., a title (e.g., *M&S glossary*) and description



Summary

- Formulation of a Discovery Metadata Repository for a major system's digital engineering artifacts will aid stakeholders in a Digital Engineering Collaborative Environment for a major system to discover and access those artifacts.
- The MSC-DMS (v1.5, 2012) provides a good current starting point for discovery metadata definition and creation for varied applications.
- The DMS-MSR standard that is in progress in SISO has the promise to be a *sustainable* successor to the MSC-DMS.
  - DMS-MSR Product Development Group (PDG) in-progress work, along with a copy of the MSC-DMS, can be accessed at https://www.sisostds.org/StandardsActivities/DevelopmentGroups/DMS-MSRPDG.aspx
  - New members can join the DMS-MSR PDG at the above web site.