



**Simulation Interoperability
Standards Organization**

"Simulation Interoperability & Reuse through Standards"

SISO-REF-066-2021

Reference for A Standards Profile for the Use of Modeling and Simulation in Support of Acquisition Activities

Volume 2

Version 1.0

17 February 2021

SAC Approved: 05/12/2021

EXCOM Approved: 05/28/2021

**Prepared by:
Acquisition Modeling and Simulation
Standards Profile
Product Development Group**

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Copyright © 2021 by the Simulation Interoperability Standards Organization, Inc.

7901 4th St. N, Suite 300-4043
St. Petersburg, FL 33702, USA

All rights reserved.

Reproduction and distribution of this document in whole or in part by any medium is permitted. Appropriate acknowledgement of the source and ownership of the material should be made with any such reproduction and distribution.

Please note that this document may be revised periodically. The latest edition will be made available at the SISO website at no charge. The document on the SISO website is considered to be the definitive version.

SISO Inc. Board of Directors
7901 4th St. N, Suite 300-4043
St. Petersburg, FL 33702, USA

Revision History

Version	Section	Date	Description
1.0	All	02/17/2021	Initial Version

TABLE OF CONTENTS

1	OVERVIEW	7
1.1	PURPOSE	7
1.2	SCOPE	7
1.3	OBJECTIVES	8
1.4	INTENDED AUDIENCE.....	9
2	REFERENCES	9
2.1	SISO DOCUMENTS	9
2.2	OTHER DOCUMENTS	9
3	DEFINITIONS, ACRONYMS, AND ABBREVIATIONS	9
3.1	DEFINITIONS	9
3.2	ACRONYMS AND ABBREVIATIONS.....	11
4	METADATA DESCRIPTION TEMPLATE	15
4.1	CROSSWALK ANALYSIS OF OTHER STANDARDS PROFILE EFFORTS.....	15
4.2	METADATA TEMPLATE.....	16
4.3	UPDATES.....	17
5	LISTING OF ARTIFACTS	18
5.1	LIFE CYCLE VIEW	18
5.2	CROSSWALK OF ISO/IEC 15288 SYSTEM LIFE CYCLE TO US DOD ACQUISITION LIFE CYCLE MODEL	18
5.3	CROSS REFERENCE MATRIX.....	20
5.4	OPERATIONAL VIGNETTES.....	21
5.4.1	<i>The NATO/PfP Interoperability and Re-Use Study (NIREUS)</i>	21
5.4.2	<i>The Simulation Exploration Experience (SEE)</i>	22
5.4.3	<i>UAS Airspace Integration and Evaluating System-of-Systems Performance</i>	22
5.4.4	<i>Operation Blended Warrior</i>	23
5.5	RATIONALE FOR THE SELECTION OF STANDARDS ARTIFACTS.....	25
ANNEX A.	BIBLIOGRAPHY	26
ANNEX B.	DEFINITIONS OF ACTIVITIES USING MODELS AND SIMULATIONS MAPPED TO THE LIFE CYCLE PHASE (INFORMATIVE)	29
	ISO/IEC 15288 CONCEPT STAGE	29
	<i>DAG Pre-Acquisition Concepts, Experimentation and Prototyping</i>	29
	<i>DAG Materiel Solution Analysis</i>	29
	ISO/IEC 15288 DEVELOPMENT STAGE.....	30
	<i>DAG Technology Maturation and Risk Reduction</i>	30
	<i>DAG Engineering and Manufacturing Development</i>	31
	ISO/IEC 15288 PRODUCTION STAGE	32
	<i>DAG Technology Production and Deployment</i>	32
	ISO/IEC 15288 UTILIZATION AND SUPPORT STAGES	34
	<i>DAG Operations and Support</i>	34
	ISO/IEC 15288 RETIREMENT STAGE	35
	<i>DAG Disposal</i>	35
ANNEX C.	FIRST EDITION STANDARDS METADATA	37
ANNEX D.	CROSSWALK MATRICES OF STANDARDS TO ACQUISITION LIFE CYCLE PHASE / TECHNICAL ACTIVITY	77

ANNEX E. STANDARDS DEVELOPMENT ORGANIZATIONS	87
INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)	87
THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS STANDARDS ASSOCIATION (IEEE-SA)	87
THE WORLD WIDE WEB CONSORTIUM (W3C)	87
THE SIMULATION INTEROPERABILITY STANDARDS ORGANIZATION (SISO)	88
THE OBJECT MANAGEMENT GROUP (OMG)	88
THE USA NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)	88
THE USA NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY (NGA)	89
THE OPEN GEOSPATIAL CONSORTIUM (OGC)	89
THE NORTH ATLANTIC TREATY ORGANIZATION (NATO)	89

LIST OF FIGURES

FIGURE 1-1 SYSTEMS ENGINEERING ACQUISITION LIFE CYCLE	8
FIGURE 5-1 ISO/IEC 15288 SYSTEM LIFE CYCLE	18
FIGURE 5-2 A “STANDARDS ENSEMBLE” FOR MODELING THE ENVIRONMENT & DEMONSTRATING TECHNOLOGY	20
FIGURE 5-3 OBW STANDARDS CLASSIFICATION	25

LIST OF TABLES

TABLE 4-1 CROSSWALK OF METADATA ELEMENTS FROM OTHER STANDARDS PROFILE EFFORTS	15
TABLE 4-2 METADATA DESCRIPTION TEMPLATE	16
TABLE 5-1 KEY SYSTEMS ENGINEERING ACTIVITIES VERSUS SYSTEM LIFE CYCLE STAGES	19
TABLE C-1 BASE OBJECT MODEL (BOM)	37
TABLE C-2 STANDARD FOR COALITION BATTLE MANAGEMENT LANGUAGE (C-BML) PHASE 1, VERSION 1.0	39
TABLE C-3 COMMON DATA BASE	41
TABLE C-4 COMMON IMAGE GENERATOR INTERFACE	43
TABLE C-5 IEEE STANDARD FOR DISTRIBUTED INTERACTIVE SIMULATION (DIS)	44
TABLE C-6 IEEE RECOMMENDED PRACTICE FOR DISTRIBUTED SIMULATION ENGINEERING AND EXECUTION PROCESS MULTI-ARCHITECTURE OVERLAY (DMAO)	46
TABLE C-7 IEEE RECOMMENDED PRACTICE FOR DISTRIBUTED SIMULATION ENGINEERING AND EXECUTION PROCESS (DSEEP)	47
TABLE C-8 DYNAMIC LINK COMPATIBLE HLA API STANDARD FOR THE HLA INTERFACE SPECIFICATION	48
TABLE C-9 REFERENCE FOR ENUMERATIONS FOR SIMULATION INTEROPERABILITY	49
TABLE C-10 FEDERATION ENGINEERING AGREEMENTS TEMPLATE	50
TABLE C-11 GUIDE FOR GENERIC METHODOLOGY FOR VERIFICATION AND VALIDATION (GM-VV) TO SUPPORT ACCEPTANCE OF MODELS, SIMULATIONS, AND DATA	51
TABLE C-12 IEEE STANDARD FOR MODELING AND SIMULATION (M&S): HIGH LEVEL ARCHITECTURE (HLA)	53
TABLE C-13 STANDARD FOR LINK 11/11B SIMULATION	55
TABLE C-14 STANDARD FOR LINK 16 SIMULATIONS	56
TABLE C-15 MILITARY SCENARIO DEFINITION LANGUAGE (MSDL)	57
TABLE C-16 NATO EDUCATION AND TRAINING NETWORK (NETN) FEDERATION ARCHITECTURE AND FOM DESIGN (FAFD)	59
TABLE C-17 OPENFLIGHT SCENE DESCRIPTION DATABASE SPECIFICATION [®]	61
TABLE C-18 STANDARD FOR REAL-TIME PLATFORM-LEVEL REFERENCE FEDERATION OBJECT MODEL (RPR FOM)	63
TABLE C-19 SEDRIS - PART 1: FUNCTIONAL SPECIFICATION	65
TABLE C-20 SEDRIS - PART 2: ABSTRACT TRANSMITTAL FORMAT (ATF)	66
TABLE C-21 SEDRIS - PART 3: TRANSMITTAL FORMAT BINARY ENCODING	67
TABLE C-22 SEDRIS LANGUAGE BINDINGS - PART 4: C	68
TABLE C-23 ENVIRONMENTAL DATA CODING SPECIFICATION (EDCS)	69
TABLE C-24 ENVIRONMENTAL DATA CODING SPECIFICATION (EDCS) LANGUAGE BINDINGS - PART 4: C	70

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

TABLE C-25 SPATIAL REFERENCE MODEL (SRM).....	71
TABLE C-26 SPATIAL REFERENCE MODEL (SRM) LANGUAGE BINDINGS - PART 4: C	72
TABLE C-27 STANDARD FOR UCATT LASER ENGAGEMENT INTERFACE.....	73
TABLE C-28 VERIFICATION, VALIDATION & ACCREDITATION (VV&A) RECOMMENDED PRACTICES GUIDE (VV&A RPG).....	74
TABLE C-29 U.S. DEPARTMENT OF DEFENSE STANDARD PRACTICE, DOCUMENTATION OF VERIFICATION, VALIDATION, AND ACCREDITATION (VV&A) FOR MODELS AND SIMULATIONS	75
TABLE C-30 WEBLVC PROTOCOL.....	76
TABLE D-1 CROSS REFERENCE OF STANDARDS TO ISO/IEC CONCEPT STAGE ACTIVITIES	77
TABLE D-2 CROSS REFERENCE OF STANDARDS TO ISO/IEC DEVELOPMENT STAGE ACTIVITIES	81
TABLE D-3 CROSS REFERENCE OF STANDARDS TO ISO/IEC PRODUCTION STAGE ACTIVITIES	83
TABLE D-4 CROSS REFERENCE OF STANDARDS TO ISO/IEC UTILIZATION AND SUPPORT STAGE ACTIVITIES	85

1 Overview

The Acquisition Community has long needed insight into what standards are available, which lifecycle phase(s) those standards most benefit, and how standard 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. [A1] This SISO Acquisition Modeling and Simulation Standards (AcqMSStds) Profile has been created to address this recognized need to provide and maintain a profile of modeling and simulation (M&S) standards for use across the acquisition life cycle. The AcqMSStds profile provides common, accepted and experience-based guidance that will support the effort to discover, identify, select and document the most appropriate modeling 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.

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 modeling and simulation standards. “A Standards Profile for the Use of Modeling and Simulation in Support of Acquisition Activities Volume 1” 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 modeling and simulation standards and practices to provide guidance to stakeholders as they execute activities within the reference acquisition life cycle.

This volume, “Reference for A Standards Profile for the Use of Modeling and Simulation in Support of Acquisition Activities Volume 2”, identifies acquisition community relevant modeling 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. The framework provided in volume 1 and the set of modeling 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, re-use, 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.

1.1 Purpose

The purpose of the AcqMSStds Profile is to provide guidance on the selection and use of modeling and simulation standards, and recommended practices to support the application of models and simulations throughout the acquisition life cycle.

The AcqMSStds Profile provides a framework to address the use of models and simulations in research, development and analysis that apply across a range of acquisition life cycles, life cycle stages and related activities. The AcqMSStds Profile is a source of information for acquisition communities for the existence of new /emerging standards as well as commercial or government-owned products.

1.2 Scope

Acquisition is a broad term that applies to more than just the purchase of an item or service; the acquisition lifecycle [sic] encompasses the design, engineering, construction, testing, deployment, sustainment, and disposal of items purchased from a supplier. [A2]

Standards are allocated as being appropriate or helpful within the context of accomplishing life cycle technical activities. The following lifecycle categories are derived from the International Organization for Standardization / International Electrotechnical Commission (ISO/IEC) JTC1/SC7 (PDTR 19760) Systems Engineering – Guide for ISO/IEC 15288 (System Life Cycle Processes) [A3] for the system engineering acquisition life cycle:

1. Concept Stage – M&S is employed to define operational gaps in capabilities, and cost/value estimates for future life cycle stages.
2. Development Stage – Model and analyze options for development. M&S is used to stimulate the system under development with simulated inputs for Verification and Validation (V&V).
3. Production Stage – Model and simulate the operational context of the system to confirm and validate functionality before it is delivered/deployed.
4. Utilization Stage – M&S is employed to quantitatively identify gaps in deployed capabilities to enable upgrades and maintenance of systems.
5. Support Stage – M&S is employed to estimate support and maintenance (spares, support staff labor, etc.) costs across the support stage of a system.
6. Retirement Stage – M&S is employed to determine the most cost-effective means for retiring systems. Systems can be recycled and/or reused in other operational contexts.

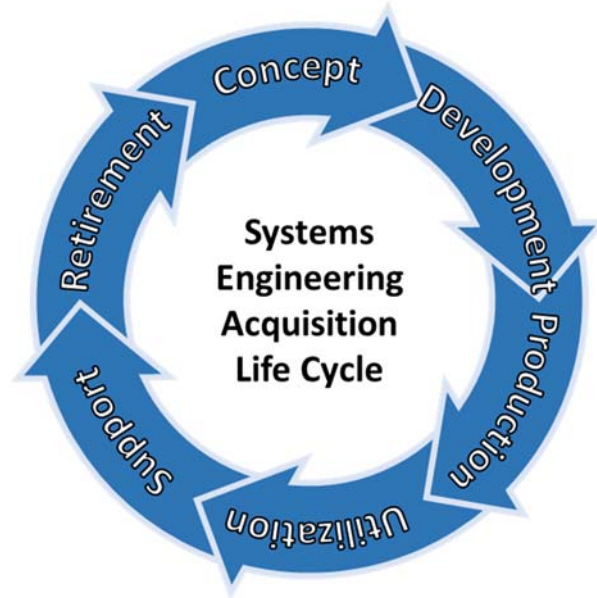


Figure 1-1 Systems Engineering Acquisition Life Cycle

Modeling and simulation inform acquisition decisions by employing executable architectures across the systems engineering acquisition life cycle. The M&S techniques used apply standards across the life cycle.

M&S standards evolve by a life cycle analogous to acquisition of systems. The SISO AcqMSStds Profile documents the maturity of standards to best inform the acquisition community on the standards to be used in acquisition programs at each life cycle stage.

In terms of maturity, the profile characterizes each modeling and simulation standard as being ‘obsolete’, ‘current’, or ‘emerging’ as appropriate. Refer to Section 3.1 for definitions of these categories of standards.

Other types of standards discussed in this document include ‘non-Government’, ‘official’, ‘open’, and ‘defacto’ standards, which are defined in the list of definitions.

1.3 Objectives

The objective of the SISO AcqMSStds Profile is to provide a solution for understanding how modeling and simulation standards apply across activities of the acquisition life cycle. These two SISO products work together to provide a “profile” of modeling and simulation standards, with guidance for the use of standards for application to project requirements in their entirety across a complete life cycle under an integrated and coordinated strategy. This profile assists each organization engaged in acquisition with the identification and application of modeling and simulation standards to best support program needs as well as assist in the satisfaction of regulatory and statutory mandates. This profile establishes a compilation of standards and recommended practices that are used to manage, coordinate, align, and integrate the development

and use of modeling and simulation artifacts through a systems acquisition life cycle across both time (e.g., acquisition phases) and organizational and activity boundaries.

1.4 Intended Audience

The intended audience for this reference product is acquisition professionals having the responsibility for identifying modeling and simulation requirements for a program. It supports anyone needing to understand the key areas of standards application to product acquisition. Standards, including government, industry, and international standards developed by communities of practice, provide the foundation for models and simulation interoperability, reusability and increased capability. Communities of interest develop these standards for their specific acquisition needs. This profile applies collectively to acquisition managers, developers and users who are involved across stages of the acquisition process, technical activities and organizational structures that support the acquisition lifecycle. This product provides methods from representatives of acquisition communities of interest to enable stakeholders to apply standards to the acquisition processes.

2 References

2.1 SISO Documents

The following SISO documents were used in generating the policies and procedures defined herein. When the following documents are superseded by an approved revision and that causes a conflict with this document, the revision of the below-referenced documents shall supersede this document. These documents are available by through the SISO web site at <https://www.sisostds.org/>.

Document Number	Title
SISO-GUIDE-005-2021	Guide for A Standards Profile for the use of Modeling and Simulation in Support of Acquisition Activities, Volume 1, Version 1.0, 17 February 2021
SISO-ADM-001-2018	Policy for Product Identification
SISO-ADM-002-2017	SISO Policies and Procedures
SISO-ADM-003-2011	SISO Balloted Product Development and Support Process (BPDSP)
SISO-ADM-005-2011	Policy for the Style and Format of SISO Documents

2.2 Other Documents

Document Number	Title
AMSP-01	NATO Modeling and Simulation Standards Profile, Edition D, Version 1, February 2018
TR-JSA-TP2-1-2011	The Technical Cooperation Program (TTCP) Technical Report: Modeling and Simulation Standards Guideline, March 31, 2011
ISO/IEC/IEEE 15288:2015	Systems and Software Engineering – System Life Cycle Processes

3 Definitions, Acronyms, and Abbreviations

3.1 Definitions

English words are used in accordance with their definitions in the latest edition of Webster's New Collegiate Dictionary [A4] except when special SISO Product-related technical terms are required.

Term	Definition
Acquisition	Process of obtaining a system, software product or software service. [A3]

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Term	Definition
Artifact	A standard or recommended practice document.
Acquisition life cycle	See "Life Cycle"
Community of Interest	A collaborative group of users who must exchange information in pursuit of their shared goals, interests, missions, or business processes and who therefore must have shared vocabulary for the information they exchange. [A5]
Life cycle	Evolution of a system, product, service, project or other human-made entity from conception through retirement. [A3]
Metadata	Data that is fundamentally abstract in nature. A set of "data about data" that characterizes the referent in a more theoretical manner than first order descriptors. [A6]
Standard	A document that provides requirements, specifications, guidelines or characteristics used consistently to ensure that materials, products, processes and services are fit for their purpose. [A7]
Standard – Current	Standards are identified as those which are in use and are currently being maintained and developed. For new projects these standards should be applied. [A8]
Standard – Defacto	Something that has gained widespread acceptance in the marketplace, but is not "officially" sanctioned by any international, national, or government organization. [A9]
Standard – Obsolete	Standards that are not being maintained and have been superseded. Users should plan replacement activities. For new projects, these standards should not be applied. [A8]
Standard – Official	Standards are called "official", or "de jure", or "by law", if they are "developed by standards development bodies with legal and recognized standing", such as ISO or SISO. [A8]
Standard – Open	A specification for software that is developed by a standards organization or a consortium to which membership is open and is available to the public for developing compliant products (with or without some license fee). [A10]
Standard – Emerging	Standards are identified as those which are being developed (e.g., to meet gaps in capability), which are not yet fully formalized or not yet widely accepted. For new projects these standards should be considered. [A8]
Standard – Non-Government	A standard that is developed by a private sector association, organization or technical society which plans, develops, establishes or coordinates standards, specifications, handbooks, or related documents.[A11]
User or End User	End users are all those persons or machines which can directly access services on the Global Information Grid, including Core Enterprise Services such as Portal, Content Discovery and Delivery, and Service Discovery and Registration. End users include both information producers and consumers. [A12]

3.2 Acronyms and Abbreviations

Acronym/Abbr	Definition
ACAT	Acquisition Category
API	Application Programming Interface
AcqMSStds	Acquisition Modeling and Simulation Standards
AIS	Automated Information System
ASSIST	Acquisition Streamlining and Standardization Information System
BOM	Base Object Model
BPDSP	Balloted Product Development and Support Process
C-BML	Coalition Battle Management Language
CDB	Common Data Base
CDD	Capability Development Document
CDS	Cross Domain Solution
CNSS	Committee on National Security Systems
CORBA	Common Object Request Broker Architecture
COI	Community of Interest
ConOps	Concept of Operations
COP	Community of Practice
CPC	Corrosion Prevention and Control
CPD	Capability Production Document
CS	Combat Support
CSS	Combat Service Support
DAG	Defense Acquisition Guidebook
DID	Data Item Description
DISR	Department of Defense Information Technology Standards and Profile Registry
DD	Data Definition
DoD	Department of Defense
DoDAF	Department of Defense Architecture Framework
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DPG	Defense Planning Guidance
DSEEP	Distributed Simulation Engineering and Execution Process
DSP	Defense Standardization Program
DTED	Digital Terrain Elevation Data
EA	Economic Analysis

