The Navy's M&S Standards Development Activities

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ABSTRACT: *Proponents of Modeling and Simulation (M&S) have long recognized the benefits of the common sense application of standards to M&S development and execution. Standards can greatly enhance our ability to reduce costs through reuse and interoperability; improve credibility by establishing a framework for acquiring models, simulations, and data; and provide a common thread for achieving consistency across a spectrum of M&S solutions. The Navy Modeling and Simulation Management Office (OPNAV N6M) is sponsoring a project to promote the use of M&S Standards across the Department of Navy. Their vision is to advocate a common set of standards and best practices to apply to Department of Navy models, simulations, and data; as well as identify supporting protocols, techniques and processes. The purpose of this paper is to provide an overview of the Navy's M&S standards development process and to identify new opportunities to develop and promote M&S Standards across the DoD and industry M&S communities. We will specifically address the project's organizational structure, nomination and evaluation processes, and outreach strategies.*

1. Navy M&S Standards Background

From its inception the Navy Modeling and Simulation (M&S) Standards Project has been driven by the M&S user/developer community. Although the Navy M&S Standards Project supports a wide diversity of M&S users, this paper is focused on users' issues associated with distributed simulation interoperability.

Impetus for a Navy-wide standards initiative was, in large part, derived directly from discussions between the Navy Modeling and Simulation Management Office (NAVMSMO) and the broad Navy M&S community. During these discussions, it became clear that programs were already reaping benefits, both tangible and intangible, from standards (Government and industry, official and *de facto*). While NAVMSMO has always taken an active role in the advancement of standards for M&S, the mandate was clear -- the Navy M&S community wanted NAVMSMO to take a more substantial, proactive role.

NAVMSMO began exploring ways to meet the *standards* needs of the Navy M&S community. They reviewed ongoing standards activities, especially those of the Simulation Interoperability Standards Organization (SISO) and the Army Model and Simulation Office (AMSO) [1 & 2]. This effort culminated in a brainstorming session among subject matter experts representing a wide range of functional interests at the Navy's Acquisition Center of Excellence (ACE) in Washington, D.C. During this meeting, the foundation for the Navy M&S Standards Project was laid.

The project has been underway for several months. NAVMSMO has been working closely with AMSO to coordinate between the Services' standards activities. It is our desire that this bipartisan effort will lead to DoD-wide M&S standards development.

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2. Navy M&S Standards Development Philosophy

2.1 Vision and Objectives

Given the importance of M&S Standards to the Navy M&S community, NAVMSMO has embraced a vision for a standards-based approach for enhancing the value of M&S to the Navy community across the acquisition, training and analysis realms. We fully intend to be guided by fiscal prudence and technical common sense.

The vision of the Navy M&S Standards Project is to promote a common set of standards for the use and reuse of Navy models, simulations and data; as well as the supporting protocols, techniques and processes.

The project's objectives support this vision by encouraging interoperability, reuse and commonality, as well as credibility and consistency. The Navy cannot pursue these objectives in a vacuum -- to do so would violate the objectives themselves. Rather, the Navy M&S Standards Project will work closely with the other Services, SISO, the Defense Modeling and Simulation Office (DMSO), and industry to adopt standards that meet common goals. Existing standards with wide appeal, particularly those embraced by industry, will have sway over new standards development or existing "cottage" standards.

2.2 Scope

DoDD 5000.59-M, the "DoD Modeling and Simulation Glossary" defines a ***standard*** as a "rule, principle or measurement established by authority, custom or general consent as a representation or example" [3]. For the purpose of this effort, types of standards include:

- Communication standards,
- Data standards,
- Recommended practices and
- Commercial / Government standards.

…and include such well known examples as:

- The High Level Architecture (HLA) and
- The Synthetic Environment Data Representation and Interface Specification (SEDRIS).

There are several standards efforts in the DoD community such as the High Level Architecture, the Joint Modeling and Simulation System (JMASS) and the Joint Technical Architecture (JTA). Standards should be applied not only in specific areas of M&S but across Services, organizations and programs. Ultimately, we must all work toward a fully synergized DoD-Wide effort that addresses all types of standards and standards applications.