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Acronym/Abbr	Definition
ESOH	Environment, Safety, and Occupational Health
EXCOM	Executive Committee
FASAB	Federal Accounting Standards Advisory Board
FCA	Functional Configuration Audit
FEDEP	Federation Development and Execution Process
FOM	Federation Object Model
FRP	Full-Rate Production
GIS	Geospatial Information System
GM	Generic Methodology
GML	Geography Markup Language
HLA	High Level Architecture
HSI	Human Systems Integration
HTML	Hyper Text Markup Language
IDEF0	Integrated DEFinition Method 0
IDEF1X	Integrated DEFinition Method 1X
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IHO	International Hydrographic Organization
INCOSE	International Council on Systems Engineering
ISO	International Organization for Standardization
JC3IEDM	Joint Command, Control, and Consultation Information Exchange Data Model
JCIDS	Joint Capabilities Integration and Development System
JLVC	Joint Live Virtual Constructive
JTC	Joint Technical Committee
KML	Keyhole Markup Language
KPP	Key Performance Parameter
KSA	Key System Attribute
LCC	Life Cycle Cost
LCSP	Life Cycle Sustainment Plan
LRIP	Low-Rate Initial Production
M&S	Modeling and Simulation
MBSE	Model Based Systems Engineering
MDA	Model Driven Architecture
MEV	Military Equipment Valuation

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Acronym/Abbr	Definition
MSDL	Military Scenario Definition Language
NAF	NATO Architecture Framework
NAS	National Air Space
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NDIA	National Defense Industrial Association
NIMA	NASA Integrated Model-Centric Architecture
NIST	National Institute of Standards and Technology
NMSSP	NATO Modeling and Simulation Standards Profile
NSS	National Security Systems
O&S	Operations and Support
OBW	Operation Blended Warrior
OGC	Open Geospatial Consortium
OMG	Object Management Group
OS	Operational Suitability
OSE	Open System Environment
OTF	Objective Terrain Format
P&P	Policies and Procedures
PDG	Product Development Group
PSG	Product Support Group
PEP	Producibility and Engineering Planning
PEO STRI	Program Executive Office Simulation, Training and Instrumentation
POM	Program Objective Memorandum
PP&E	Property, Plant and Equipment
PPBE	Planning, Programming, Budgeting, and Execution
PRR	Production Readiness Review
RPG	Recommended Practices Guide
RPR	Real-time Platform-level Reference
R&D	Research and development
RM	Reference model
SAC	Standards Activity Committee
SCM	Supply Chain Management
SDO	Standards Development Organization
SE	Systems engineering

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Acronym/Abbr	Definition
SEDRIS	Synthetic Environment Data Representation and Interchange Specification
SFFAS	Statement of Federal Financial Accounting Standards
SISO	Simulation Interoperability Standards Organization
SIW	Simulation Interoperability Workshop / Simulation Innovation Workshop
SME	Subject Matter Expert
STANAG	Standardization Agreement
STD	Standard
STEM	Science, Technology, Engineering and Mathematics
SVR	System Verification Review
SysML	Systems Modeling Language
T&E	Test and Evaluation
TADIL TALES	Tactical Digital Information Link-Technical Advice and Lexicon for Enabling Simulation
TENA	Test and Training Enabling Architecture
TGS	Terrain Generation Service
TOC	Total Ownership Cost
TPM	Technical Performance Measure
TRR	Test Readiness Review
TTCP	The Technical Cooperation Program
UAS	Unmanned Aircraft Systems
UI	User interface
UML	Unified Modeling Language
URL	Uniform Resource Locator
USA	United States of America
USAF	United States Air Force
USMC	United States Marine Corps
VMASC	Virginia Modeling Analysis & Simulation Center
V&V	Verification and Validation
VV&A	Verification, Validation and Accreditation
W3C	World Wide Web Consortium
X3D	Extensible three-dimensional
XMI	XML Model Interchange
XML	Extensible Markup Language

4 Metadata Description Template

This volume contains information relevant for identifying a wide variety “artifacts” in the form of standards, recommended practices, and other documents supportive of the acquisition modeling and simulation community. Metadata is defined as the “Information describing the characteristics of data; data or information about data.” Metadata facilitates the discovery of artifacts and includes the viewpoints of the usability of an artifact across the acquisition lifecycle stages.

4.1 Crosswalk Analysis of Other Standards Profile Efforts

Other standards profile efforts have been leveraged to assist in the development of a suitable metadata structure including The NATO M&S Standards Profile, The Technical Cooperation Program (TTCP) Standards Guideline, and the Department of Defense (DoD) Modeling and Simulation Related Standards and Best Practices Guide.[A8] The crosswalk in Table 4-1 depicts an analysis of metadata elements shared across these profiles. An “X” is indicated next to each metadata element that was present in each of the three standards profiles. This list is the basis of the metadata template employed by this SISO Reference Product.

Table 4-1 Crosswalk of Metadata Elements from Other Standards Profile Efforts

Metadata Element	NATO	TTCP	DoD	Metadata Description
Standard Title	X	X	X	Full title of the standard
Standard Identifier	X	X	X	Unique identifier; could be the one provided by a standards development organization (SDO)
Version Identifier	X	X	X	Alpha indicators designating Editions and Amendments
Standards Development Organization	X	X	X	Name of the organization
SDO Periodic Review Date		X	X	The date the standard is scheduled for periodic review by the SDO
DSP Document Identifier			X	If listed in the DSP/ASSIST, the standard unique identifier
DSP Status			X	If listed in the DSP/ASSIST, the status of the standard noted in the ASSIST
DISR Document Identifier			X	If listed in the DISR, the standard unique identifier
DISR Status			X	If listed in the DISR, the status of the standard noted in the current DISR baseline
STANAG identifier	X	X	X	If listed as a STANAG, the standard unique identifier
STANAG status	X	X	X	(Study Draft, Approval/Ratification Draft, Ratification Withdrawn, Promulgated, Inactive, Superseded, Cancelled)
Abstract	X	X	X	Description of the standard
Technical Maturity [Current]	X	X	X	Description of how mature the standard is, e.g., how long it has been in evolution or existence, have implementations been developed, etc.
Applicability	X	X	X	The intended uses of the standard
Information on implementation	X	X	X	Specific examples of how the standard has been used in programs and products
Implementation Guidance		X	X	Available implementation guidance

Metadata Element	NATO	TTCP	DoD	Metadata Description
Implementation Training Resources		X	X	List of training opportunities
Implementation Vendor Support		X	X	List of potential supporting vendors
Implementation Literature References		X	X	Sources of literature references
Limitations of this Standard	X	X	X	Description of standard's limitations
Standards Category		X	X	One of the categories used to classify standards listed in the guide.
Standard Type	X	X	X	General M&S, M&S Interoperability, Simulation Software Standards, Data Standards, etc.
Public Availability	X	X	X	How the standard can be accessed by the general public
Cost of Standard		X	X	The cost required to acquire the standard
URL or Instructions to Access or Acquire	X	X	X	Standard location
Input Date	X	X	X	Date the standard was included in the guide
Last Updated	X	X	X	Date of last update for the standards metadata in the guide
Keywords	X			Key search words to help find this standard

4.2 Metadata Template

In view of the analysis above, this Reference Product establishes the following metadata structure to describe artifacts listed in ANNEX C. Each element is designated as Required or Optional. The Required elements are those that must be completed to minimally describe each artifact.

Table 4-2 Metadata Description Template

Required?	Metadata Element	Metadata Element Description
Yes	Title	The title of the artifact.
Yes	Identifier	Unique identifier of the artifact (usually provided by a standards development organization).
Yes	Version	Version information designating editions and amendments (usually provided by a standards development organization).
Yes	Standards Development Organization (SDO)	Name of the organization currently responsible for the content of the artifact
Yes	Abstract	A narrative description of the artifact.
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.

Required?	Metadata Element	Metadata Element Description
Yes	Type	Describes the nature of the artifact according to the following categories below. It is permissible to characterize an artifact as multiple types. <ul style="list-style-type: none"> • 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.
Yes	Availability	Description of those eligible to access the artifact
Yes	Access	Location of the artifact (e.g., URL) or instructions to obtain the artifact
Yes	Input Date	Date the artifact was accepted into this Reference
Yes	Last Updated	Date the metadata describing the artifact was last updated
Yes	Keywords	Key search words to help find this artifact
Yes	Applicability	The intended uses of the artifact
No	SDO Periodic Review Date	The date the artifact is scheduled for periodic review by the SDO
No	Information on implementation	Specific examples of how the artifact has been used in programs and products
No	Implementation Guidance	Available implementation guidance
No	Implementation Training Resources	List of training opportunities
No	Implementation Vendor Support	List of potential supporting vendors
No	Implementation Literature References	Sources of literature references
No	Limitations	Description of artifact's limitations whether technical or proprietary.
No	Cost	The cost required to acquire the artifact

4.3 Updates

Upon initial approval and publication, information in this Volume will be reviewed periodically by the Product Support Group (PSG) in accordance with SISO-ADM-003. As the PSG identifies candidate artifacts for inclusion or changes to existing artifacts, appropriate actions will be taken to update the metadata and the Volume will be republished approximately annually.

The PSG will also periodically review the structure of the metadata fields used to describe the artifacts to ensure they are still valid and relevant. If changes to the structure of the metadata template are required, changes will be proposed to limit the impact on existing metadata values. However, the Product Support Group terms of reference to be provided are expected to contain a much more responsive “living record” of the contents of the metadata fields. In this way the currency of the contents can be refreshed upon community member nomination and an expedited review board process.

5 Listing of Artifacts

5.1 Life Cycle View

Every system under development, whatever the kind or size, follows a life cycle from its initial conceptualization through its eventual retirement. A system life cycle is typically defined by stages to facilitate planning, provisioning, operating and supporting the system-of-interest. These stages provide a conceptual progression of a system through established decision-making gates to reduce risk and to ensure satisfactory progress. In practice these stages can be sequential or concurrent as described in Agile development frameworks [A13].

A reference system progresses through a common series of stages where it is conceptualized, developed, produced, utilized, supported and retired. To establish the top level of life cycle stages, the representative life cycle model shown in Figure 6-1 was extracted from the ISO/IEC 15288 Standard (2003).

Standards artifacts identified in Volume 2 are presented in the Life Cycle View. The Life Cycle View is intended to assist the stakeholder in locating and applying specific standards and recommended practices that support their modeling and simulation needs with respect to their acquisition life cycle.

Concept Stage	Development Stage	Production Stage	Utilization Stage	Support Stage	Retirement Stage
---------------	-------------------	------------------	-------------------	---------------	------------------

Figure 5-1 ISO/IEC 15288 System Life Cycle

5.2 Crosswalk of ISO/IEC 15288 System Life Cycle to US DoD Acquisition Life Cycle Model

When applying model and simulation standards, each acquisition community of practice (COP) is driven by the nature of its business, the system it is acquiring, its social responsibilities, and its business strategy. These provide constraints on the organization and its use of modeling and simulation tools and model and simulation standards in their acquisition of systems. Many COPs have developed and published conceptual models of their acquisition life cycle to guide their acquisition professionals in the execution of their responsibilities throughout the system life cycle.

There is no one, common, universally applied acquisition life cycle model embraced and endorsed by all COPs. Consequently, there is considerable difficulty in consistently and uniformly mapping modeling and simulation activities to acquisition phases since these different communities have different models and names for the various stages as a system progresses from its genesis to its death. This also introduces difficulty in applying modeling and simulation in support of acquisition activities to other COPs.

The ISO/IEC 15288 Life Cycle mapped with the DoD Acquisition Life Cycle stages has been used to develop a common reference model by the PDG Drafting Groups in their analyses to support the identification and application of modeling and simulation activities across the various acquisition communities of practice. Using the ISO/IEC 15288 and DoD Acquisition Life Cycle processes as a common reference model within this profile has facilitated the mapping of activities that utilize modeling and simulation to life cycle phases.

Forty-four key systems engineering activities that utilize modeling and simulation within the system life cycle have been identified. These key activities were distilled from activities described in the Defense Acquisition Guidebook (DAG). Table 5-1 shows the mapping of the key activities to the DoD Acquisition Life Cycle Stages described in the DAG, and the system life cycle stages as described by ISO/IEC 15288.

Table 5-1 Key Systems Engineering Activities versus System Life Cycle Stages

ISO/IEC 15288	DAG	Activities Using Modeling and Simulation
Concept	Pre-Acquisition Concepts, Experimentation and Prototyping	<ul style="list-style-type: none"> • ConOps Modeling • Cost / Schedule Performance Trades • System Interoperability Discoveries • Portfolio Coverage Analysis
	Material Solution Analysis	<ul style="list-style-type: none"> • Assess Materiel Solutions • Estimate Life Cycle Costs • Model ConOps and Mission Context • Interoperability and Warfighter Integration Analysis • Industrial / Manufacturing Capability Analysis • Supportability and Sustainment Modeling
Development	Technology Maturation and Risk Reduction	<ul style="list-style-type: none"> • Trade Studies • System Threat Integration • Model Environment and Demonstrate Technology • Interoperability and Supportability Analysis • Operational Suitability and Affordability • Industrial / Manufacturing Capability and Readiness Assessment • Estimate Manpower / Cost • Model System to Performance Specifications • T&E Planning • Human Interface Prototyping
	Engineering and Manufacturing Development	<ul style="list-style-type: none"> • Ensure Operational Supportability • Reduce Logistics Footprint • Survivability Analysis • Human Systems Integration (HSI) • Design for Producibility • Demonstrate System Safety • Verify Functionality and Performance to Specifications / Needs • Manpower Estimates
Production	Production and Deployment	<ul style="list-style-type: none"> • Industrial / Manufacturing Readiness Assessment • Environment, Safety and Occupational Health (ESOH) Models • Military Equipment Valuation • Corrosion Prevention and Control • Refine LCSP • Production Qualification Testing • Verify and Validate Production Configuration • Economic Analysis
Utilization	Operations and Support	<ul style="list-style-type: none"> • Training • Determine System Risk / Hazard Severity • ECP Impact Analysis
Support		<ul style="list-style-type: none"> • Supply Chain Management • Monitor Performance and Adjust Product Support • Supportability Assessment • Disposal Planning • Validate Failures and Determine Root Causes
Retirement	Disposal	<ul style="list-style-type: none"> • None

5.3 Cross Reference Matrix

This volume of the AcqMSStds Profile includes a cross reference of standards to the 44 key systems engineering activities identified in Table 5-1, that use the models and simulations identified in the profile. Each standard in the profile must have at least one relevant relationship with a modeling and/or simulation activity. It may be useful to consider a spreadsheet in which the rows are the available standards, and the columns are the activities that use modeling and/or simulation. In ANNEX D, a depiction of these matrices is shown broken down by life-cycle phase. When a robust implementation of the standards profile is achieved, it is anticipated that every activity/ bullet (in a column) has at least one standard or best practice intersection. This may not be true today and would indicate a “standards gap”. As additional columns (technical activities) are proposed, defined, and added to Volume 2, the search for one or more relevant standards should be identified. If no applicable standard or best practice exists, the gap is identified, and Standards Development Organizations can consider initiating professional standards development groups that would be a means of addressing this unfulfilled need. Figure 5-2 illustrates an example of a compact matrix in which only those standards that were (or could have been) employed are depicted for a given technical activity. In this case, the life-cycle technical activity was to Model the Environment and Demonstrate Technology.

ISO/IEC SYSTEM LIFE CYCLE STAGES		Development Stage									
DEFENSE ACQUISITION GUIDEBOOK LIFE CYCLE STAGES		Technology Maturity and Risk Reduction									
Acquisition Activities M&S Artifacts and Standards		Trade Studies	System Threat Integration	Model Environment and Demonstrate Technology	Interoperability and Supportability Analysis	Operational Suitability and Affordability	Industrial/Manufacturing Capability and Readiness Assessment	Estimate Manpower/Cost	Model System to Performance Specifications	Test and Evaluation Planning	Human Interface Prototyping
		011	012	013	014	015	016	017	018	019	020
Rec	Standard										
0001	Base Object Model (BOM)			X							
0002	Standard for Coalition Battle Management Language (C-BML) Phase 1, Version 1.0.			X							
0003	Common Data Base			X							
0004	Common Image Generator Interface										
0005	IEEE Standard for Distributed Interactive Simulation (DIS)										
0006	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process Multi-Architecture Overlay (DMAO)										
0007	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP)				X						

Figure 5-2 A “Standards Ensemble” for Modeling the Environment & Demonstrating Technology

The next section describes the concept of employing operational vignettes to distill practical experience from recognized and published community experts which allow the construction of these matrix “overlays” / “standards ensembles”. These artifacts would offer future acquisition community practitioners a “standards playbook” that could improve modeling & simulation support efficiency and responsiveness while reducing program risk. Practitioners most often spend a large fraction of their professional lives within one, or potentially two life-cycle phases. Being able to benefit from other seasoned practitioners who have

documented their approaches and outcomes in a structured way is an invaluable resource.

5.4 Operational Vignettes

The PDG leadership instituted a pragmatic approach that would test the profile baseline against relevant, diverse, practical and substantive related experience. The PDG chose to employ an approach that leveraged the information and talent resident within the broader SISO community. By employing a handful of application vignettes and leveraging the expertise of a small core of seasoned veterans (whose experience spans both the modeling & simulation and acquisition communities), the technical approach foundation was laid that would form the basis for productive evolution. The PDG appreciates the time invested and expertise shared by Rich Reading, Cutlass Engineering, NATO/PfP Interoperability and Re-Use Study (NIREUS), Dr. Zack Crues, NASA, Simulation Exploration Experience (SEE), and Bob Lutz, JHU/APL (UAS Airspace Integration & Triton) to support the vignette approach.

The chosen vignettes provide rich publicly available information in the form of professional papers or supporting web sites. The three vignettes or use cases chosen, provide a rich cross-section of anticipated stakeholder communities (NATO, DoD, and NASA). In each case, a short overview, one or more life-cycle technical activities supported, as described and related in Sections 5.2 and 5.3, and several standards or best practices that were, or could have been, employed are listed. The vignettes validate the use of standards for identified technical activities, and through continued use of the profile and additional vignettes, it is expected that contributors to future iterations of this profile will build a more complete and robust set of technical activities, standards, and examples that become more diverse yet comprehensive in their coverage of the acquisition life-cycle.

More importantly, the intended principal audience for this profile product, the acquisition community, will be better served. When challenged with planning and executing modeling and simulation support programs that help satisfy their principal responsibilities, they will understand that these artifacts are practical and proven in situations similar to their own.

5.4.1 The NATO/PfP Interoperability and Re-Use Study (NIREUS)

This early exploration study was commissioned to explore the benefits of increasing simulation-based acquisition approaches to the challenges and complexities of naval ship design. NIREUS involved twelve nations and sought to explore approaches that would provide technical insights into factors that affect the design of surface warships that include landing decks for aviation assets. [A14] The study was commissioned to explore the opportunities for simulation-based design and virtual prototyping to help significantly reduce costs, improve design, as well as provide insights into future NATO multi-national cross-deck operations and needed standards. [A15]

Two of the technical activities accomplished during this multi-year exploration, were “Model ConOps and mission context” as well as “Model environment and demonstrate technology”. The international study team represented four areas of concentration:

- Overall integration & visualization
- Air vehicle modeling and flight dynamics within coupled air wake
- Ship modeling
- Ship motion

Relevant standards and best practices included:

- High Level Architecture (HLA)
- Verification, Validation, and Accreditation (VV&A) processes and documentation
- IEEE Recommended Practice for the High Level Architecture (HLA) Federation Development and Execution Process (FEDEP)
- IEEE Standard for Distributed Interactive Simulation (DIS)
- Digital Geography Information Exchange Standard (DIGEST)
- Synthetic Environment Data Representation and Interchange Specification (SEDRIS)

- 3D CAD Standards

5.4.2 The Simulation Exploration Experience (SEE)

The motivation for this program was to attract more Science, Technology, Engineering, and Mathematics (STEM) majors in college to help fill gaps forecast in the technical workforce necessary in NASA and SISO sponsoring organizations. [A16] This program challenged university teams from around the globe from 2011-2015 with support from industry and government mentors and technical tool vendors. The lunar base scenario has inspired teams to go beyond their classroom experience, learn about important existing and emerging standards that will affect their future work, and expose these talented participants to potential employers after graduation. For more information, this program has a web site (www.exploresim.com) that provides additional information on the past, present, and near-future events. [A17]

The technical activities exercised included Concept of Operations (ConOps) modeling and System Interoperability discoveries. Depending on the system modeling choices of the university engineering teams, teams conducted Trade Studies to assess adequacy of candidate solutions to integrate with the mining base and vehicle concepts being conceived by their counterparts.

One of the specific modeling and simulation goals by the NASA designers was to bring knowledge of current simulation capabilities to support complex system-of-systems modeling using the High Level Architecture (IEEE 1516-2010). Due to the majority of the student participants being engineering majors, a significant amount of modeling was conducted in MATLAB. Other standards that could/should have been incorporated had the timelines not been so constraining would have been NASA-STD-7009 – Standards for Modeling and Simulation and perhaps emerging standards related to VV&A.

5.4.3 UAS Airspace Integration and Evaluating System-of-Systems Performance

This program explored the integration complexities of unmanned aircraft systems (UASs) into the National Air Space (NAS). The exploitation of a synthetic or hybrid environment for evaluating concepts and system components might help address this challenge. [A18], [A19] Some of the challenges to be considered involve the inter-organizational problem space. The developers of systems, operational users, and custodians of the airspace all have competing interests. In addition, while technical standards may allow the interoperability of simulation systems at one location, when the centers of excellence of each of the stakeholder communities must come together from their geographically dispersed locations, additional network and security challenges emerge.

Safety concerns drove the development approach of supporting technical infrastructure to perform the technical activities focused on establishing safety related empirical data. The technical activities conducted for UAS integration within the NAS, and the United States Navy program, Triton, include:

- Demonstrate system safety
- System threat integration (where in this system the “threat” could be a Visual Flight Rules, non-radio-equipped light aircraft)
- Assess materiel solutions.

Standards employed included the High Level Architecture, Distributed Interactive Simulation, and Distributed Simulation Engineering and Execution Process – IEEE1730-2010 (formerly Federation Development and Execution Process). Best Practices included the use of existing Cross Domain Solution (CDS) gateways to connect networks of different classification level at locations that were DoD, NASA, FAA, and Northrop Grumman. Due to the nature of the study questions, significant attention was paid to concurrent Verification, Validation, and Accreditation (VV&A) but in a tailored approach that would build confidence over time. The baseline document for best practices was the DoD M&S VV&A Recommended Practice Guide (RPG).

5.4.4 Operation Blended Warrior

“Operation Blended Warrior (OBW) is a collaborative LVC event conducted between DoD and Industry for the purpose of uncovering and documenting the challenges to rapidly developing and integrating a training LVC environment. Capitalizing on the phenomenal capabilities demonstrated at I/ITSEC by our industry partners, OBW has developed a networked architecture to allow those capabilities to be integrated in a fashion representative of their real-life intended purpose.” [A20]

The use of standards is critical to the success of OBW. Figure 5-2 provides a characterized profile of standards used in support of OBW. The application of standards within the architecture laid out for OBW is why OBW participants with related M&S capabilities can interact with each other and support the overall training scenario. The OBW standards focus grew each year since the first event held in 2015. OTB participants learned more and more on the role and effective use of M&S standards for synthetic environments and M&S interoperability, and how these standards enable the conduct of real-time wargaming across multiple computers.

Standards Profile						
Technical Area ¹	Standard ²	Function ³	Type ⁴	Usage ⁵	Specification ⁶	Implementation ⁷
Simulation Technical Interoperability	Institute of Electrical and Electronics Engineers (IEEE) High Level Architecture (HLA)	Specifies architecture enabling interoperability across training simulations	Simulation Interoperability Standards Organization (SISO)	Global	IEEE-1516-2010	Runtime Infrastructure Scalable (RTIS)
Simulation Communication	IEEE Distributed Interactive Simulation (DIS)	Data exchange protocol for federating US Army (USA), US Air Force (USAF), and US Marine Corps (USMC) legacy Modeling and Simulation (M&S)	IEEE	Global	IEEE-1278.x	Unicast, Broadcast, Multicast
	Test and Training Enabling Architecture (TENA)	Supports interoperability between the live training range domain and the larger M&S community	DoD	Global	TENA Middleware Release 6	Logical Range Object Model (LROM)
	One Semi-Automated Forces (OneSAF) Objective Terrain Format (OTF) Specification OneSAF OTF Specification 8.0	Standard provides specification for the format used to capture terrain skin, features, and networks for synthetic environment databases.	PEO STRI OneSAF	DoD	OneSAF OTF Specification 8.0	Terrain Specification Format
Federation Object Model (FOM)	Real-Time Platform Reference (RPR) 2.0	Rule set for data exchange	SISO	Global	JLVC FOM v0.8	Federation Agreement
Federation Data Model	eXtensible Markup Language (XML)	Data Source/Format	Software Engineering, Conceptual			

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Standards Profile						
Technical Area ¹	Standard ²	Function ³	Type ⁴	Usage ⁵	Specification ⁶	Implementation ⁷
			Modeling & Scenarios			
	XML Model Interchange (XMI)	Conceptual Modeling & Scenarios				
	Unified Modeling Language (UML)	System Engineering	Conceptual Modeling & Scenarios	Software Engineering		
	eXtensible Three-Dimensional (X3D)	Data Source/Format	Conceptual Modeling & Scenarios, Visualization			
	OpenFlight Scene Description Database Specification ®	Visual database standard	Defacto Standard	Global		
Meta-Data Specification	DoD Discovery Metadata Specification (DDMS)	Architecture Framework, System Engineering	DoD	DoD	DDMS 5.1	XML – Order of Battle (OOB) extensions
Federation DIS Enumerations	SISO-REF-010-00v20-0, Reference for: Enumerations for Simulation Interoperability	Enumerates platforms and munitions	SISO	Global		Per federate requirements
Geospatial Data	Common Database (CDB) 3X	Simulation ready synthetic terrain database for runtime and storage	Open Geospatial Consortium (OGC)	Global	CDB Specification 3.2	TGS repository
	GeoTIFF	Data Source/Format	Software Engineering	Public Domain		Georeferencing
	Geography Markup Language	Data Source/Format	Software Engineering			
	Digital Terrain Elevation Data (DTED)	Data Source/Format	Visualization Software Engineering	Global		Terrain
Common Runtime Data Store	Shapefile Spatial Data Format	System Engineering	Conceptual Modeling & Scenarios, Imagery & 3D Models, Environmental Data, Visualization, Software Engineering	Global		Geospatial Vector Data
Distribution /Delivery	HyperText Markup Language (HTML) 5	Browser agnostic web delivery	World Wide Web Consortium (W3C)	Global	HTML 5.x	HTML 5 capable browser

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Standards Profile						
Technical Area ¹	Standard ²	Function ³	Type ⁴	Usage ⁵	Specification ⁶	Implementation ⁷
Geospatial Map Layers	OGC-Web specification	Open exchange of map and visualization layers	OGC	Global	Version 1.0/1.1X specification	Terrain Generation Service (TGS) Map Layers API
Tactical Data Comms	Tactical Digital Information Link - Technical Advice and Lexicon for Enabling Simulations (TADIL TALES)	Conceptual Modeling & Scenarios, Information Exchange Data Model, Data Source/Format	DoD	DoD		

Figure 5-2 OBW Standards Classification

The participants of OBW expanded knowledge and experience in applying standards to allow I/ITSEC attendees to see first-hand the skills, capabilities and complexity of challenges overcome through standardized interoperability of multiple capabilities. The Acquisition M&S Standards Profile PDG project worked with leadership of the OBW project from 2016 when the I/ITSEC 2016 OBW planning was underway through 2017 in a collaborative effort to specifically document details on the standards applied by the products and capabilities employed by the OBW architecture. The “OBW Standards Profile” provides a standard view of the OBW vignettes by documenting the standards used to generate and simulate each vignette.

5.5 Rationale for the Selection of Standards Artifacts

ANNEX C contains the current list of standards from the NATO Modeling and Simulation Standards Profile [A8] that are considered the starting point or baseline for the profile. Each standard or best practice is described using the metadata template above. In future iterations to the content of the profile, the following standards are being considered for inclusion in this Volume, however, they are not included in the baseline because the metadata for these standards is not contained within ANNEX BC.

- Unified Profile for DoDAF/MODAF/NAF (UPDM)
- NASA Standard 7009 for Modeling and Simulation
- Model Process Control (MPC) Interface Specification
- Model Based Systems Engineering

Suggestions for changes to either technical activities, standards, or citations for definitions are always welcomed, but before they can be considered they must have complete and authoritative data and the identification of point of contact who agrees to keep the artifact information current. A richer discussion on the concept(s) for keeping the standards profile current and agile are expected as part of the development of the product support group roles and responsibilities.

ANNEX E contains the list of SDOs of interest to Modeling and Simulation that apply to the ANNEX C standards artifacts.

ANNEX A. Bibliography

- [A1] Zimmerman, P. (2012) Standards Profile for Modeling and Simulation Data, Proceedings of the Simulation Interoperability Standards Organization (SISO) Fall 2012 Simulation Interoperability Workshop (SIW), Orlando, FL.
- [A2] CRS Report RL34026, "Defense Acquisitions: How DOD Acquires Weapon Systems and Recent Efforts to Reform the Process", Moshe Schwartz, Specialist in Defense Acquisition, May 23, 2014
- [A3] ISO/IEC/IEEE 15288:2015(E) Systems and Software Engineering — System Life Cycle Processes, First edition 2015-05-15. Retrieved May 2018 from <https://www.iso.org/standard/63711.html>
- [A4] Webster's New Collegiate Dictionary
- [A5] Extracted from Committee on National Security Systems (CNSS) Instruction No. 4009 26 April 2010 (Glossary) – Applied as the reference for COI as listed in DoD Instruction 8320.02. [<https://www.dni.gov/index.php/who-we-are/organizations/ise/ise-resources/ise-glossary>]
- [A6] Metrics for Modeling and Simulation (M&S) Investments, Scientific and Technical Report, November 2008
- [A7] International Organization for Standardization - <http://www.iso.org/iso/home/standards.htm>
- [A8] NATO (2012), NATO Modeling and Simulation Standards Profile, (Edition (D) Version 1), NATO Standardization Agency (NSA), AMSP-01
- [A9] DoDM 4120.24, Defense Standardization Program and the DoD Modeling and Simulation (M&S) Related Standards and Best Practices Guide, 01 October 2010. [<https://www.msco.mil/DocumentLibrary/MSReferences/Standards/DoD%20MS%20Stds%20and%20Best%20Practices%20Guide.pdf>]
- [A10] Morse, K. L., "The Standards Cabbage Patch – Where Do Standards Come From? August 4 2010.
- [A11] Office of Management and Budget (OMB), Circular No. A–119 Revised, Washington, D.C. 20503, February 10, 1998.
- [A12] Definition from DISA Data Services Environment Glossary, <http://www.disa.mil/computing/infrastructure/data-services-environment>
- [A13] Scaled Agile Framework (Agile SAFe), <https://www.scaledagileframework.com/>
- [A14] White, Sally A; Reading, Richard A; (2001) NATO/PfP HLA Federation of VTOL Operations Supporting Simulation Based Acquisition, Proceedings of the European 2001 SIW, 01E-SIW-034.
- [A15] Reading, Richard A; Springall, Tony; Hyland, David; (2003) NATO Standards for Virtual Ships, Proceedings of the European 2003 SIW, 03E-SIW-060.
- [A16] Crues, Edwin (Zack); Telephone Interview with Crash Konwin; Simulation Exploration Experience (SEE) Motivations, Processes, and Lessons Learned; July 2015.
- [A17] Elfrey, Priscilla; Lift-Off 2: Updated Brief Guide for Simulation Exploration Experience (SEE 2015); March 2015.
- [A18] Lutz, Robert; LeSueur, Kenneth G.; Fast, Paul R.; Graeff, Richard; et al; A Persistent LVC Simulation Environment for UAS Airspace Integration. Proceedings of the Interservice/Industry, Simulation, and Education Conference (I/ITSEC), Dec 2010.
- [A19] Lutz, Robert; Hanrahan, Thomas; Graeff, Rick; et al. Advanced Modeling & Simulation Techniques for Evaluating System-of-Systems Performance. Proceedings of the Interservice/Industry, Simulation, and Education Conference (I/ITSEC), Dec 2013.
- [A20] Interservice/Industry Training, Simulation and Education Conference (I/ITSEC) 2016 OBW Flyer - Section on "What is OBW?" (pdf filename: Playbook_OBW_NTSAfinal)
- [A21] Systems Engineering Handbook, INCOSE-TP-2003-002-04, 4th Ed.-2015.
- [A22] Defense Acquisition Guidebook, Chapter 4 – Systems Engineering, Production Date: 16 September 2013, Section 4.3.18.5.
- [A23] Interoperability (n.d.). In Wikipedia. Retrieved August 2013, <http://en.wikipedia.org/wiki/Interoperability>.
- [A24] Retrieved August 2013 from: Forbes Group <http://www.forbesgroup.com/uploads/toolbox/Portfolio-Analysis-Matrix-explanation-and- questionnaire>.
- [A25] Defense Acquisition Guidebook, Chapter 3 – Affordability and Life-Cycle Resource Estimates, Date: 16 September 2013, Section 3.1.2 – Life-Cycle Cost Categories and Program Phases (p 77).
- [A26] MITRE System Engineering Guide. Retrieved August 2013 from: <http://www.mitre.org/publications/systems-engineering-guide/se-lifecycle-building-blocks>.

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

- [A27] Tolk, Dr. Andreas, "Moving towards a Lingua Franca for M&S and C3I – Developments concerning the C2IEDM", Virginia Modeling Analysis & Simulation Center (VMASC), Old Dominion University Norfolk, VA 23529, 2004 Euro Simulation Interoperability Workshop, Edinburgh, Scotland, June 2004. Retrieved August 2013 from: www.sisostds.org
- [A28] Defense Acquisition University (2012). Defense Acquisition Acronyms and Terms, (16th ed., p B-121) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A29] Defense Acquisition Guidebook, Chapter 4 – Systems Engineering, Production Date: 16 September 2013, Section 4.3.19.1 Modeling and Simulation (p 392).
- [A30] Trade Studies (n.d.). In Wikipedia. Retrieved August 2013 from http://en.wikipedia.org/wiki/Trade_Studies.
- [A31] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-258) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A32] Chairman of the Joint Chiefs of Staff Instruction J-8 CJCSI 3170.01G, March 2009, p GL-6.
- [A33] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-9) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A34] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-146) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A35] Interoperability (n.d.), ACQuipedia, Retrieved August 2013, from <https://dap.dau.mil/acquipedia/Pages/ArticleDetails.aspx?aid=fb7a9b64-83cd-4c1d-9147-c32b4ae9a556>
- [A36] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-182) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A37] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A38] Defense Acquisition Guidebook, Chapter 11 – Department of Defense Decision Support Systems, Production Date: 16 September 2013, Section 11.8. Modeling and Simulation (M&S) Support to the Entire Product (p 971).
- [A39] T&E Management Guide, January 2005 (5th ed., para 13-8, p 13-8)
- [A40] Scott Ambler, Human Interface Prototyping, Retrieved August 2013, <http://www.agilemodeling.com/artifacts/uiPrototype.htm>
- [A41] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-147) Fort Belvoir, Virginia: Defense Acquisition University Press."
- [A42] Ransom, LTC D.S., "Logistics Transformation-Reducing the Logistics Footprint", U.S. ARMY War College, Carlisle Barracks, PA, 5 April 2002.
- [A43] Defense Acquisition Guidebook, Chapter 5 – Life-Cycle Logistics, Production Date: 16 September 2013, Section 5.4.5.5.2. Supportability Analysis (p 515).
- [A44] AEROSPACE SYSTEMS SURVIVABILITY HANDBOOK SERIES, Volume 5, Survivability. Models and Simulations, 31 July 2001, Joint Technical Coordinating Group on Aircraft Survivability (JTCA/AS), Arlington VA, p 6 and 7.
- [A45] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-116) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A46] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-197) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A47] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-258) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A48] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-266) Fort Belvoir, Virginia: Defense Acquisition University Press."
- [A49] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-159) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A50] Environment, Safety, and Occupational Health High Level Activity Model, "Perform Environment, Safety, and Occupational Health (ESOH) Operations", pg. 2, June 17, 2004. Retrieved August 2013 from: <http://www.acq.osd.mil/ie/download/el/esoh-activity-model-definition.pdf> "
- [A51] Strategy and Implementation Guidance for General Equipment Valuation, March 14, 2016, OUSD(AT&L) and OUSD(C)

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

- [A52] Defense Acquisition Guidebook, Chapter 5 – Life-Cycle Logistics, Production Date: 16 September 2013, Section 5.1.2.2. Life-Cycle Sustainment Plan (pg. 419).
- [A53] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-203) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A54] Defense Acquisition Guidebook, Chapter 4 –Systems Engineering, Production Date: 16 September 2013, Section 4.2.6 Production and Deployment Phase (pg. 237).
- [A55] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-90) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A56] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-270) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A57] Defense Acquisition Guidebook, Chapter 4 – Systems Engineering, Production Date: 16 September 2013, Section 4.3.4.2. Technical Performance Measures (pg. 299).
- [A58] Defense Acquisition Guidebook, Chapter 10 – Decisions Assessments and Periodic Reporting, Production Date: 16 September 2013, Section 10.11.3.5. Determinations by the Senior Official (pg. 886).
- [A59] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-250) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A60] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-264) Fort Belvoir, Virginia: Defense Acquisition University Press."
- [A61] Defense Acquisition University (2015). Defense Acquisition Acronyms and Terms, (16th ed., p B-252) Fort Belvoir, Virginia: Defense Acquisition University Press.
- [A62] Defense Acquisition Guidebook, Chapter 4 –Systems Engineering, Production Date: 16 September 2013, Section 4.3.18.7 Demilitarization and Disposal (pg. 348).
- [A63] Defense Acquisition Guidebook, Chapter 12 – Decisions Assessments and Periodic Reporting, Production Date: 16 September 2013, Section 12.1.3.1. "As-Is" Analysis (pg. 984).

ANNEX B. Definitions of Activities Using Models and Simulations Mapped to the Life Cycle Phase (INFORMATIVE)

ISO/IEC 15288 Concept Stage

ISO/IEC Concept Stage activities correspond to the DAG Pre-Acquisition Concepts, Experimentation and Prototyping and Materiel Solution Analysis phases.

DAG Pre-Acquisition Concepts, Experimentation and Prototyping

Acquisition activities applied in support of this stage include:

- Concept of Operations (ConOps) modeling: A ConOps document is produced early in the requirements definition process to describe what the system will do (not how it will do it) and why (rationale). It should also define any critical, top-level performance requirements or objectives (stated either qualitatively or quantitatively) and system rationale. It is designed to give an overall picture of the operation. [A21]
- Cost / Schedule / Performance trades: Cost, Schedule, Performance, and Risk are the basic elements through which DoD acquisition professionals make tradeoffs and track program status. Risk cuts across the other three elements (Cost Risk, Schedule Risk, and Performance Risk). In DoD Directive (DoDD) 5000.01, paragraph 4.2, "The primary objective of Defense acquisition is to acquire quality products that satisfy user needs with measurable improvements to mission capability and operational support, in a timely manner, and at a fair and reasonable price." [A22]
- System Interoperability Discoveries: The ability of diverse systems and organizations to work together (inter-operate). While the term was initially defined for information technology or systems engineering services to allow for information exchange, a more broad definition takes into account social, political, and organizational factors that influence system-to-system performance. [A23]
- Portfolio Coverage Analysis: Portfolio analysis has been devised to help associations to bridge the gap between strategy formulation and strategy implementation. In other words, it helps you make the hard choices of where to put your money. Portfolio analysis is a systematic way to analyze the products and services that make up an association's business portfolio. [A24]

DAG Materiel Solution Analysis

Acquisition activities applied in support of this stage include:

- Assess Materiel Solutions: As part of the investment management phase of a project, assess materiel solutions and satisfy phase-specific entrance criteria designated by the Milestone Decision Authority (MDA) for the next milestone. [A3]
- Estimate Life Cycle Costs (LCC): For a defense acquisition program, LCC consists of research and development (R&D) costs, investment costs, operating and support costs, and disposal costs over the entire life cycle. These costs include not only the direct costs of the acquisition program, but also include indirect costs that would be logically attributed to the program. In this way, all costs that are logically attributed to the program are included, regardless of funding source or management control. [A25]
- Model ConOps and Mission Context: User-oriented document that "describes systems characteristics for a proposed system from a user's perspective. A ConOps also describes the user organization, mission, and objectives from an integrated systems point of view and is used to communicate overall quantitative and qualitative system characteristics to stakeholders." A ConOps "describes the proposed system in terms of the user needs it will fulfill, its relationship to existing systems or procedures, and the ways it will be used. ConOps can be tailored for many purposes, for example, to obtain consensus among the acquirer, developers, supporters, and user agencies on the operational concept of a proposed system. Additionally, a ConOps may focus on communicating the user's needs to the developer or the developer's ideas to the user and other interested parties." [A26]
- Interoperability & Warfighter Integration Analysis: Common to all current solutions dealing with models and simulation interoperability is that the system designer tasked with the integration has

to know what data is located where, the meaning of data and its context, and into what format the data have to be transformed to be used in respective distributed applications within the overall system. [A27]

- Industrial / Manufacturing Capability Analysis: Industrial Capability Analysis [A28] includes:
 - An analysis of the industrial capability to design, develop, support, and if appropriate, restart an acquisition program (Title 10 U.S.C. § 2440). It is a required part of the acquisition strategy for Acquisition Category (ACAT) I programs.
 - Consideration of requirements for efficient manufacture during the design and production of the system
 - The availability of raw materials, special alloys, composite materials, components, tooling, and production test equipment
 - The use of advanced manufacturing technology, processes, and systems
 - The use of contract solicitations that encourage competing offerors to acquire modern technology, production equipment, and production systems (including hardware and software) investment in advanced manufacturing technology, production equipment, and processes
 - During source selection, increased emphasis on the efficiency of production
 - Expanded use of commercial manufacturing processes rather than readiness assessment is a systematic, metrics-based process that assesses processes specified by DoD.
- Supportability & Sustainment Modeling: Modeling is essential to aid in understanding complex systems and system interdependencies, and to communicate among team members and stakeholders. Simulation provides a means to explore concepts, system characteristics, and alternatives; open up the trade space; facilitate informed decisions and assess overall system performance. [A29] Modeling and simulation provide:
 - Insight into program cost, schedule, performance, and supportability risk
 - Understanding of capabilities and the requirements set
 - Data to inform program and technical decisions
 - Efficient communication and shared understanding among stakeholders about relationships between system requirements and the system being developed, through precise engineering artifacts and traceability of designs to requirements
 - Better analysis and understanding of system designs (including system elements and enabling system elements), therefore providing a greater understanding of the reasons for defects and failures at all levels
 - Greater efficiencies in design and manufacturing by reducing the time and cost of iterative build/test/fix cycles
 - Timely understanding of program impacts of proposed changes.