2.3 Approach

We recognize that well developed processes and methodologies are key to the success of any large-scale effort. Our approach has been to rely upon the best technical experts available to help us develop streamlined processes, objective evaluation criteria and valuable products.

Most of the activity will be executed by volunteer labor. As with any "coalition of the willing", it is of the highest importance to provide added value to participants in the development process. Participants will have the opportunity to build technical relationships with other M&S experts; to learn about emerging technologies and practices; and to have a "say" in the activities of a critical M&S initiative.

Our philosophy therefore reflects a focus on the M&S user's top priorities; an effective organizational infrastructure for standards development; a structured approach for leveraging and/or developing standards; and an outreach strategy to continuously look for collaborative ways to employ standards.

2.4 Guiding Principles

Most useful standards will be:

- Easier to use than to deviate from,
- Widely accepted by the community, both technologically and sociologically and
- Endorsed by appropriate authorities.

Who should ultimately endorse these Navy M&S standards? The clear answer is, "It depends". In some cases, it is "good advice from qualified subject matter experts"; in other cases we expect some of the standards will be outright mandates, approved at the flag or Secretariat level.

3. Standards – The Culture of Change

Standards are not always a welcome change. There are several impediments to the implementation and use of standards. Even when sound technical benefits can be demonstrated, multiple types of impediments can

hinder successful execution of standards-based approaches.

Most prudent software developers and program managers are wary of the unknown. They are required to balance a program's goals and requirements against budgets and schedules. Emerging requirements and mandates are often at odds with these responsibilities. When sponsors, developers or users are saddled with the added responsibility of adhering to a standard, they may soon become fearful of the attendant impact to cost and schedule – and rightly so. This fear can manifest itself in exaggerated compliance cost estimates, administrative and technical roadblocks, and, at its worst, political stonewalling.

This problem is especially prevalent in situations where an otherwise good standard is "mandated" before a sufficient amount of socialization (i.e. wide community review and comment), technical usage and a certain degree of community buy-in is accomplished. Naturally, successful testing of the candidate standard in realistic situations will greatly enhance its acceptance in the community.

Naturally, there are many other impediments to standardization. It's unclear whether or not in all circumstances these are real or perceived – whatever the case, we cannot ignore them. These impediments include:

- Preventing creativity in technical efforts,
- The "Not Invented Here" Philosophy,
- Loss of control over project design and development,
- Increased cost due to imposed methodologies,
- Inability to anticipate all relevant scenarios [4],
- Difficulty with the inclusion of legacy systems [4],
- Managing in the face of rapid technological change [4],
- Tension between immediate and future needs and
- Tension between local and global needs.

In the Navy's project we have endeavored to address these impediments head on. Our process is based on user requirements. The process is sufficiently open to allow input from a multitude of sources. We have opted to take a common sense approach with steps that seek to sufficiently socialize stakeholders and establish credibility in candidate standards. This is accomplished through a review by key technical personnel and broad based community participation at critical points in the approval process.

4. Standards – Reaping the Benefits

There are proven benefits from employing standards. In the M&S community there are several projects that have reaped the benefits of standards. These paybacks include both tangible and intangible benefits.

Tangible benefits include: reduced cost; increased interoperability with other programs; ability to retrieve and employ common authoritative data; reuse of M&S resources that are adapted or reconfigured quickly; consistency in communicating technical elements; consistent depiction of the real world in M&S software; and the ability to build M&S faster, cheaper and with less risk.

From these tangible benefits flow some "fortuitous" intangible benefits. Standardization necessitates a sharing of knowledge among interested parties. Through sharing, cross-pollination of ideas from disparate communities and geographic localities is bound to take place. Ineffective stovepipes begin to tear down and successful stovepipes evolve toward interoperable systems from economies developed in other communities. User communities can only benefit by such free exchanges of information.

Standardization in particular areas can result in a more efficient use of resources by allowing competing components to accentuate those factors that make them competitive. Rather than concentrating on some of the common (possibly banal) aspects of their businesses, competing groups can focus on what really sets them apart over their competition – and then united, attack common problems.

Many programs recognize standards as a potential solution to cost reduction. Although empirical data are not always available to completely capture cost reductions or actual funds saved, programs can benefit when standards are employed.