ISO/IEC 15288 Development Stage

ISO/IEC Development Stage activities correspond to the DAG Technology Maturation and Risk Reduction and Engineering and Manufacturing Development phases.

DAG Technology Maturation and Risk Reduction

Acquisition activities applied in support of this stage include:

- Trade Studies: The activity of a multidisciplinary team to identify the most balanced technical solutions among a set of proposed viable solutions. Commonly referred to as a "bake-off", these viable solutions are judged by their satisfaction of a series of measures or cost functions. [A30]
- System Threat Integration: Describes the threat to be countered and the projected threat environment. The threat information must be validated by the DoD components for Acquisition Category (ACAT) II programs. (DoDI 5000.02) [A39][A31]
- Model Environment & Demonstrate Technology: A demonstration of the military utility of a significant new technology and an assessment to clearly establish operational utility and system integrity. [A32] Chairman Joint Chiefs of Staff Instruction. These efforts also include evaluation of

synthetic environment and proof-of-principle demonstrations in field exercises to evaluate system upgrades or provide new operational capabilities. [A33]

- Interoperability & Supportability Analysis: The ability of systems, units, or forces to provide data, information, materiel, and services to and accept the same from other systems, units, or forces and to use the data, information, materiel, and services so exchanged to enable them to operate effectively together. Supportability analysis is the current body of procedures and methodologies employed by DoD to accomplish the planning, development, systems engineering, production and management that are essential to ensure logistics supportability of military systems and equipment delivered to users. [A35]
- Operational Suitability & Affordability [A36]:
 - Operational Suitability (OS): The degree to which a system can be placed and sustained satisfactorily in field use with consideration being given to availability, compatibility, transportability, interoperability, reliability, wartime usage rates, maintainability, safety, human factors, habitability, manpower, logistics supportability, natural environmental effects and impacts, documentation, and training requirements.
 - Affordability: A determination that the Life Cycle Cost (LCC) of an acquisition program is in consonance with the long-range investment and force structure plans of the DoD or individual DoD components. [A37]
- Industrial / Manufacturing Capability and Readiness Assessment: An analysis of the industrial capability to design, develop, support, and if appropriate, restart an acquisition program (Title 10 U.S.C. § 2440). It is a required part of the acquisition strategy for Acquisition Category (ACAT) I programs. [A28]
- Estimate Manpower / Cost: A part of the Planning, Programming, Budgeting, and Execution (PPBE) process; responds to the guidance and priorities of the Defense Planning Guidance (DPG) within fiscal constraints to provide a fairly detailed and comprehensive description of the proposed program including a time-phased allocation of resources (forces, funding, and manpower) projected five years into the future (Program Objective Memorandum (POM)). [A34]
- Model System to Performance Specifications: Models and simulations, modified as appropriate to the task, are used to provide consistent and efficient test planning, pre-test results prediction, posttest evaluation, and the validation of system interoperability; and to supplement design qualification, actual test and evaluation, manufacturing, and post-production and operational support. [A33][A38]
- Test & Evaluation (T&E) Planning: A key phase in structuring the T&E program to support the resolution of critical issues. T&E planning yields information on critical technical and operational issues, ensures all data sources necessary for a thorough evaluation are tapped, and evaluation results are communicated in an effective and timely manner. [A39]
- Human Interface Prototyping: An iterative analysis technique in which users are actively involved in the mocking-up of the user interface (UI) for a system. [A40] UI prototypes have several purposes:
 - As an analysis artifact that enables you to explore the problem space with your stakeholders.
 - As a requirements artifact to initially envision the system.
 - As a design artifact that enables you to explore the solution space of your system.
 - As a vehicle for you to communicate the possible UI design(s) of your system.
 - As a potential foundation from which to continue developing the system (if you intend to throw the prototype away and start over from scratch then you don't need to invest the time writing quality code for your prototype).

DAG Engineering and Manufacturing Development

Acquisition activities applied in support of this stage include:

- Ensure Operational Supportability/Ensure Life Cycle Sustainability: Translates force provider capability and performance requirements into tailored product support to achieve specified and evolving life cycle product support availability, reliability, and affordability parameters. Life cycle sustainment considerations include supply; maintenance; transportation; sustainment engineering;

data management; configuration management; human systems integration (HSI); environment, safety (including explosives), and occupational health; protection of critical program information and anti-tamper provisions, supportability, and interoperability. [A41]

- Reduce Logistics Footprint: The logistical footprint is defined as the physical presence of CS/CSS (Combat Support/Combat Service Support) oriented equipment, supplies, personnel (including contractors & civilians), and infrastructure within a given combat zone. [A42] Alternatives should be addressed to look for opportunities to reduce the costs and logistics footprint. [A43]
- Survivability Analysis: Simulation models are best used to determine which parts might be damaged in an encounter with an enemy defense system. Components that contribute to a large number of mission failures are often identified using these techniques. This information can be used as justification for installing enhanced components or redundant systems to improve survivability. [A44] Concept and Technology Development and System Development and Demonstration survivability analysis activities may include significant participation by modeling and simulation in order to better define system operational requirements and clarify the characteristics of competing alternative approaches. Modeling, simulation, analysis, and T&E activities are keys to successful completion of phase activities.
- Human Systems Integration (HSI): Includes the integrated and comprehensive analysis, design and assessment of requirements, concepts and resources for system manpower, personnel, training, safety and occupational health, habitability, personnel survivability, and human factors engineering. (DoDI 5000.02 and the Joint Capabilities Integration and Development System (JCIDS) Manual) See Human Factors Engineering. [A45]
- Design for Producibility: Applies to production engineering tasks to ensure a smooth transition from development into production. Producibility Engineering and Planning (PEP), a systems and planning engineering approach, assures that an item can be produced in the required quantities and in the specified time frame, efficiently and economically, and will meet necessary performance objectives within its design and specification constraints. As an essential part of all engineering design, it is intended to identify potential manufacturing problems and suggest design and production changes or schedule tradeoffs that would facilitate the production process. [A46]
- Demonstrate System Safety: The application of engineering and management principles, criteria, and techniques to optimize safety within the constraints of operational effectiveness, time, and cost throughout all phases of the system life cycle. [A47]
- Verify Functionality and Performance to Specifications / Needs: Process by which a system or components are exercised and results analyzed to provide performance-related information. The information has many uses including risk identification and risk mitigation and empirical data to validate models and simulations. T&E enables an assessment of the attainment of technical performance, specifications, and system maturity to determine whether systems are operationally effective, suitable and survivable for intended use, and/or lethal. [A48]
- Manpower Estimates: An estimate of the most effective mix of DoD manpower and contract support for an acquisition program. Includes the number of personnel required to operate, maintain, support, and train for the acquisition upon full operational deployment. Once the Manpower Estimate is approved by the component manpower authority, it serves as the authoritative source for reporting manpower in other program documentation. Required for all Acquisition Category (ACAT) I programs. [A49]

ISO/IEC 15288 Production Stage

ISO/IEC Production Stage activities correspond to the single DAG Technology Production and Deployment phase.

DAG Technology Production and Deployment

Acquisition activities applied in support of this stage include:

- Industrial / Manufacturing Readiness Assessment: The Production Readiness Review (PRR) for the system determines whether the system design is ready for production, and whether the

developer has accomplished adequate production planning for entering Low-Rate Initial Production (LRIP) and Full-Rate Production (FRP). Production readiness increases over time with incremental assessments accomplished at various points in the life cycle of a program. In the early stages, production readiness assessments should focus on high-level manufacturing concerns such as the need for identifying high-risk and low-yield manufacturing processes or materials, or the requirement for manufacturing development efforts to satisfy design requirements. As the system design matures, the assessments should focus on adequate production planning, facilities allocation, producibility changes, identification and fabrication of tools and test equipment, and long-lead items. The system PRR, held prior to Milestone C, should provide evidence that the system can be produced with low risk and no breaches in cost, schedule, and performance thresholds. See also the System Capability and Manufacturing Process Demonstration described in DoDI 5000.02. [A28]

- Environment, Safety, and Occupational Health (ESOH) Models: Environment, Safety, and Occupational Health Operations refers to distinct business areas within DoD that address environmental quality, restoration, range sustainability, occupational health, and safety activities as well as fire and emergency services. While each program within these business areas operates in accordance with specific laws, regulations, DoD guidance, service-level guidance, and best practices, there are sets of common activities operating across these areas. Common activities include identifying and understanding the environment, safety, health, or readiness issue; risk assessment; developing solutions; implementing solutions; developing agreements; and the conduct of monitoring. [A50]
- General Equipment Valuation (GEV): DoD Components will complete the following in preparation for DoD audit:
 - Establish and validate opening balances based on deemed cost
 - Make an unreserved assertion that its General Equipment (GE) is presented fairly and in accordance with Generally Accepted Accounting Principles (GAAP)
 - Following the making of the “unreserved assertion”, components have processes, systems and controls in place to record transactions at historical cost in compliance with GAAP. Some of these processes may involve manual “work arounds” until the end state target environment is achieved

In addition, DoD Components are expected to work toward and achieve the end state target environment, which will include process improvement through automation, integration and monitoring. [A51]

- Corrosion Prevention & Control: In addition to its significant financial impact, corrosion can also adversely affect system availability and ESOH. Therefore, it is extremely important to plan for and implement corrosion prevention and mitigation as early as possible in the acquisition life cycle (even prior to Milestone A) to minimize the life-cycle impact. The execution of a program’s Corrosion Prevention and Control (CPC) planning should contribute to reduced corrosion vulnerability with lower life-cycle costs; and improved ESOH, maintainability, and availability. [A22]
- Refine LCSP: The Life Cycle Sustainment Plan (LCSP) documents the Program Manager’s plan for formulating, implementing and executing the sustainment strategy so that the system’s design as well as the development of the product support package (including any support contracts) are integrated and contribute to the Warfighter’s mission requirements by achieving and maintaining the Sustainment Key Performance Parameters (KPPs) and Key System Attributes (KSAs). The LCSP is a living document describing the approach and resources necessary to develop and integrate sustainment requirements into the system’s design, development, testing and evaluation, fielding and operations. [A52] The LCSP should be tailored to meet program needs documenting the current program plan in the following areas:
 - The maintenance and support concepts
 - How the sustainment metrics will be achieved and sustained throughout the life-cycle
 - How sustainment is addressed as an integral part of the program’s acquisition strategy and system design process
 - The assigned responsibilities and management approach for achieving effective and timely acquisition, product support, and availability throughout the life-cycle including the Program Manager’s role in planning for and executing sustainment

- The funding required and budgeted by year and appropriation for the main sustainment cost categories including operating & support costs
- The plan for identifying and selecting sources of repair or support
- The sustainment risk areas and mitigation plans
- Product support implementation status
- Results and recommendations from DoD Component Independent Logistics Assessments (ILAs)
- Production Qualification Testing (PQT): A technical test completed prior to the Full-Rate Production (FRP) decision to ensure the effectiveness of the manufacturing process, equipment, and procedures. This testing also serves the purpose of providing data for the independent evaluation materiel release so that the evaluator can address the adequacy of the materiel with respect to the stated requirements. These tests are conducted on a number of samples taken at random from the first production lot, and are repeated if the process or design is changed significantly and when a second or alternative source is brought online. [A53]
- Verify & Validate Production Configuration: A multi-disciplined product and process assessment to ensure that the system under review can proceed into Low-Rate Initial Production (LRIP) and Full-Rate Production (FRP) within cost (program budget), schedule (program schedule), risk, and other system constraints. It confirms completion of all incremental accomplishments for system verification, for example, Test Readiness Reviews (TRRs) and Functional Configuration Audits (FCAs). It assesses the system final product, as evidenced in its production configuration, and determines if it meets the functional requirements (derived from the Capability Development Document (CDD) and draft Capability Production Document (CPD)) documented in the Functional, Allocated, and Product Baselines. The System Verification Review (SVR) establishes and verifies final product performance. The SVR is often conducted concurrently with the Production Readiness Review (PRR). A Functional Configuration Audit (FCA) may also be conducted concurrently with the System Verification Review (SVR), if desired. (Defense Acquisition Guidebook and Electronic Industries Association Standard 632) [A54]
- Economic Analysis: A systematic approach to selecting the most efficient and cost-effective strategy for satisfying an agency's need. An Economic Analysis evaluates the relative worth of different technical alternatives, design solutions, and/or acquisition strategies, and provides the means for identifying and documenting the costs and associated benefits of each alternative to determine the most cost-effective solution. Normally associated with Automated Information System (AIS) acquisition programs. [A55]

ISO/IEC 15288 Utilization and Support Stages

ISO/IEC Utilization and Support Stages correspond to the single DAG Operations and Support phase.

DAG Operations and Support

Acquisition activities applied in support of this stage include:

- Training: Any activity that results in enabling users, operators, maintainers, leaders and support personnel, to acquire, gain or enhance knowledge, skills, and concurrently develops their cognitive, physical, sensory, team dynamics and adaptive abilities to conduct joint operations and achieve maximized and fiscally sustainable system life cycles. The systems engineering concept of a purposely designed 'total system' includes not only the mission system-equipment, but more critically, the people who operate, maintain, lead and support these acquired systems. Including the training, training systems; and the operational and support infrastructure. [A56]
- Determine System Risk / Hazard Severity: The Risk Management process is the overarching process that encompasses identification, analysis, mitigation planning, mitigation plan implementation, and tracking of program risks. Risk management is the primary method of mitigating program uncertainties and is therefore critical to achieving cost, schedule, and performance goals at every stage of the life cycle. Effectively managing risks helps the Program

Manager and Systems Engineer develop and maintain a system's technical performance, and ensure realistic life-cycle cost and schedule estimates. [A57]

- Engineering Change Proposal (ECP) Impact Analysis: The change management process in systems engineering is the process of requesting, determining attainability, planning, implementing, and evaluating changes to a system. It has two main goals: supporting the processing of changes and enabling traceability of changes. A "Significant Change" or a "Critical Change" in cost, schedule or performance is actionable to the program Senior Official for reporting the change and its impact. [A58]
- Supply Chain Management (SCM): A cross-functional approach to procuring, producing, and delivering products and services to customers. The broad management scope includes sub-suppliers, suppliers, internal information, and funds flow. (Joint Publication 1-02). SCM provides an intellectual and organizational approach to managing, integrating, and assuring all the elements that affect the flow of materiel to the joint force. Military SCM is the discipline that integrates acquisition, supply, maintenance, and transportation functions with the physical, financial, information, and communications networks in a results-oriented approach to satisfy joint force materiel requirements. [A59]
- Monitor Performance and Adjust Product Support: Technical Performance Measures (TPMs) support assessment of design and integration progress toward achieving Key Performance Parameters (KPPs) and Key System Attributes (KSAs). The Systems Engineer defines, collects, and analyzes performance measurement data for all TPMs to assess performance over time against threshold and objective values. The Systems Engineer should assess all TPMs at each technical review and audit to determine leading indicators and risk mitigation activities as appropriate. [A60]
- Supportability Analysis: An analytical tool, conducted as part of the Systems Engineering Process (SEP), to determine how to most cost-effectively support the system over its entire life cycle. It provides the basis for related design requirements that may be included in specifications. [A61] A key product of the supportability analysis is the maintenance plan which evolves and drives all sustainment resource requirements throughout the life cycle:
 - Pre-Systems Acquisition: Determining the capabilities and major constraints (cost, schedule, available technology) that frame the acquisition strategy and program structure for both the system and its support concept
 - Acquisition: Designing, producing and deploying the equipment and its support system
 - Operations: Adjusting to the operational environment by assessing readiness trends/issues, cost trends, evolving materiel conditions, and taking timely corrective actions to support the users.
- Disposal Planning: 1.) The second effort of the Operations and Support (O&S) phase as established and defined by DoDI 5000.02. At the end of its useful life, a system shall be demilitarized and disposed of in accordance with all legal and regulatory requirements and policy relating to safety (including explosives safety), security, and the environment. 2.) The act of getting rid of excess, surplus, scrap, or salvage property under proper authority. Disposal may be accomplished by, but not limited to, transfer, donation, sale, declaration, abandonment, or destruction. [A62]
- Validate Failures and Determine Root Causes: Procedure by which each potential failure mode is analyzed to determine its effects on the system and then classified according to its severity. It further attempts to identify all single points of failure; that is, those points where failure of the component can cause failure of the entire system. [A63]

ISO/IEC 15288 Retirement Stage

DAG Disposal

Models and simulations can be applied across all the life cycle phases of acquisition whenever information is needed by a decision authority to make decisions on continued system development, use or retirement. The last phase, retirement, represents the culmination of activities that begin at the design phase. At the

end of a system's useful life, the AcqMSStd's profile identifies models and simulations for assistance in determining how a system must be phased out and disposed of in accordance with legal and regulatory requirements and policy relating to safety, security, and the environment. [A62]

ANNEX C. First Edition Standards Metadata

Table C-1 Base Object Model (BOM)

Metadata Element	Metadata Element Description
Title	Base Object Model (BOM)
Identifier	This standard is comprised of two documents: 1. the "BOM Template Specification", SISO-STD-003-2006, 2. the "Guide for Base Object Model (BOM) Use and Implementation", SISO-STD- 003.1-2006
Version	SISO-STD-003, year of publication: 2006
SDO	SISO
Abstract	Base Object Models (BOMs) provide a component framework for facilitating interoperability, reuse, and composability. The BOM concept is based on the assumption that piece-parts of models, simulations, and federations can be extracted and reused as modelling building-blocks or components. The interplay within a simulation or federation can be captured and characterized in the form of reusable patterns. These patterns of interplay are sequences of events between simulation elements. The representation of the pattern of interplay is captured in the first BOM document. (Reference SISO-STD-003-2006). The second document, the "Guide for Base Object Model (BOM) Use and Implementation", introduces methodologies for creating BOMs and implementing them in the context of a larger simulation environment. The document is a means of familiarizing the reader with the concept of BOMs and providing guidance for BOM development, integration, and use in supporting simulation development. (Reference SISO-STD-003.1-2006)
Technical Maturity	Current. The BOM specification and guide were published by SISO in 2006. First uses of BOMs were known to be successful.
Type	Conceptual Modelling and Scenarios
Availability	The standard's specification and guide can be accessed on the SISO website under the "products" heading.
Access	www.sisostds.org and www.boms.info
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Automation, Behavior, BOM, Components, Composability, Conceptual Model, FEDEP, Interoperability, Metadata, Patterns, Requirements, Reuse
Applicability	The BOM template has constructs that allow the expression of 1) a conceptual model (in terms of events and states), 2) a data exchange model based on the HLA OMT, and 3) the relationships between 1 and 2. Parts 1 and 2 can be use independently or together in combination with part 3. BOMs are intended to improve the reusability and composability of models, simulations and federations.
SDO Periodic Review Date	
Information on Implementation	Some evidence of successful initial use in the USA and France.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Metadata Element	Metadata Element Description
Limitations	A more concise, but less rich in semantics, as compared with other generalized modeling standards such as UML. Specifically targeted to, but not limited to M&S.
Cost	

Table C-2 Standard for Coalition Battle Management Language (C-BML) Phase 1, Version 1.0

Metadata Element	Metadata Element Description
Title	Standard for Coalition Battle Management Language (C-BML) Phase 1, Version 1.0.
Identifier	SISO-STD-011-2014
Version	1
SDO	SISO
Abstract	<p>A Battle Management Language (BML) is an unambiguous language used to (a) Command and control forces and equipment conducting military operations and to (b) Provide situational awareness and a shared, common operational picture. BML is particularly relevant in a network centric environment for enabling mutual understanding. A Coalition BML developed and applied by all Services and by coalition members would not only allow interoperability among their C2 systems and simulations, but also among themselves. As it is almost impossible to imagine a situation in the future when a single Service will be unilaterally employed, these efforts must be embedded into international standards. Because future military operations, and a significant amount of training, will be Joint in nature, it is critical that a Joint Service approach be taken to the BML development effort.</p> <p>The Coalition Battle Management Language (C-BML) is a standard language for expressing and exchanging plans, orders, requests, and reports across command and control (C2) systems, live, virtual and constructive (LVC) modeling and simulation (M&S) systems, and autonomous systems participating in coalition operations. C-BML task representation is organized according to the 5Ws (Who, What, When, Where, Why). The C-BML standard describes a sufficient data model to unambiguously define a set of military orders that can be interpreted by C2, M&S, and ultimately autonomous systems. The standard describes the data model as a subset of JC3IEDM and specifies the information exchange content and structure in the form of an Extensible Markup Language (XML) schema. The development of a second generation of standards – C2SIM, unifying MSDL and C-BML, are being undertaken by a single SISO C2SIM PDG.</p>
Technical Maturity	Current. Version 1.0 of the C-BML was approved 14 Apr 2014. Different experimentations have been completed which prove the validity of this concept.
Type	Information Exchange Data Model
Availability	Via SISO web site
Access	www.sisostds.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	C2, Simulation, MSDL
Applicability	Any significant effort to leverage interoperability between C2 systems and simulations.
SDO Periodic Review Date	
Information on Implementation	Many experiences in different nations and MSG activities with predecessor activities that have led to the current standard.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	The first version of C-BML is based on an XML schema; later

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Metadata Element	Metadata Element Description
	versions will include a standardized approach to extensibility.
Cost	

Table C-3 Common Data Base

Metadata Element	Metadata Element Description
Title	Common Data Base
Identifier	CDB
Version	1.1
SDO	Open Geospatial Consortium (OGC)
Abstract	<p>Intention of the CDB standard is to define the organization and storage structure of a worldwide single synthetic representation of the earth. It makes use of several commercial and simulation data formats (including e.g., TIFF, GeoTIFF, JPEG 2000, OpenFlight, and Shape) endorsed by leaders of the database tools industry. It uses the computer's native file system to store data in files and directories. A CDB data store thus contains a number of datasets organized in tiles, layers, and levels of detail (LODs), representing the features and models of a synthetic environment for the purposes of distributed simulation applications.</p> <p>The CDB standard is composed of the below series of associated OGC documents approved 2016-09-23, defining rules and guidelines for data representation of real world features.</p> <ul style="list-style-type: none"> - Volume 0 Primer for the OGC CDB Standard - Model and Physical Data Store Structure - Volume 1 OGC CDB Core Standard - Model and Physical Data Store Structure - Volume 2 OGC CDB Core - Model and Physical Structure - Informative Annexes - Volume 3 OGC CDB Terms and Definitions - Volume 4 OGC CDB Best Practice use of Shapefiles for Vector Data Storage - Volume 5 OGC CDB Radar Cross Section (RCS) Models - Volume 6 OGC CDB Rules for Encoding Data using OpenFlight - Volume 7 OGC CDB Data Model Guidance Formerly Annex A Volume Part 2 - Volume 8 OGC CDB Spatial and Coordinate Reference Systems Guidance - Volume 9 OGC CDB Schema Package - Volume 10 OGC CDB Implementation Guidance - Volume 11 OGC CDB Core Standard Conceptual Model - Volume 12 OGC CDB Navaids Attribution and Navaids Attribution Enumeration Values
Technical Maturity	Current. Version 1.0 of the standard was approved 23 September 2016 by the OGC. Consequences of further aligning CDB and other OGC standards (like GML, CityGML, and GeoPackage) cannot be anticipated yet.
Type	Synthetic Environment
Availability	The standard is available to the public at no cost (no login required); it can be found on the OGC website under the "Standards and Supporting Documents" heading.
Access	https://portal.opengeospatial.org/files/15-113r5
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	geospatial data repository, geospatial formats, GEOINT

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Metadata Element	Metadata Element Description
Applicability	<ul style="list-style-type: none"> - Best suited for native CDB-compliant client-applications including image generators, radar simulations, Computer Generated Forces, etc. (missing “CDB-aware” tools, data extraction complexity and costs increase for non- native CDB-compliant client-applications). - Use of a CDB data store as an on-line database repository imposes runtime publishers to be developed for client-applications.
SDO Periodic Review Date	
Information on Implementation	<p>CAE originally designed and developed the Common Database Specification for the United States Special Operations Command (USSOCOM). It was followed by several known implementations of the Common Database Specification, up to the version 3.2 (released by Presagis in March 2014), to which the US Government has unrestricted rights.</p> <p>The structure of a CDB data store composed of tiles, layers, and levels of detail (up to 34 LODs) has been influenced by CAE runtime publishing requirements.</p>
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	<ul style="list-style-type: none"> - Missing at present “CDB-aware” tools to understand and access the overall construction / structure of a CDB data store (API and Starter Kit only exist for the Common Database version 3.2, released by Presagis). - The number of files in a CDB data store representing a large-sized terrain database may result in a challenging deployment operation. - Best practices (e.g., for use of OpenFlight and Shape files, Spatial and Coordinate Reference Systems) leave place for sufficient variations that interoperability and exchange results can vary significantly. - The standard does not provide implementation details for developing specific off-line data store editors or runtime publishers.
Cost	

Table C-4 Common Image Generator Interface

Metadata Element	Metadata Element Description
Title	Common Image Generator Interface
Identifier	SISO-STD-013-2014
Version	Version 4
SDO	CIGI development began in 2000 by The Boeing Company. Over the years CIGI matured under supervision of SISO culminating in an approved open version in August 2014.
Abstract	CIGI is an interface designed to promote a standard way for a host device to communicate with an image generator. As this interface is designed to be a real-time interface; bandwidth requirements have been minimized. CIGI is not to be associated with any particular hardware interface. With CIGI, it is possible to connect a host with an arbitrary number of image generators. The communications can be performed during either synchronous (the host's frame rate matches the image generator's frame rate) or asynchronous operation. To construct complex simulations, a high level of abstraction is provided by CIGI, using so-called building blocks. Each of these building blocks is generic in nature and represents a related group of data. With these building blocks, things such as high-level image generator commands, out-the-window view portals, entities, special effects, articulated parts, atmospheric effects, mission functions and sensor simulation objects can be specified.
Technical Maturity	Current. In use and supported by several commercially available image generators. The SISO Product Support Group (CIGI-PSG) provides support to the generation of registered extension packet IDs as defined in section 6.3 of the CIGI standard.
Type	Synthetic Natural Environment / Visual Systems Interfacing
Availability	CIGI is available as a C++ class library or a C language SDK/API. Both are freely available at http://cigi.sourceforge.net as open source software under the GNU Lesser General Public License.
Access	http://www.sisostds.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Image Generator, Interoperability, CIGI
Applicability	Specifically designed to support the communication between host devices and image generators.
SDO Periodic Review Date	
Information on Implementation	Supported by several commercially available image generators.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	The first open version of the standard (v4) concentrated on organizing content rather than adding functionality. Future work on the standard will examine how functionality can be expanded.
Cost	

Table C-5 IEEE Standard for Distributed Interactive Simulation (DIS)

Metadata Element	Metadata Element Description
Title	IEEE Standard for Distributed Interactive Simulation (DIS)
Identifier	DIS (IEEE 1278 series)
Version	Current official versions: <ul style="list-style-type: none"> - IEEE 1278.1-2012 – Standard for Distributed Interactive Simulation – Application Protocols - IEEE 1278.1A-1998 (R2002) – Standard for Distributed Interactive Simulation - Supplement to Application Protocols – Enumeration & Bit-encoded Values - IEEE-1278.2-2015 – Standard for Distributed Interactive Simulation - Communication Services and Profiles - IEEE 1278.3-1996 (R2002) - Recommended Practice for Distributed Interactive Simulation - Exercise Management and Feedback. - ANSI/IEEE 1278.4-2002 - Recommended Practice for Distributed Interactive Simulation - Verification Validation & Accreditation
SDO	“DIS workshops” organization until 1997, presently SISO, as a Standards Sponsor of The Institute of Electrical and Electronics Engineers, Inc. (IEEE)
Abstract	DIS is an interoperability standard based on exchanges of formatted messages between simulation applications / simulators. Simulation state information and interactions are encoded in messages known as Protocol Data Units (PDUs) and exchanged between hosts using existing transport layer protocols, though normally broadcast User Datagram Protocol (UDP) is used.
Technical Maturity	Current. More than 20 years of use in many NATO countries; very mature technology.
Type	M&S Interoperability
Availability	Available to the public with an IEEE copyright and a fee
Access	www.ieee.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	protocol Data Unit, PDU, DIS, Distributed Interactive Simulation, simulation, exercises, distributed, interoperability, verification, validation, certification
Applicability	Distributed Interactive Simulation (DIS) is a protocol for linking simulations of various types at multiple locations to create realistic, complex, virtual worlds for the simulation of highly interactive activities. This protocol can be used to bring together systems built for separate purposes, technologies from different eras, products from various vendors, and platforms from various services, and permits them to interoperate. DIS exercises are intended to support a mixture of virtual entities with computer-controlled behavior (computer generated forces), virtual entities with live operators (human-in-the-loop simulators), live entities (operational platforms and test and evaluation systems), and constructive entities (wargames and other automated simulations).
SDO Periodic Review Date	
Information on Implementation	Many operational implementations in various nations. Best example is the US Air Force Distributed Mission Operation (DMO) program.
Implementation Guidance	
Implementation Training Resources	

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Metadata Element	Metadata Element Description
Implementation Vendor Support	
Implementation Literature References	
Limitations	The primary limitation of this standard is that it is applicable to only real time (simulated time = wall clock time) simulation and has a fixed object model defined at the platform level.
Cost	

Table C-6 IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process Multi-Architecture Overlay (DMAO)

Metadata Element	Metadata Element Description
Title	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process Multi-Architecture Overlay (DMAO)
Identifier	IEEE DMAO
Version	IEEE 1730.1-2013
SDO	SISO on behalf of IEEE
Abstract	Many special issues must be addressed when building a distributed simulation environment that involves multiple simulation architectures (e.g., HLA, DIS, TENA). Issues like time management, interest management, and object model reconciliation are all more difficult to resolve when multiple simulation architectures are in play. While the DSEEP provides an architecture-neutral description of the process required to build distributed simulation environments, it does not address the unique issues/solutions associated with the development and execution of multi architecture simulation environments, leaving developers with little or no sources of practical guidance.
Technical Maturity	Current. The Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP) Multi-Architecture Overlay (DMAO) was approved as an IEEE Recommended Practice (IEEE 1730) in January 2011.
Type	M&S Methodology, Architecture and Processes: Systems Engineering Processes
Availability	Copies of this standard may be purchased from IEEE. The first version is freely available only to members.
Access	www.ieee.org . or www.sisostds.org for SISO members only.
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Distributed, Simulation, Architecture
Applicability	The DMAO extends the process described in the DSEEP to address multi-architecture development and execution. It is designed as an overlay, associating issues and solutions relevant to multi-architecture development to existing DSEEP activities.
SDO Periodic Review Date	
Information on Implementation	No known implementation yet.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	Needs to be tailored for specific uses and interoperability standards selected.
Cost	

Table C-7 IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP)

Metadata Element	Metadata Element Description
Title	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP)
Identifier	IEEE Stds 1730™-2010
Version	1
SDO	SISO
Abstract	<p>The DSEEP (Distributed Simulation Engineering and Execution Process) is the successor of former guides based on DIS and HLA. The most known is the FEDEP (Federation Development and Execution Process, whose full name is HLA FEDEP) which was a process of engineering in support of the development of federations of simulation based on the architecture HLA. The FEDEP evolved in two successive versions: the first one was based on HLA 1.3 and was published by the DOD (1998), the second is a standard IEEE (IEEE Stds 1516.3™-2003) published by the IEEE. Both versions of the FEDEP are now obsolete and are not any more accessible on the site IEEE: they are replaced by the DSEEP and the DMAO (Distributed Simulation Engineering and Execution Process Multi-Architecture Overlay).</p> <p>The DSEEP is generic and makes a reference to no architecture or specific protocol; however, it proposes in appendices for the standards IEEE DIS, HLA and TENA. The DSEEP is applicable to the distributed systems of simulation which use only one standard of interoperability either DIS, HLA, or TENA. The vocabulary used by the DSEEP is abstracted enough to avoid any reference to a particular standard: for example, we do not speak of a federation, nor of federated.</p> <p>For the distributed systems which use several architectures and/or protocols, the DSEEP was generalized in a more recent guide called DMAO (IEEE Stds 1730.1™- 2013).</p>
Technical Maturity	Current. DSEEP is an update of the FEDEP standardized as IEEE Stds 1516.3™-2003
Type	M&S methodology, architecture and processes
Availability	Via SISO and IEEE web sites
Access	www.sisostds.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Distributed, Simulation, Engineering Process
Applicability	Distributed systems of simulation
SDO Periodic Review Date	
Information on Implementation	Many experiences in different nations
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	Appendices only for standards IEEE DIS, IEEE HLA and TENA
Cost	

Table C-8 Dynamic Link Compatible HLA API Standard for the HLA Interface Specification

Metadata Element	Metadata Element Description
Title	Dynamic Link Compatible HLA API Standard for the HLA Interface Specification
Identifier	IEEE 1516.1 (SISO-STD-004.1-2004).
Version	2006 (year of publication)
SDO	Simulation Interoperability Standards Organization
Abstract	This standard defines link compatible C++ and Java Application Programmer Interfaces (APIs) consistent with the High Level Architecture Interface Specification and is applicable to HLA Runtime Infrastructures and federates developed in compliance with that specification. The primary objective of this standard is to provide a mechanism to permit federates to utilize RTIs developed in compliance with the High Level Architecture and this specification, without recompiling or relinking federate code.
Technical Maturity	Obsolete. In use for 4 years and incorporated into the 2010 version of the core IEEE HLA specification. However it was not declared obsolete by SISO as it can be still in use by people working with the 1516-2000 version.
Type	M&S Interoperability
Availability	Freely downloadable from the SISO web site.
Access	www.sisostds.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	HLA, High Level Architecture, API, Application Programmer Interface, RTI, Run Time Interface, interoperability, architecture, simulation
Applicability	Applicable to the HLA federates using the C++ and Java interfaces to implement the IEEE 1516-2000 series of HLA specifications.
SDO Periodic Review Date	
Information on Implementation	Unknown within NATO applications.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	This standard is intended to establish the C++ and Java API specifications but it is not intended to facilitate functional compatibility.
Cost	

Table C-9 Reference for Enumerations for Simulation Interoperability

Metadata Element	Metadata Element Description
Title	Reference for Enumerations for Simulation Interoperability
Identifier	SISO-REF-010-2020
Version	Version 28, 7 May 2020
SDO	Simulation Interoperability Standards Organization (SISO) as per the Standards Activity Committee Special Working Group (SAC SWG) Enumerations. The process and organization to capture, review, and approve enumerations is defined separately in reference document Enumerations for Simulation Operations Manual (SISO-REF-010.1-2016).
Abstract	<p>This reference product is essentially a data dictionary for distributed simulation. It specifies the numerical values and associated definitions for those fields that are identified as enumerations in SISO standards and in SISO-sponsored standards published by IEEE.</p> <p>The reference product is made available in archive form; as such, it comprises the following files:</p> <ul style="list-style-type: none"> - README file - Enumerations data file (XML) and related schema (XSD); - Enumerations in a RPR FOM "RPR-Enumerations" module (XML); - C99 Makefile; - Enumerations document in Word format, PDF, and HTML format; and - Translators (XSL) to: <ul style="list-style-type: none"> - Microsoft Excel; - C99 Header.
Technical Maturity	Current. Version 28 of the reference product was approved 7 May 2020.
Type	Information Exchange Data Model
Availability	The reference product is available to the public at no cost (no login required); it can be found on the SISO website under the "Products & Publications" heading.
Access	https://www.sisostds.org/ProductsPublications/ReferenceDocuments.aspx
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Enumerations, Interoperability, DIS, HLA
Applicability	Any distributed simulation architecture, but not limited to DIS, HLA, and TENA.
SDO Periodic Review Date	
Information on Implementation	Many operational implementations in various nations, all over the world.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	None.
Cost	

Table C-10 Federation Engineering Agreements Template

Metadata Element	Metadata Element Description
Title	Federation Engineering Agreements Template
Identifier	SISO-STD-012-2013
Version	2013
SDO	Simulation Interoperability Standards Organization (SISO)
Abstract	The Federation Engineering Agreements Template (FEAT) provides a standardized format for recording federation agreements to increase their usability and reuse. The template is an eXtensible Markup Language (XML) schema from which compliant XML-based federation agreement documents can be created. Creating the template as an XML schema allows XML-enabled tools to both validate conformant documents, and edit and exchange agreements documents without introducing incompatibilities.
Technical Maturity	Current. The standard is based on lessons learned from experimentation (e.g., US LV CAR Implementation program, MSG-052) and was further evaluated in MSG-106 (2012-2013).
Type	M&S Interoperability
Availability	freely available
Access	The data files associated with SISO-STD-012-2013 may be downloaded from the SISO Product Data Files webpage. http://www.sisostds.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Federation Agreements, XML
Applicability	Capture and unambiguously document federation agreements for the benefit of all stakeholders in a simulation.
SDO Periodic Review Date	
Information on Implementation	Used only in experimentation so far. JHU/APL has developed a FEAT Editor, a Java-based tool to simplify development of federation agreements conformant with the XML schema. http://sourceforge.net/projects/feateditor/
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	There is currently no documentation other than the schema.
Cost	

Table C-11 Guide for Generic Methodology for Verification and Validation (GM-VV) to Support Acceptance of Models, Simulations, and Data

Metadata Element	Metadata Element Description
Title	Guide for Generic Methodology for Verification and Validation (GM-VV) to Support Acceptance of Models, Simulations, and Data.
Identifier	GM-VV. The methodology consists of three documents: <ul style="list-style-type: none"> - GM-VV Volume 1 “Introduction and Overview” - GM-VV Volume 2 “Implementation Guide” - GM-VV Volume 3 “Reference Manual”
Version	Current status of the GM-VV documents: <ul style="list-style-type: none"> - GM-VV Volume 1 “Introduction and Overview”, SISO-GUIDE-001.1-2012 (approved 5 October 2012) - GM-VV Volume 2 “Implementation Guide”, SISO-GUIDE-001.2-2013 (approved 6 June 2013) - GM-VV Volume 3 “Reference Manual”, SISO-REF-039-2013 (approved 29 October 2013)
SDO	Simulation Interoperability Standards Organization (SISO)
Abstract	<p>This product provides the international community with guidance for a generic V&V and Acceptance methodology for models, simulations, and data. The product leverages and harmonizes with the contributions from other national and international V&V and Acceptance initiatives such as the current IEEE Std 1516.4™- 2007 “IEEE Recommended Practice for Verification, Validation, and Accreditation of a Federation—An Overlay to the High Level Architecture Federation Development and Execution Process”, IEEE Std 1278.4™-1997 “IEEE Trial-Use Recommended Practice for Distributed Interactive Simulation—Verification, Validation, and Accreditation”, the REVVA projects, the V&V International Test Operations Procedures (ITOP) Working Group, and the US DoD VV&A Recommended Practices Guide. The initial GM-VV draft documents have been produced by the REVVA consortium. The GM-VV document set includes the following:</p> <ul style="list-style-type: none"> - GM-VV Vol. 1 “Introduction and Overview”. This document provides an overall description of the methodology. It presents the core concepts of the methodology as well as how its architecture binds them together to establish the foundations of the tailorable implementation. - GM-VV Vol. 2 “Implementation Guide”. This document extends Volume 1 by providing guidance on how to apply the methodology. It unfolds the methodology’s architecture by elaborating on the processes, products, interactions among the roles, and how to tailor the methodology. - GM-VV Vol. 3 “Reference Manual”: This document presents the foundations of the concepts, their dependencies and rationale. This document is meant to be referenced whenever a deeper technical understanding of the methodology is required. <p>Note that outside of the United States there may not be a formal accreditation process and the terms “acceptance” or “accepted for use” may be used; the term acceptance is the decision to use a simulation for a specific purpose and the term accreditation is the official certification that a model or simulation is acceptable for use for a specific purpose. The GM V&V standard should not treat accreditation aspects. Vol. 1 and 2 are balloted SISO Guidance Products. Vol. 3 is a non-balloted SISO Reference Product.</p>
Technical Maturity	Current. The GM-VV products are building upon the contributions of

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Metadata Element	Metadata Element Description
	mature national and international V&V projects. All three documents have been reviewed and commented within SISO. In addition, there have been case studies conducted (9 use cases introduced in Volume 3).
Type	M&S Methodology, Architecture and Processes, Verification and Validation (V&V)
Availability	Via SISO website.
Access	www.sisostds.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Verification, Validation
Applicability	GM-VV methodology was experienced in some benchmarking cases in Canada and Europe. One operational use has been announced (NLD).
SDO Periodic Review Date	
Information on Implementation	Use cases have been introduced in past SISO workshops.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	A lack of maturity and limited tool support.
Cost	

Table C-12 IEEE Standard for Modeling and Simulation (M&S): High Level Architecture (HLA)

Metadata Element	Metadata Element Description
Title	IEEE Standard for Modeling and Simulation (M&S): High Level Architecture (HLA)
Identifier	IEEE 1516-2010, IEEE 1516.1-2010, IEEE 1516.2-2010
Version	2010 (year of publication), nickname: "HLA Evolved"
SDO	The IEEE 1516 series of standards are sponsored by the Simulation Interoperability Standards Organization (SISO) Standard Activities Committee, serving as the IEEE Computer/Simulation Interoperability (C/SI) Standards Committee.
Abstract	<p>The High Level Architecture for M&S (HLA) is defined by 3 technical documents.</p> <ol style="list-style-type: none"> 1. IEEE 1516-2010 (Framework and Rules) 2. IEEE 1516.1-2010 (Federation Interface Specification) 3. IEEE 1516.2-2010 (Object Model Template) <p>The standards contained in this architecture are interrelated and need to be considered as a product set, as a change in one is likely to have an impact on the others. As such, the HLA is an integrated approach that has been developed to provide a common architecture for simulation.</p> <p>The Framework and Rules is the capstone document for a family of related HLA standards. It defines the HLA, its components, and the rules that outline the responsibilities of HLA federates and federations to ensure a consistent implementation. The Federate Interface Specification defines the standard services of and interfaces to the HLA Runtime Infrastructure (RTI). These services are used by the interacting simulations to achieve a coordinated exchange of information when they participate in a distributed federation. The Object Model Template provides a specification for describing object models that define the information produced or required by a simulation application, and for reconciling definitions among simulations to produce a common data model for mutual interoperation.</p>
Technical Maturity	Current. The initial IEEE standard was published and copyrighted in 2000. HLA is considered a mature standard and is in use in numerous countries. The current version (published in 2010) is already in use, including in NATO (Snow Leopard project).
Type	M&S Interoperability
Availability	Copies of this document may be purchased from the Institute of Electrical and Electronics Engineers at the IEEE Customer Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, U.S.A. or via the IEEE website. SISO members may download one copy free via the SISO website.
Access	www.ieee.org ; www.sisostds.org (SISO members only)
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	architecture, class attribute, federate, federation, federation execution, federation object model, framework, High Level Architecture, instance attribute, interaction class, joined federate, object class, object model template, rules, runtime infrastructure, simulation object mode
Applicability	The High Level Architecture is a technical architecture developed to facilitate the reuse and interoperation of simulation systems and assets. The HLA provides a general framework within which developers can structure and describe their simulation systems

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Metadata Element	Metadata Element Description
	and/or assets and interoperate with other simulation systems and assets. The HLA consists of three main components. The first component specifies the Framework and Rules. The second component provides the interface specifications. The third component describes the Federation Object Model requirements in the Object Model Template (OMT) Specification.
SDO Periodic Review Date	
Information on Implementation	Widely implemented within NATO and PfP nations; limited implementation of HLA in NATO federations. There are a wide variety of commercial, open source and government support tools. Many support the more recent and current version of the standard.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	HLA is not “plug and play”. Some parts of the standards are left open to the RTI implementer, thus different RTIs are not guaranteed to interoperate, but this situation is improving thanks to the more recent version of HLA.
Cost	

Table C-13 Standard for Link 11/11B Simulation

Metadata Element	Metadata Element Description
Title	Standard for Link 11/11B Simulation
Identifier	SISO-STD-005-2020X Draft
Version	Version 1.0 (DRAFT), 17 January 2020
SDO	Simulation Interoperability Standards Organization (SISO).
Abstract	A SISO standard that defines methods to simulate a Link 11/11B tactical data link network within a Distributed Interactive Simulation (DIS) or High Level Architecture (HLA) federation. The standard defines three levels of fidelity ranging from pure message exchange to sophisticated Link 11/11B network modelling. The three parts of the standard describe Link 11/11B network simulation using DIS (including some extensions), Link 11/11B network simulation using HLA, and a Base Object Model (BOM) as a general modeling approach to Link 11/11B network modeling. The DIS-specific part of the Link 11/11B standard in more detail explains the usage of DIS Transmitter and Signal Protocol Data Units (PDUs). High Level Architecture/Real-time Platform Reference (RPR)-FOM based simulations also will be able to simulate Link 11/11B networks by incorporating the corresponding FOM extensions described by the Link 11/11B standard into their FOM/SOM. This is easily accomplished using the BOM defined in the appendix of the Link 11/11B standard.
Technical Maturity	Emerging. Near Completion.
Type	Information Exchange Data Model
Availability	Draft is available on the SISO Link 11/11B PDG website.
Access	http://www.sisostds.org/
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Tactical Data Link, LINK 11, LINK 11B
Applicability	There are immediate and overdue operational requirements for existing military simulations to exchange Link 11/11B data using a single interoperability method (i.e., DIS or HLA) instead of implementing additional protocols like SIMPLE.
SDO Periodic Review Date	
Information on Implementation	There will be a draft implementation soon from the Canadian Defense Ministry, as well as the U.K. E-3D training program.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	This standard should only apply to Link 11/11B network simulation via DIS or HLA.
Cost	

Table C-14 Standard for LINK 16 Simulations

Metadata Element	Metadata Element Description
Title	Standard for LINK 16 Simulations
Identifier	SISO-STD-002-2006 (approved 10 Jul 06)
Version	2006
SDO	Simulation Interoperability Standards Organization (SISO).
Abstract	<p>There are immediate operational requirements for military simulation applications to simulate the exchange of Link 16 data messages during a simulation execution. This standard provides means to incorporate the Link 16 message exchange into Distributed Interactive Simulation (DIS) or High Level Architecture (HLA) simulation networks, thus eliminating the need for additional transport protocols such as Standard Interface for Multiple Platform Link Evaluation (SIMPLE). The Link 16 standard defines five fidelity levels ranging from pure message exchange only to sophisticated Link 16 network modelling including Return Trip Timing messages, Net Entry and Exit, Actual versus Perceived location and encryption methods.</p> <p>The three parts of the standard describe Link 16 network simulation using DIS (including some extensions), Link 16 network simulation using HLA, and a Base Object Model (BOM) as a general modeling approach to Link 16 network modeling. The DIS-specific part of the Link 16 standard in more detail explains the usage of DIS Transmitter and Signal Protocol Data Units (PDUs). High Level Architecture/Real-time Platform Reference (RPR)-FOM based simulations also will be able to simulate Link 16 networks by incorporating the corresponding FOM extensions described by the Link 16 standard into their FOM/SOM. This is easily accomplished using the BOM defined in the appendix of the Link 16 standard.</p>
Technical Maturity	Current. In use by the U.S. Air Force, Navy, and Marines for distributed simulation training. Product Support Group at SISO established.
Type	Information Exchange Data Model
Availability	On the SISO website.
Access	http://www.sisostds.org/
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Tactical Data Link, LINK 16
Applicability	There are immediate and overdue operational requirements for existing military simulations to exchange Link 16 data using a single interoperability method (i.e., DIS or HLA) instead of implementing additional protocols like SIMPLE. Information on implementation: In use in NATO and partner countries.
SDO Periodic Review Date	
Information on Implementation	
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	This standard applies only to Link 16/JTIDS/MIDS. It does not address Link 16 over SATCOM.
Cost	

Table C-15 Military Scenario Definition Language (MSDL)

Metadata Element	Metadata Element Description
Title	Military Scenario Definition Language (MSDL).
Identifier	SISO-STD-007-2008.
Version	Version 1 (reaffirmed 11 May 2015)
SDO	SISO
Abstract	The Military Scenario Definition Language (MSDL) is intended to provide a standard initialization mechanism for loading Military Scenarios independent of the application generating or using the scenario. Standard MSDL is defined utilizing an XML schema, thus enabling exchange of all or part of scenarios between, for example, C2 planning applications, simulations, and scenario development applications. XML-based scenario representations can readily be checked for conformance against the standard's schema. The scope of MSDL is bounded by the situation, defined at one instant in time, combined with the course of action about to be taken in context to that situation. The intent is for MSDL to include that information which is either core or common to the situation and course of action (COA) of a military scenario. Definition of COA falls under the scope of the Coalition Battle Management Language (C-BML). The development of a second generation of standards – C2SIM, unifying MSDL and C-BML, is being undertaken by a single SISO C2SIM PDG.
Technical Maturity	Current. The MSDL Standard evolved from a common scenario format definition initiated by the USA OneSAF Program in 2001. The initial scenario format as proposed by OneSAF was matured and enhanced through additional US and international involvement as part of the SISO standards development process that resulted in a ratified MSDL standard in Oct 2008. MSDL version 1 is an official SISO standard – approved 14 Oct 2008 and reaffirmed 11 May 2015. MSDL version 2 (C2SIM Initialize) is being developed under the auspices of the C2SIM PDG.
Type	Conceptual Modeling and Scenarios
Availability	Via SISO web site.
Access	http://www.sisostds.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Scenario, Simulation, C-BML
Applicability	MSDL provides the M&S community with the ability to create military scenarios that can be shared and reused among a variety of simulations. Furthermore, MSDL provides a mechanism for reusing military scenarios between independent simulations and federated simulations. <ul style="list-style-type: none"> - Facilitation of interoperability for multiple military simulation products. - Real-world scenario data capture (e.g., C4I) easily ported to military simulations. - Easier comparison of military simulation products using the same initial conditions. - Enables third-party products for military scenario design.
SDO Periodic Review Date	
Information on Implementation	User experience across NATO MSG-145 nations in support of standards-based C2 and simulation interoperation as well as the USA OneSAF community.
Implementation Guidance	
Implementation Training	

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Metadata Element	Metadata Element Description
Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	Mainly targeted to land operations; needs to be generalized to joint operations.
Cost	

Table C-16 NATO Education and Training Network (NETN) Federation Architecture and FOM Design (FAFD)

Metadata Element	Metadata Element Description
Title	NATO Education and Training Network (NETN) Federation Architecture and FOM Design (FAFD)
Identifier	AMSP-04
Version	v2.0
SDO	NATO
Abstract	<p>The purpose of NETN Federation Architecture and FOM Design Document (FAFD) is to provide a common reference federation agreements document (FAD) for all federations in the NATO Education and Training Network (NETN). Agreements that are common to all NETN-based federations are specified in this document. Principles and format for information exchange between federates in a NETN-based federation are defined in the FAD. STANAG 4603 (HLA) is used and part of the federation agreements are provided as HLA Federation Object Model (FOM) modules.</p> <p>The NETN FAFD is intended to be used as a template and/or reference when developing federation-specific agreements. In any specific federation more detailed and other types of agreements are almost always required. This reference agreement document is not intended to replace the need for developing federation-specific agreements.</p> <p>This version of the NETN Reference FAD was developed by NATO Modelling and Simulation Group (NMSG) Task Group MSG-106 SPHINX. This task group was initiated to continue the work of MSG-068 and supporting the ACT with M&S recommendations for establishing a NATO-wide network for education and training (NETN). A technical subgroup of MSG-106, Federation Agreements and FOM Design (FAFD) subgroup was created with representatives from the participating NATO and partner nations. This group represented a broad community of practice with respect to federation architecture and design. Major systems, federations and training networks were represented in the FAFD group. The input provided and the harmonization of federation architecture and design agreements form the basis of this document.</p> <p>Key modules included in the NETN FAFD v2.0 are:</p> <ul style="list-style-type: none"> - RPR FOM v2.0 (Final) - RPR FOM v2.0 Extensions for representing platforms and aggregates - Enhanced Logistics modelling using Service Consumer-Provider Patterns - CBRN modelling - Multi-Resolution-Modelling (Aggregation/Disaggregation) - Transfer of Modelling Responsibilities (TMR) - Simulation-C2 using C-BML and Simulator Instruction Modules - Extensions of MSDL to support initial allocation of modelling responsibilities
Technical Maturity	<p>Current. The NETN FAFD has been used in experimentation (MSG-068 Final Experiment, SEESIM 12 NTF Experiment) and in exercises (Viking 11 and Viking 14). The technical maturity is strong and proven. Maintenance of NETN FAFD v2.0 is conducted by MSG-134 on behalf of MS3. User feedback and proposals for new modules are received through CSO and managed by MSG-134. AMSP-04 is in the process to be released by NSO as STANREC 4800.</p>

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Metadata Element	Metadata Element Description
Type	Information Exchange Data Model
Availability	The NETN FAFD v2.0 is under custodianship of NATO Modelling and Simulation Group M&S Standards Subgroup (NMSG MS3) and is currently in the process of becoming AMSP-04 and covered by STANREC 4800.
Access	Current version to be published on CSO website.
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Federation, Architecture, Distributed, Simulation
Applicability	The NETN FAFD is intended as a reference document for creating federation-specific agreements on information exchange and simulation interoperability. The FOM modules described in the FAFD can be extended and complemented with additional modules.
SDO Periodic Review Date	
Information on Implementation	The NETN FAFD has been used in experimentation (MSG-068 Final Experiment, SEESIM 12 NTF Experiment) and in exercises (Viking 11 and Viking 14). Extensive use of NETN FAFD is planned for exercise Viking 18 to federate simulation and C2 systems originating from NATO and Partner nations including USA, SWE, FRA, NLD, DNK. It has also been used extensively in various research activities in SWE and NLD. The technical maturity is strong and proven.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	The standard does not cover all aspects of federated simulation interoperability and the set of modules represent the prioritization made by MSG-068 and MSG-106 when developing this version. The standard is extensible and will incrementally include additional modules.
Cost	

Table C-17 OpenFlight Scene Description Database Specification ®

Metadata Element	Metadata Element Description
Title	OpenFlight Scene Description Database Specification ®
Identifier	OpenFlight ®
Version	16.7
SDO	None – Owned and controlled by Presagis
Abstract	OpenFlight is a widely adopted 3D visual database standard for real-time 3D visualization and has become the “de facto” standard in the visual simulation industry. The OpenFlight format is widely used today in the high-end real-time visual simulation industry as the standard interchange format between different image generation systems and is administered by Presagis. OpenFlight is intended for use in real-time systems and supports variable levels of detail, degrees of freedom, sound, instancing (both within a file and to external files), replication, animation sequences, bounding volumes for real-time culling, scene lighting features, light points and light point strings, transparency, texture mapping, material properties, and many other features. Military visual simulation includes battle simulation, fighter jet flight simulation and tank simulation while visual simulation also includes geospecific terrain for accurate fly through of regions of the planet.
Technical Maturity	Current. OpenFlight is a very mature “de facto” standard although minor revisions occur periodically.
Type	Synthetic Natural Environment / Imagery and 3D Models
Availability	Documentation for the standard and its Application Programming Interface (API) are freely available.
Access	The standard specification can be downloaded for free at: http://s3.amazonaws.com/software.presagis.com/products/creator/OpenFlight%20API/OpenFlight%20Specification/openflight16-7.pdf?AWSAccessKeyId=AKIAIFF4NQXNFLJAHMQ&Expires=1614988800&Signature=AeP5AKSbOgIU%2FzumF1ziPj7Wg3s%3D The OpenFlight API can be downloaded for free at: http://www.presagis.com/products_services/products/modeling-simulation/free_tools/openflight_api/ .
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	3D visualization format, Presagis, real-time visualization, OpenFlight, visualization database, 3D geometry model, interchange format
Applicability	The actual specification is of most use to software developers but it is also of interest to model developers (visual artists) as it determines what visual effects can be modelled (e.g. transparency) and how they are represented.
SDO Periodic Review Date	
Information on Implementation	The standard is used in a very large number of end-user applications (e.g., flight simulators) and in software development tools from Presagis and other companies. Many major commercial businesses have incorporated OpenFlight in their products.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	OpenFlight is owned and controlled by Presagis and the standard or its open source availability may change at any time. Although the

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Metadata Element	Metadata Element Description
	OpenFlight file format allows for vendor-specific data field additions, some modelling and simulation tools may not fully support vendor specific additions to the file format. It is protected under the copyright and trademark laws of the United States of America.
Cost	

Table C-18 Standard for Real-time Platform-level Reference Federation Object Model (RPR FOM)

Metadata Element	Metadata Element Description
Title	Standard for Real-time Platform-level Reference Federation Object Model (RPR FOM).
Identifier	SISO-STD-001.1-2015.
Version	2
SDO	SISO
Abstract	<p>While the HLA Standards dictate how federates exchange data, it is a Federation Object Model (FOM) that dictates what data is being exchanged in a particular federation. HLA does not mandate the use of any particular FOM, however, several "reference FOMs" have been developed to promote a-priori interoperability. That is, in order to communicate, a set of federates must agree on a common FOM (among other things), and reference FOMs provide ready-made FOMs that are supported by a wide variety of tools and federates. Reference FOMs can be used as is, or can be extended to add new simulation concepts that are specific to a particular federation or simulation domain.</p> <p>The RPR FOM was developed by a SISO Product Development Group (PDG). Its goal was not to just implement the DIS Protocol Data Unit structures within HLA object and interaction classes, but rather to provide an intelligent translation of the concepts used in DIS to an HLA environment.</p> <p>The Real-time Platform Reference Federation Object Model 2.0 (RPR FOM 2.0) defines a hierarchy of object and interaction classes for the HLA that provides the capabilities defined in IEEE Std 1278.1™-1995, IEEE Standard for Distributed Interactive Simulation — Application Protocols, and its supplement, IEEE Std 1278.1a™-1998, IEEE Standard for Distributed Interactive Simulation — Application Protocols. SISO-STD-001-2015, Standard for Guidance, Rationale, and Interoperability Modalities for the Real-time Platform Reference Federation Object Model encapsulates guidance in the use of RPR FOM 2.0. It provides descriptions of FOM classes and datatypes and the relationship between the DIS- and the HLA-based RPR FOM, as well as rules for accomplishing specific distributed simulation tasks.</p>
Technical Maturity	Current. RPR FOM 2.0 is based on the IEEE 1278.1-1995 version of the DIS Standard and became a SISO standard in 1999. It corresponds to the version US DoD 1.3 version of HLA. RPR FOM 2.0 corresponds to the IEEE 1516 version of HLA.
Type	Information Exchange Data Model
Availability	Via SISO web site
Access	www.sisostds.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Distributed, Simulation, HLA
Applicability	Enables federations of real-time, platform-based simulations, typically allowing DIS users achieve HLA compliance.
SDO Periodic Review Date	
Information on Implementation	In use in many HLA federations.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature	

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Metadata Element	Metadata Element Description
References	
Limitations	Mainly targeted to entity-level simulations. Not suitable to be used at operation level.
Cost	

Table C-19 SEDRIS - Part 1: Functional Specification

Metadata Element	Metadata Element Description
Title	SEDRIS - Part 1: Functional Specification
Identifier	ISO/IEC 18023-1:2006(E), Amd: 1:2012
Version	2006 (year of publication)
SDO	International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) Joint Technical Committee 1 (ISO/IECJTC 1) Sub-Committee 24. (SC 24)
Abstract	<p>ISO/IEC 18023-1:2005 addresses the concepts, syntax and semantics for the representation and interchange of environmental data. It specifies:</p> <ul style="list-style-type: none"> - a data representation model for expressing environmental data; - specifications of the data types and classes that together constitute the data representation model; and - an application program interface that supports the storage and retrieval of environmental data using the data representation model. <p>ISO/IEC 18023-1:2005 also specifies topological, rule-based, and other constraints that ensure appropriate data can be available for applications that rely on automatically generated behaviors when interacting with environmental data.</p>
Technical Maturity	Current.
Type	Synthetic Natural Environment: General, Interchange of Environmental Data
Availability	The standard can be accessed on the website at http://iso.org
Access	http://standards.sedris.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Data Interchange, Environmental Data, Geospatial Data, M&S, Modelling, Representations, SEDRIS, Simulation, Synthetic Environment Data Representation Interchange Specification, Virtual Environment
Applicability	SEDRIS (ISO/IEC 18023) may be applied to the representation of any environmental data including: (a) terrain, (b) ocean, (c) atmosphere, and (d) space.
SDO Periodic Review Date	
Information on Implementation	Used widely in the USA, most frequently by ground forces. Some use in other nations (France, for example).
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	None identified
Cost	

Table C-20 SEDRIS - Part 2: Abstract transmittal format (ATF)

Metadata Element	Metadata Element Description
Title	SEDRIS - Part 2: Abstract transmittal format (ATF)
Identifier	ISO/IEC 18023-2:2006(E)
Version	2006 (year of publication)
SDO	International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) Joint Technical Committee 1 (ISO/IECJTC 1) Sub-Committee 24. (SC 24)
Abstract	ISO/IEC 18023-2 specifies the abstract syntax of a SEDRIS transmittal. Actual encodings (e.g., binary encoding) are specified in other parts of ISO/IEC 18023.
Technical Maturity	Current.
Type	Synthetic Natural Environment: General, Interchange of Environmental Data
Availability	The standard can be accessed on the website at http://iso.org
Access	http://standards.sedris.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Data Interchange, Environmental Data, Geospatial Data, M&S, Modeling, Representations, SEDRIS, Simulation, Synthetic Environment Data Representation Interchange Specification, Virtual Environment
Applicability	SEDRIS (ISO/IEC 18023) may be applied to the representation of any environmental data including: (a) terrain, (b) ocean, (c) atmosphere, and (d) space.
SDO Periodic Review Date	
Information on Implementation	Used widely in the USA, most frequently by ground forces. Some use in other nations (France, for example).
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	None identified
Cost	

Table C-21 SEDRIS - Part 3: Transmittal Format Binary Encoding

Metadata Element	Metadata Element Description
Title	SEDRIS - Part 3: Transmittal Format Binary Encoding
Identifier	ISO/IEC 18023-3:2006(E), Amd: 1:2012
Version	2006 (year of publication)
SDO	International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) Joint Technical Committee 1 (ISO/IECJTC 1) Sub-Committee 24. (SC 24)
Abstract	SEDRIS Transmittal Binary Encoding defines a binary encoding technique that allows encoding DRM objects specified in ISO/IEC 18023-1 according to the abstract syntax specified in ISO/IEC 18023-2. The name of this binary encoding is SEDRIS Transmittal Format (STF).
Technical Maturity	Current.
Type	Synthetic Natural Environment: General, Interchange of Environmental Data
Availability	The standard can be accessed on the website at http://iso.org
Access	http://standards.sedris.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Data Interchange, Environmental Data, Geospatial Data, M&S, Modelling, Representations, SEDRIS, Simulation, Synthetic Environment Data Representation Interchange Specification, Virtual Environment
Applicability	SEDRIS (ISO/IEC 18023) may be applied to the representation of any environmental data including: (a) terrain, (b) ocean, (c) atmosphere, and (d) space.
SDO Periodic Review Date	
Information on Implementation	Used widely in the USA, most frequently by ground forces. Some use in other nations (France, for example).
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	None identified
Cost	

Table C-22 SEDRIS Language Bindings - Part 4: C

Metadata Element	Metadata Element Description
Title	SEDRIS Language Bindings - Part 4: C
Identifier	ISO/IEC 18024-4:2006(E)/Amd 1:2012
Version	2006 (year of publication)
SDO	International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) Joint Technical Committee 1 (ISO/IECJTC 1) Sub-Committee 24. (SC 24)
Abstract	ISO/IEC 18024-4:2006 specifies a language-dependent layer for the C programming language. ISO/IEC 18023-1 specifies a language-independent application program interface (API) for SEDRIS. For integration into a programming language, the SEDRIS API is embedded in a language-dependent layer obeying the particular conventions of that language.
Technical Maturity	Current.
Type	Synthetic Natural Environment: General, Interchange of Environmental Data
Availability	The standard can be accessed on the website at http://iso.org
Access	http://standards.sedris.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Data Interchange, Environmental Data, Geospatial Data, M&S, Modelling, Representations, SEDRIS, Simulation, Synthetic Environment Data Representation Interchange Specification, Virtual Environment
Applicability	SEDRIS (ISO/IEC 18023) may be applied to the representation of any environmental data including: (a) terrain, (b) ocean, (c) atmosphere, and (d) space.
SDO Periodic Review Date	
Information on Implementation	Used widely in the USA, most frequently by ground forces. Some use in other nations (France, for example).
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	None identified
Cost	

Table C-23 Environmental Data Coding Specification (EDCS)

Metadata Element	Metadata Element Description
Title	Environmental Data Coding Specification (EDCS)
Identifier	ISO/IEC 18025:2014(E)
Version	2014 (year of publication)
SDO	International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) Joint Technical Committee 1 (ISO/IECJTC 1) Sub-Committee 24. (SC 24)
Abstract	EDCS specifies objects used to model environmental concepts. EDCS includes a collection of nine dictionaries that define environmental concepts, objects, attributes, and quantitative measures of objects. EDCS supports the encoding and communication of qualitative and quantitative information associated with physical environments, both real and virtual. This is accomplished by specifying nine EDCS dictionaries of environmental concepts and the EDCS application program interface. EDCS specifies labels and codes and environmental phenomenon to provide a standard way of identifying concepts.
Technical Maturity	Current.
Type	Synthetic Natural Environment: General, Interchange of Environmental Data
Availability	The standard can be accessed on the website at http://iso.org
Access	http://standards.sedris.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Data Interchange, Environmental Data, Geospatial Data, M&S, Modelling, Representations, SEDRIS, Simulation, Synthetic Environment Data Representation Interchange Specification, Virtual Environment
Applicability	SEDRIS (ISO/IEC 18023) may be applied to the representation of any environmental data including: (a) terrain, (b) ocean, (c) atmosphere, and (d) space.
SDO Periodic Review Date	
Information on Implementation	Used widely in the USA, most frequently by ground forces. Some use in other nations (France, for example).
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	None identified
Cost	

Table C-24 Environmental Data Coding Specification (EDCS) language bindings - Part 4: C

Metadata Element	Metadata Element Description
Title	Environmental Data Coding Specification (EDCS) language bindings - Part 4: C
Identifier	ISO/IEC 18041-4:2016(E)
Version	2007 (year of publication)
SDO	International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) Joint Technical Committee 1 (ISO/IECJTC 1) Sub-Committee 24. (SC 24)
Abstract	ISO/IEC 18041-4:2007 specifies the binding of the application programming interface (API) defined in ISO/IEC 18025 to the C programming language. The Environmental Data Coding Specification (EDCS) is a mapping between data and meaning. Data in a system may need to be identified as to purpose, metric and usage. This specification defines a standard set of terms for providing this information. ISO/IEC 18041-4:2007 defines a standard binding for the C computer programming language.
Technical Maturity	Current.
Type	Synthetic Natural Environment: General, Interchange of Environmental Data
Availability	The standard can be accessed on the website at http://iso.org
Access	http://standards.sedris.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Data Interchange, Environmental Data, Geospatial Data, M&S, Modeling, Representations, SEDRIS, Simulation, Synthetic Environment Data Representation Interchange Specification, Virtual Environment
Applicability	SEDRIS (ISO/IEC 18023) may be applied to the representation of any environmental data including: (a) terrain, (b) ocean, (c) atmosphere, and (d) space.
SDO Periodic Review Date	
Information on Implementation	Used widely in the USA, most frequently by ground forces. Some use in other nations (France, for example).
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	None identified
Cost	

Table C-25 Spatial Reference Model (SRM)

Metadata Element	Metadata Element Description
Title	Spatial Reference Model (SRM)
Identifier	ISO/IEC 18026:2009(E)
Version	2009 (year of publication)
SDO	International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) Joint Technical Committee 1 (ISO/IECJTC 1) Sub-Committee 24. (SC 24)
Abstract	ISO/IEC 18026:2009 specifies the Spatial Reference Model (SRM) defining relevant aspects of spatial positioning and related information processing. The SRM allows precise and unambiguous specification of geometric properties such as position (location), direction, and distance.
Technical Maturity	Current.
Type	Synthetic Natural Environment: General, Interchange of Environmental Data
Availability	The standard can be accessed on the website at http://iso.org
Access	http://standards.sedris.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Data Interchange, Environmental Data, Geospatial Data, M&S, Modeling, Representations, SEDRIS, Simulation, Synthetic Environment Data Representation Interchange Specification, Virtual Environment
Applicability	SEDRIS (ISO/IEC 18023) may be applied to the representation of any environmental data including: (a) terrain, (b) ocean, (c) atmosphere, and (d) space.
SDO Periodic Review Date	
Information on Implementation	Used widely in the USA, most frequently by ground forces. Some use in other nations (France, for example).
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	None identified
Cost	

Table C-26 Spatial Reference Model (SRM) language bindings - Part 4: C

Metadata Element	Metadata Element Description
Title	Spatial Reference Model (SRM) language bindings - Part 4: C
Identifier	ISO/IEC 18042-4:2006(E), Amd 1:2011
Version	2006 (year of publication)
SDO	International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) Joint Technical Committee 1 (ISO/IECJTC 1) Sub-Committee 24. (SC 24)
Abstract	ISO/IEC 18042-4:2005 specifies a language-independent application program interface (API). For integration into a programming language, the Spatial Reference Model (SRM) API is embedded in a language-dependent layer obeying the particular conventions of that language. ISO/IEC 18042-4:2005 specifies such a language-dependent layer for the C language.
Technical Maturity	Current.
Type	Synthetic Natural Environment: General, Interchange of Environmental Data
Availability	The standard can be accessed on the website at http://iso.org
Access	http://standards.sedris.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Data Interchange, Environmental Data, Geospatial Data, M&S, Modeling, Representations, SEDRIS, Simulation, Synthetic Environment Data Representation Interchange Specification, Virtual Environment
Applicability	SEDRIS (ISO/IEC 18023) may be applied to the representation of any environmental data including: (a) terrain, (b) ocean, (c) atmosphere, and (d) space.
SDO Periodic Review Date	
Information on Implementation	Used widely in the USA, most frequently by ground forces. Some use in other nations (France, for example).
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	None identified
Cost	

Table C-27 Standard for UCATT Laser Engagement Interface

Metadata Element	Metadata Element Description
Title	Standard for UCATT Laser Engagement Interface
Identifier	SISO-STD-016-00-2016
Version	Version 1.0, 9 May 2016
SDO	SISO
Abstract	This standard applies to the optical interface primarily used to communicate a simulated weapon engagement from a weapon simulator platform to a target simulator platform. Additionally, the Laser Engagement interface has a secondary use to communicate administrative and other kind of information (i.e., umpire control-gun commands, indoor positioning and player association). The Laser engagement Standard is the first physical implementation of an external interface defined in the UCATT functional Architecture for Live Simulation Training Systems
Technical Maturity	Current. UCATT Laser engagement Standard is based on the optical code OSAG 2.0 standard which is widely used throughout various nations.
Type	Physical interface specification including data definitions
Availability	Via SISO web site
Access	https://www.sisostds.org/ProductsPublications/Standards/SISOStandards.aspx
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Live Simulation & Training, TES, TESS, Laser engagement, Optical Codeset, UCATT, OSAG, AGDUS, STC, SAT
Applicability	Contributes to live simulation interoperability by providing a common Laser standard.
SDO Periodic Review Date	
Information on Implementation	Used in projects in FRA, DEU, USA, GBR, NOR, NLD, SWE, FIN, SVN (potentially some under the name "OSAG 2.0 Standard") Limitations of this Standard: Not known
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	
Cost	

Table C-28 Verification, Validation & Accreditation (VV&A) Recommended Practices Guide (VV&A RPG)

Metadata Element	Metadata Element Description
Title	Verification, Validation & Accreditation (VV&A) Recommended Practices Guide (VV&A RPG)
Identifier	VV&A RPG
Version	RPG 2012
SDO	U.S. Department of Defense
Abstract	<p>The VV&A RPG provides general instructions on how, when, and under what circumstances formal VV&A procedures should be employed. In particular, it:</p> <ul style="list-style-type: none"> - describes the interrelated processes that make up VV&A - defines roles and responsibilities of the participants - identifies special topics associated with VV&A - identifies tools and techniques - provides reference material on related areas. <p>This set of documents also includes an informal discussion of the key concepts of VV&A – the principles, rationale, terminology, and general approach to conducting VV&A for models and simulations. It provides an analogy from everyday life intended to demonstrate the practicality of VV&A, and concludes with a summary of the costs and benefits and an introduction to the remainder of the RPG.</p>
Technical Maturity	Current. Used on dozens of applications in the USA.
Type	M&S Methodology, architectures and Processes: Verification & Validation
Availability	May be accessed freely from the Websites below.
Access	https://vva.msco.mil
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Verification, Validation, Accreditation, Recommended Practices Guide, RPG
Applicability	This guide is applicable to the planning, conduction and documentation of all verification, validation and accreditation of models and simulations. Its recommendations should be tailored to the requirements of the specific M&S application.
SDO Periodic Review Date	
Information on Implementation	Use of the RPG is voluntary but recommended.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	None
Cost	

Table C-29 U.S. Department of Defense Standard Practice, Documentation of Verification, Validation, and Accreditation (VV&A) For Models and Simulations

Metadata Element	Metadata Element Description
Title	U.S. Department of Defense Standard Practice, Documentation Of Verification, Validation, and Accreditation (VV&A) For Models And Simulations
Identifier	MIL-STD-3022
Version	28 January 2008
SDO	U.S. DoD
Abstract	This standard was developed by the US DoD Modelling and Simulation Coordination Office in coordination with the Military Departments. It establishes templates for the four core products of the Modeling and Simulation Verification, Validation, and Accreditation processes. The intent of this standard is to provide consistent documentation that minimizes redundancy and maximizes reuse of information. This promotes a common framework and interfacing capability that can be shared across all Modeling and Simulation programs within the US Department of Defense, other government agencies and allied nations.
Technical Maturity	Emerging. Approved by the US DoD in January 2008.
Type	M&S Methodology, Architectures and Processes: Verification & Validation
Availability	Yes, from US Dept. of Defense MIL-STD-3022.
Access	https://vva.msco.mil
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	Verification, Validation, Accreditation, VV&A, Accreditation Plan, Accreditation Report, V&V Plan, V&V Report
Applicability	This standard is approved for use by all Departments and Agencies of the US Department of Defense.
SDO Periodic Review Date	
Information on Implementation	Not known
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	Not known
Cost	

Table C-30 WebLVC Protocol

Metadata Element	Metadata Element Description
Title	WebLVC Protocol
Identifier	WebLVC
Version	Version 0.8 – January 2020 (emerging standard)
SDO	Simulation Interoperability Standards Organization
Abstract	WebLVC is a protocol for enabling web and mobile applications (typically JavaScript applications running in a web browser) to play in traditional M&S federations (which may be using Distributed Interactive Simulation (DIS), High Level Architecture (HLA), Test and Training Enabling Architecture (TENA), or related protocols and architectures). In a nutshell, WebLVC takes the semantics of DIS or HLA Federation Object Models (FOMs), and represents them using messages in the JSON (JavaScript Object Notation) format, which are typically passed between server and client using WebSockets.
Technical Maturity	Current. The WebLVC Protocol is used by numerous M&S organizations around the world. Currently SISO has a Product Development Group (PDG) working on the WebLVC standard. The SISO draft standard was balloted in 2020, and is in comment resolution as of February 17, 2021.
Type	M&S Interoperability
Availability	Will be publicly available and free to download as with all SISO standards
Access	http://www.sisostds.org
Input Date	February 17, 2021
Last Updated	February 17, 2021
Keywords	LVC, JSON, Distributed, Simulation
Applicability	Applies to anyone who wants to develop web-based applications and achieve interoperability with traditional M&S applications and federations – whether those applications are used for training, experimentation, analysis, or other purposes. The Standard will allow web and mobile applications developed by different organizations to interoperate with each other, and with existing native M&S assets.
SDO Periodic Review Date	
Information on Implementation	Commercial products available and successfully used.
Implementation Guidance	
Implementation Training Resources	
Implementation Vendor Support	
Implementation Literature References	
Limitations	Not known
Cost	

ANNEX D. Crosswalk Matrices of Standards to Acquisition Life Cycle Phase / Technical Activity

ANNEX D contains a series of tables that provide the explicit example of the N (standards) by M (technical activities) matrix of potential application intersections. These intersections are not made explicit by an “X” since these tables represent templates to be used as tools to establish the actual intersections for stakeholder operational vignettes. Stakeholders apply these templates to better align the application of standards specific to each technical activity.

ANNEX D breaks out the crosswalk matrixes by stages Concept, Development, Production, Utilization and Support. The technical activities related the Retirement phase have not been documented at the time of publication for this reference product.

Table D-1 provides a listing of standards that may apply to the acquisition activities of the Concept Stage listed across the top of the table.

Table D-1 Cross Reference of Standards to ISO/IEC Concept Stage Activities

ISO/IEC SYSTEM LIFE CYCLE STAGES		Concept Stage									
DEFENSE ACQUISITION GUIDEBOOK LIFE CYCLE STAGES		Pre-Materiel Solution Analysis				Materiel Solution Analysis					
M&S Artifacts and Standards`	Acquisition Activities	CONOPS Modeling	Cost/Schedule Performance Trades	System Interoperability Discoveries	Portfolio Coverage Analysis	Assess Material Solutions	Estimate Life Cycle Costs	Model CONOPS and Mission Context	Interoperability and Warfighter Integration Analysis	Industrial/Manufacturing Capability Analysis	Supportability and Sustainment Modeling
		001	002	003	004	005	006	007	008	009	010
Rec	Standard										
0001	Base Object Model (BOM)										
0002	Standard for Coalition Battle Management Language (C-BML) Phase 1, Version 1.0.										
0003	Common Data Base										

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

ISO/IEC SYSTEM LIFE CYCLE STAGES		Concept Stage									
DEFENSE ACQUISITION GUIDEBOOK LIFE CYCLE STAGES		Pre-Materiel Solution Analysis				Materiel Solution Analysis					
Acquisition Activities	M&S Artifacts and Standards``	CONOPS Modeling	Cost/Schedule Performance Trades	System Interoperability Discoveries	Portfolio Coverage Analysis	Assess Material Solutions	Estimate Life Cycle Costs	Model CONOPS and Mission Context	Interoperability and Warfighter Integration Analysis	Industrial/Manufacturing Capability Analysis	Supportability and Sustainment Modeling
Rec	Standard	001	002	003	004	005	006	007	008	009	010
0004	Common Image Generator Interface										
0005	IEEE Standard for Distributed Interactive Simulation (DIS)										
0006	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process Multi-Architecture Overlay (DMAO)										
0007	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP)										
0008	Dynamic Link Compatible HLA API Standard for the HLA Interface Specification										
0009	Reference for Enumerations for Simulation Interoperability										
0010	Federation Engineering Agreements Template										

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

ISO/IEC SYSTEM LIFE CYCLE STAGES		Concept Stage										
DEFENSE ACQUISITION GUIDEBOOK LIFE CYCLE STAGES		Pre-Materiel Solution Analysis				Materiel Solution Analysis						
M&S Artifacts and Standards`	Acquisition Activities	CONOPS Modeling	Cost/Schedule Performance Trades	System Interoperability Discoveries	Portfolio Coverage Analysis	Assess Material Solutions	Estimate Life Cycle Costs	Model CONOPS and Mission Context	Interoperability and Warfighter Integration Analysis	Industrial/Manufacturing Capability Analysis	Supportability and Sustainment Modeling	
		Rec	Standard	001	002	003	004	005	006	007	008	009
0011	Guide for Generic Methodology for Verification and Validation (GM-VV) to Support Acceptance of Models, Simulations, and Data.											
0012	IEEE Standard for Modelling and Simulation (M&S): High Level Architecture (HLA)											
0013	Standard for Link 11/11B Simulation											
0014	Standard for LINK 16 Simulations											
0015	Military Scenario Definition Language (MSDL).											
0016	NATO Education and Training Network (NETN) Federation Architecture and FOM Design (FAFD)											
0017	OpenFlight Scene Description Database Specification ®											
0018	Standard for Real-time Platform-level Reference Federation Object Model (RPR FOM).											
0019	SEDRIS - Part 1: Functional Specification											
0020	SEDRIS - Part 2: Abstract transmittal format (ATF)											

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

ISO/IEC SYSTEM LIFE CYCLE STAGES		Concept Stage										
DEFENSE ACQUISITION GUIDEBOOK LIFE CYCLE STAGES		Pre-Materiel Solution Analysis				Materiel Solution Analysis						
M&S Artifacts and Standards``	Acquisition Activities	CONOPS Modeling	Cost/Schedule Performance Trades	System Interoperability Discoveries	Portfolio Coverage Analysis	Assess Material Solutions	Estimate Life Cycle Costs	Model CONOPS and Mission Context	Interoperability and Warfighter Integration Analysis	Industrial/Manufacturing Capability Analysis	Supportability and Sustainment Modeling	
		Rec	Standard	001	002	003	004	005	006	007	008	009
0021	SEDRIS - Part 3: Transmittal Format Binary Encoding											
0022	SEDRIS Language Bindings - Part 4: C											
0023	Environmental Data Coding Specification (EDCS)											
0024	Environmental Data Coding Specification (EDCS) language bindings - Part 4: C											
0025	Spatial Reference Model (SRM)											
0026	Spatial Reference Model (SRM) language bindings - Part 4: C											
0027	Standard for UCATT Laser Engagement Interface											
0028	Verification, Validation & Accreditation (VV&A) Recommended Practices Guide (VV&A RPG)											
0029	U.S. Department of Defense Standard Practice, Documentation Of Verification, Validation, and Accreditation (VV&A) For Models And Simulations											
0030	WebLVC Protocol											

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Table D-2 provides a listing of standards that may apply to the acquisition activities of the Development stage listed across the top of the table.

Table D-2 Cross Reference of Standards to ISO/IEC Development Stage Activities

ISO/IEC SYSTEM LIFE CYCLE STAGES		Development Stage																	
DEFENSE ACQUISITION GUIDEBOOK LIFE CYCLE STAGES		Technology Maturity and Risk Reduction									Engineering and Manufacturing Development								
M&S Artifacts and Standards	Acquisition Activities	Trade Studies	System Threat Integration	Model Environment and Demonstrate Technology	Interoperability and Supportability Analysis	Operational Suitability and Affordability	Industrial/Manufacturing Capability and Readiness Assessment	Estimate Manpower/Cost	Model System to Performance Specifications	Test and Evaluation Planning	Human Interface Prototyping	Ensure Life Cycle Sustainability	Reduce Logistics Footprint	Survivability Analysis	Human Systems Integration	Design for Producibility	Demonstrate System Safety	Verify Functionality and Performance to Specifications and/or needs	Manpower Estimates
		011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028
Rec	Standard																		
0001	Base Object Model (BOM)																		
0002	Standard for Coalition Battle Management Language (C-BML) Phase 1, Version 1.0.																		
0003	Common Data Base																		
0004	Common Image Generator Interface																		
0005	IEEE Standard for Distributed Interactive Simulation (DIS)																		
0006	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process Multi-Architecture Overlay (DMAO)																		
0007	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP)																		
0008	Dynamic Link Compatible HLA API Standard for the HLA Interface Specification																		
0009	Reference for Enumerations for Simulation Interoperability																		
0010	Federation Engineering Agreements Template																		
0011	Guide for Generic Methodology for Verification and Validation (GM-VV) to Support Acceptance of Models, Simulations, and Data.																		
0012	IEEE Standard for Modelling and Simulation (M&S): High Level Architecture (HLA)																		
0013	Standard for Link 11/11B Simulation																		
0014	Standard for LINK 16 Simulations																		

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

ISO/IEC SYSTEM LIFE CYCLE STAGES		Development Stage																	
DEFENSE ACQUISITION GUIDEBOOK LIFE CYCLE STAGES		Technology Maturity and Risk Reduction										Engineering and Manufacturing Development							
M&S Artifacts and Standards	Acquisition Activities	Trade Studies	System Threat Integration	Model Environment and Demonstrate Technology	Interoperability and Supportability Analysis	Operational Suitability and Affordability	Industrial/Manufacturing Capability and Readiness Assessment	Estimate Manpower/Cost	Model System to Performance Specifications	Test and Evaluation Planning	Human Interface Prototyping	Ensure Life Cycle Sustainability	Reduce Logistics Footprint	Survivability Analysis	Human Systems Integration	Design for Producibility	Demonstrate System Safety	Verify Functionality and Performance to Specifications and/or needs	Manpower Estimates
		011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028
Rec	Standard																		
0015	Military Scenario Definition Language (MSDL).																		
0016	NATO Education and Training Network (NETN) Federation Architecture and FOM Design (FAFD)																		
0017	OpenFlight Scene Description Database Specification ®																		
0018	Standard for Real-time Platform-level Reference Federation Object Model (RPR FOM).																		
0019	SEDRIS - Part 1: Functional Specification																		
0020	SEDRIS - Part 2: Abstract transmittal format (ATF)																		
0021	SEDRIS - Part 3: Transmittal Format Binary Encoding																		
0022	SEDRIS Language Bindings - Part 4: C																		
0023	Environmental Data Coding Specification (EDCS)																		
0024	Environmental Data Coding Specification (EDCS) language bindings - Part 4: C																		
0025	Spatial Reference Model (SRM)																		
0026	Spatial Reference Model (SRM) language bindings - Part 4: C																		
0027	Standard for UCATT Laser Engagement Interface																		
0028	Verification, Validation & Accreditation (VV&A) Recommended Practices Guide (VV&A RPG)																		
0029	U.S. Department of Defense Standard Practice, Documentation Of Verification, Validation, and Accreditation (VV&A) For Models And Simulations																		
0030	WebLVC Protocol																		

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Table D-3 provides a listing of standards that may apply to the acquisition activities of the Production Stage listed across the top of the table.

Table D-3 Cross Reference of Standards to ISO/IEC Production Stage Activities

ISO/IEC SYSTEM LIFE CYCLE STAGES		Production Stage							
DEFENSE ACQUISITION GUIDEBOOK LIFE CYCLE STAGES		Production and Deployment							
Acquisition Activities M&S Artifacts and Standards		Industrial/Manufacturing Readiness Assessment	Environment, Safety and Occupational Health (ESOH) Models	General Equipment Valuation	Corrosion Presentation and Control	Refine LCSP	Production Qualification Testing	Verify and Validate Production Configuration	Economic Analysis
		029	030	031	032	033	034	035	036
Rec	Standard								
0001	Base Object Model (BOM)								
0002	Standard for Coalition Battle Management Language (C-BML) Phase 1, Version 1.0.								
0003	Common Data Base								
0004	Common Image Generator Interface								
0005	IEEE Standard for Distributed Interactive Simulation (DIS)								
0006	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process Multi-Architecture Overlay (DMAO)								
0007	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP)								
0008	Dynamic Link Compatible HLA API Standard for the HLA Interface Specification								
0009	Reference for Enumerations for Simulation Interoperability								
0010	Federation Engineering Agreements Template								
0011	Guide for Generic Methodology for Verification and Validation (GM-VV) to Support Acceptance of Models, Simulations, and Data.								
0012	IEEE Standard for Modelling and Simulation (M&S): High Level Architecture (HLA)								
0013	Standard for Link 11/11B Simulation								
0014	Standard for LINK 16 Simulations								
0015	Military Scenario Definition Language (MSDL).								
0016	NATO Education and Training Network (NETN) Federation Architecture and FOM Design (FAFD)								
0017	OpenFlight Scene Description Database Specification *								
0018	Standard for Real-time Platform-level Reference Federation Object Model (RPR FOM).								
0019	SEDRIS - Part 1: Functional Specification								

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

ISO/IEC SYSTEM LIFE CYCLE STAGES		Production Stage							
DEFENSE ACQUISITION GUIDEBOOK LIFE CYCLE STAGES		Production and Deployment							
Acquisition Activities M&S Artifacts and Standards		Industrial/Manufacturing Readiness Assessment	Environment, Safety and Occupational Health (ESOH) Models	General Equipment Valuation	Corrosion Presentation and Control	Refine LCSP	Production Qualification Testing	Verify and Validate Production Configuration	Economic Analysis
		029	030	031	032	033	034	035	036
Rec	Standard								
0020	SEDRIS - Part 2: Abstract transmittal format (ATF)								
0021	SEDRIS - Part 3: Transmittal Format Binary Encoding								
0022	SEDRIS Language Bindings - Part 4: C								
0023	Environmental Data Coding Specification (EDCS)								
0024	Environmental Data Coding Specification (EDCS) language bindings - Part 4: C								
0025	Spatial Reference Model (SRM)								
0026	Spatial Reference Model (SRM) language bindings - Part 4: C								
0027	Standard for UCATT Laser Engagement Interface								
0028	Verification, Validation & Accreditation (VV&A) Recommended Practices Guide (VV&A RPG)								
0029	U.S. Department of Defense Standard Practice, Documentation Of Verification, Validation, and Accreditation (VV&A) For Models And Simulations								
0030	WebLVC Protocol								

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

Table D-4 provides a listing of standards that may apply to the acquisition activities of the Utilization and Support Stage listed across the top of the table.

Table D-4 Cross Reference of Standards to ISO/IEC Utilization and Support Stage Activities

ISO/IEC SYSTEM LIFE CYCLE STAGES		Utilization and Support							
DEFENSE ACQUISITION GUIDEBOOK LIFE CYCLE STAGES		Operations and Support							
Acquisition Activities		Training	Determine System Risk / Hazard Severity	ECP Impact Analysis	Supply Chain Management	Monitor Performance and Adjust Product Support	Supportability Assessment	Disposal Planning	Validate Failures and Determine Root Causes
Rec	Standard								
0001	Base Object Model (BOM)								
0002	Standard for Coalition Battle Management Language (C-BML) Phase 1, Version 1.0.								
0003	Common Data Base								
0004	Common Image Generator Interface								
0005	IEEE Standard for Distributed Interactive Simulation (DIS)								
0006	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process Multi-Architecture Overlay (DMAO)								
0007	IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP)								
0008	Dynamic Link Compatible HLA API Standard for the HLA Interface Specification								
0009	Reference for Enumerations for Simulation Interoperability								
0010	Federation Engineering Agreements Template								
0011	Guide for Generic Methodology for Verification and Validation (GM-VV) to Support Acceptance of Models, Simulations, and Data.								
0012	IEEE Standard for Modelling and Simulation (M&S): High Level Architecture (HLA)								
0013	Standard for Link 11/11B Simulation								
0014	Standard for LINK 16 Simulations								
0015	Military Scenario Definition Language (MSDL).								
0016	NATO Education and Training Network (NETN) Federation Architecture and FOM Design (FAFD)								
0017	OpenFlight Scene Description Database Specification *								
0018	Standard for Real-time Platform-level Reference Federation Object Model (RPR FOM).								

SISO-REF-066-2021
Reference for A Standards Profile for the Use of Modeling and Simulation
in Support of Acquisition Activities, Volume 2

ISO/IEC SYSTEM LIFE CYCLE STAGES		Utilization and Support								
DEFENSE ACQUISITION GUIDEBOOK LIFE CYCLE STAGES		Operations and Support								
Acquisition Activities M&S Artifacts and Standards		Training	Determine System Risk / Hazard Severity	ECP Impact Analysis	Supply Chain Management	Monitor Performance and Adjust Product Support	Supportability Assessment	Disposal Planning	Validate Failures and Determine Root Causes	
		Rec	Standard	037	038	039	040	041	042	043
0019	SEDRIS - Part 1: Functional Specification									
0020	SEDRIS - Part 2: Abstract transmittal format (ATF)									
0021	SEDRIS - Part 3: Transmittal Format Binary Encoding									
0022	SEDRIS Language Bindings - Part 4: C									
0023	Environmental Data Coding Specification (EDCS)									
0024	Environmental Data Coding Specification (EDCS) language bindings - Part 4: C									
0025	Spatial Reference Model (SRM)									
0026	Spatial Reference Model (SRM) language bindings - Part 4: C									
0027	Standard for UCATT Laser Engagement Interface									
0028	Verification, Validation & Accreditation (VV&A) Recommended Practices Guide (VV&A RPG)									
0029	U.S. Department of Defense Standard Practice, Documentation Of Verification, Validation, and Accreditation (VV&A) For Models And Simulations									
0030	WebLVC Protocol									

ANNEX E. Standards Development Organizations

The following Standards Development Organizations are those of interest to Modeling and Simulation. This list and associated descriptions is adopted from the NATO Modeling and Simulations Standards. [A8]

International Organization for Standardization (ISO)

The International Organization for Standardization, widely known as ISO, is an international standard-setting body that promulgates world-wide proprietary industrial and commercial standards. ISO is composed of representatives from various national standards organizations, and acts as a consortium with strong links to member governments. Founded on 23 February 1947, the organization, headquartered in Geneva, Switzerland, has 157 national members out of the 195 total countries in the world. While ISO defines itself as a non-governmental organization, its ability to set standards that often become law, either through treaties or national standards, makes it more powerful than most non-governmental organizations. ISO standards are developed by technical committees comprising experts from the industrial, technical and business sectors which have asked for the standards, and which subsequently put them to use. Many groups wish to contribute to the process of the development of International Standards, because they are affected by those standards. They participate in the technical work of ISO through national delegations appointed by the member bodies of ISO or through liaison organizations of international or broadly-based groups. Since 1947, the ISO has published more than 16,000 International Standards. The ISO's work program ranges from standards for traditional activities, such as agriculture and construction, through mechanical engineering, to medical devices, to the newest information technology developments, such as the digital coding of audio-visual signals for multimedia applications. ISO is officially recognized by NATO as an SDO, under a Technical Cooperation Agreement (TCA) signed by NSA. With the exception of a small number of isolated standards, ISO standards are normally not available free of charge, but for a purchase fee. The official URL for access to ISO Standards is www.iso.org.

The Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA)

The IEEE is one of the leading standards development organizations in the world. IEEE performs its standards development and maintenance functions through the IEEE Standards Association (IEEE-SA). IEEE standards affect modeling and simulation as well as a wide range of industries including: power and energy, biomedical and healthcare, Information Technology (IT), telecommunications, transportation, nanotechnology, information assurance, and many more. Individuals, including IEEE members of any grade, IEEE Society affiliates, or non-IEEE members are eligible for IEEE-SA membership. Corporate Membership is designed for corporations, government agencies, trade associations, user groups, universities and other standards developing organizations that want to actively participate in standards development. All IEEE members (individual or corporate) are entitled to ballot on an unlimited number of proposed standards projects. Non-members of the IEEE can participate in the balloting process by paying a "balloting fee". Currently, IEEE collection of standards consists of more than 2,100 IEEE standards, including drafts. At the present time, IEEE is officially recognized by NATO. IEEE Standards Association ("IEEE-SA") offers copyright permission, on a non-discriminatory basis, for any and all uses. IEEE-SA associated materials include IEEE standards and drafts, IEEE-SA policies, procedures, by-laws and publications associated with the IEEE Standards Information Network ("IEEE-SIN"). The payment of royalty may be required, depending on the amount of material to be utilized and/or the intended use of those materials. The official URL for access to IEEE Standards is <http://standards.ieee.org/>.

The World Wide Web Consortium (W3C)

The W3C is an international consortium where member organizations, a full-time staff, and the public work together to develop Web standards. W3C's mission is to lead the World Wide Web to its full potential by developing protocols and guidelines that ensure long-term growth for the Web. W3C develops Web Standards and Guidelines. W3C primarily pursues its mission through the creation of Web standards and

guidelines. W3C also engages in education and outreach, develops software, and serves as an open forum for discussion about the Web. There are many other organizations developing standards for the Internet or the Web in general, and in some cases, their activities may overlap with W3C activities. To help coordinate the development of the Web, W3C engages in liaisons with numerous organizations after careful consideration of the costs and benefits. The Consortium is governed by its membership, which comprises about 400 organizations. Members include only businesses, non-profit organizations, universities, and governmental entities. There is no provision for individual membership. Since 1994, the W3C has published more than 90 such standards, called W3C Recommendations. The W3C is not officially recognized by NATO. Access to W3C Recommendations is under a royalty-free patent license, allowing anyone to implement them. The URL for W3C recommendations is www.w3.org.

The Simulation Interoperability Standards Organization (SISO)

SISO is an international organization dedicated to the promotion of modeling and simulation interoperability and reuse for the benefit of a broad range of Modeling and Simulation communities. SISO's Standards Activity Committee develops and supports simulation interoperability standards, both independently and in conjunction with other organizations. SISO is a Category C Liaison Organization with ISO/IEC (JTC 1) for the development of standards for the representation and interchange of data regarding Synthetic Environment Data Representation and Interchange Specification (SEDRIS). Each person who registers for and attends a Simulation Innovation Workshop (SIW) is considered a member of SISO, effective as of the date of such registration. SISO membership automatically expires at the end of any calendar year in which a member fails to attend at least one SISO Workshop. SISO membership exceeds 1400 individuals from 28 countries, representing over 400 organizations. Currently, more than 35 SISO Standards and Reference products have been developed and approved. SISO is officially recognized by NATO as an SDO, under a TCA signed by the NMSG in 2007. SISO standards are normally free of charge. The official website for SISO standards is www.sisostds.org.

The Object Management Group (OMG).

OMG has been an international, open membership, not-for-profit computer industry consortium since 1989. OMG produces and distributes only specifications – not software. Software products implementing OMG specifications – e.g., MDA (Model Driven Architecture), UML (Unified Modeling Language) or CORBA (Common Object Requesting Broker Architecture) – are available from hundreds of sources including vendor companies and sources of freeware and open-source software, including both OMG members and non-members. Dozens of standards organizations and other consortia maintain liaison relationships with OMG. OMG is an ISO Publicly Available Specifications submitter, able to submit specifications directly into ISO's fast-track adoption process. Any organization may join OMG and participate in standards-setting process. Membership includes over 800 companies from both the computer industry and software-using companies. Half of the OMG member companies are software end-users in over two dozen vertical markets, and the other half represent virtually every large organization in the computer industry and many smaller ones. Most of the organizations that shape enterprise and Internet computing today are represented on the Board of Directors. More than 170 specifications have been formally published. There is no official OMG recognition by NATO so far. All of OMG specifications may be downloaded without charge from OMG website: www.omg.org.

The USA National Institute of Standards and Technology (NIST)

The National Institute of Standards and Technology (NIST) was known as the National Bureau of Standards (NBS) between 1901 and 1988. It is a non-regulatory agency of the United States Department of Commerce. The mission of NIST is to promote U.S.A. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. Two standards published and promoted by NIST are included in the AMSP-01: Integration Definition for Information Modeling (IDEF1X) and Integration Definition for Function Modeling (IDEF0). Standards promoted by NIST are available at their website: <http://ts.nist.gov/Standards/ssd.cfm>.

The USA National Geospatial-Intelligence Agency (NGA)

The NGA and the National System for Geospatial-Intelligence (NSG) are responsible for establishing geospatial intelligence (GEOINT) standards for the United States defense and intelligence communities. GEOINT standards ensure the timely access to relevant and accurate GEOINT data, services, and products regardless of source, exploitation process, or production element. The National Center for Geospatial Intelligence Standards (NCGIS) at NGA and the Geospatial Intelligence Standards Working Group (GWG) provide critical support to this mission. The NGA has issued a new document that provides guidance and direction to develop an overall baseline for common geospatial standards used to share, manipulate, and exploit digital geospatial data. The document, "Geospatial Intelligence Standards: Enabling a Common Vision," (<http://www.nga.mil/NGASiteContent/StaticFiles/OCR/ncgis-eb.pdf>) outlines the standards that will be used in the National System for Geospatial-Intelligence (NSG).

The Open Geospatial Consortium (OGC)

The OGC is an international voluntary consensus standards organization. In the OGC, more than 370 commercial, governmental, non-profit and research organizations worldwide collaborate in an open consensus process encouraging development and implementation of standards for geospatial content and services, GIS data processing and data sharing. Prior to 2004, the organization was known as Open GIS Consortium. Most of the OGC standards are based on a generalized architecture captured in a set of documents collectively called the Abstract Specification, which describes a basic data model for geographic features to be represented. Atop the Abstract Specification is a growing number of specifications, or standards, that have been (or are being) developed to serve specific needs for interoperable location and geospatial technology, including GIS. The OGC is divided into three operational units: The Specification program, the Interoperability Program, and Outreach and Community Adoption. The OGC has a close relationship with ISO/TC 211 (Geographic Information/Geomatics). The OGC abstract specification is being progressively replaced by volumes from the ISO 19100 series under development by this committee. Further, the OGC standards Web Map Service, GML and Simple Features Access are ISO standards. Further information can be found at www.opengeospatial.org.

The North Atlantic Treaty Organization (NATO)

The standardization activity in NATO is complex and covers multiple domains. NATO RTO's NMSG is the Delegated Tasking Authority in the NATO Modeling and Simulations standardization domain. Dedicated NMSG Task Groups were established with the aim to develop NATO standardization documents, e.g., STANAGs and APs. Examples of STANAGs developed by NMSG include STANAG 4603 on HLA, 4662/4663/4664 on SEDRIS. The efforts of several NMSG Task Groups were continued by SISO and resulted in Modeling and Simulations standards (e.g., C-BML, Conceptual Modeling). In the framework established by the NATO Standardization Policy, NMSG will be actively involved in the SISO activities to ensure that the standards developed by SISO meet NATO requirements so they could be adopted by NATO via cover STANAG. More details on the standardization process in NATO are available in the NATO Modeling and Simulations Standards Profile.