The following are a few projects that have provided tangible benefits by reducing costs associated with employing M&S; increasing interoperability with other M&S; retrieving and employing data; and the reuse of existing resources.

One project that has effectively applied standards to increase interoperability is the Synthetic Environment Data Representation and Interchange Specification (SEDRIS). The SEDRIS project captures data of the physical environment in a standard Data Representation Model (DRM) and provides access methods using an interface specification and Read and

Write Application Programming Interfaces (APIs). The APIs can be used to create and read an associated interchange format known as the SEDRIS Transmittal Format (STF) that is based on the DRM.

SEDRIS supports interoperability among heterogeneous simulations by providing complete and unambiguous interchange of environmental data [5]. Not only has SEDRIS met its objective of solving the M&S system environmental data interchange problem, it has also solved the related interchange and reuse problems encountered by database producers and operational users.

By promoting environmental data reuse and interoperability, SEDRIS has provided a tangible benefit of minimizing the cost to access and reuse environmental data as well as promoting an intangible benefit of a deeper understanding of the requirements and choices associated with employing environmental data.

Another project that has applied standards to effectively retrieve and employ data is the Master Environmental Library (MEL). The MEL provides the user a broad spectrum of environmental data and information residing at geographically distinct regional sites.

Instead of having to use multiple interfaces, MEL provides a single Web interface to facilitate discovery, access, subscription and delivery of information and data to meet program environmental requirements [6]. The MEL uses metadata in the Federal Geographic Data Committee (FGDC) standard format to describe the environmental data.

MEL's single point of Web access to regional data sites provides tangible benefits that include:

- Information delivered in standard formats,
- Authoritative environmental representations and
- Global and regional scales of coverage.

The goals and relationship between these two programs provide a strong focus on standards. The objective is to provide users the capability to discover and order data, described in the MEL using standard FGDC metadata, through the MEL interface. The users can then receive the data either in its native format or in the SEDRIS Transmittal Format.

The High Level Architecture has also applied standards to effectively reuse M&S resources. The HLA is a general-purpose architecture for simulation reuse and interoperability.

The HLA is based on the premise that no simulation can satisfy all uses and users. An individual simulation, or set of simulations, developed for one purpose can be applied to another application under the HLA concept of the federation: a composable set of interacting simulations.

The intent of the HLA is to provide a structure that will support reuse of capabilities available in different simulations, ultimately reducing the cost and time required to create a synthetic environment for a new purpose, and fostering the possibility of distributed, collaborative development of complex simulation applications [7].

5. Navy M&S Standards Development Process

5.1 Organization

Sponsorship: This Navy M&S Standards Project is sponsored by the Navy Modeling and Simulation Management Office (NAVMSMO) within the Office of the Chief of Naval Operations [8].

In order to carry out this task, NAVMSMO formed the Navy M&S Standards Steering Group. Final endorsement of candidate standards will be at the appropriate level within the Navy M&S "chain of command".

Navy M&S Standards Steering Group. The Standards Steering Group (SSG) is a steady state body responsible for shepherding the standards nomination and review process. The SSG has representation from the Navy Secretariat, Chief of Naval Operations, Fleet and Systems Commands. This broad participation and a true teaming approach will ensure that candidate standards are rigorously evaluated and appropriately promoted. Participation in the SSG is currently limited to Government personnel and their designates. While SSG membership is replete with domain experts it is not primarily a technical deliberation body. Technical reviews of candidate standards will be delegated to highly targeted Technical Subgroups.

Technical Subgroups (TSGs). TSGs are temporary bodies whose main responsibility is to perform rigorous technical reviews of candidate standards (in some cases, where clear economies are gained, a

technical subgroup may review several related standards). Technical Subgroups are chaired by leaders in fields related to the standards under consideration and will be appointed by the SSG. Once appointed, the TSG chair will select subgroup participants based on areas of expertise. Output of the TSGs will be reviewed by the SSG.

5.2 Conceptual Process View

The Navy M&S Standards Steering Group has developed a Navy M&S Standards Development Process that supports the vision of the Navy Modeling and Simulation Management Office. The steps within the Navy's M&S Standards Development Process focus on three key activities to Nominate, Evaluate and Advocate Navy M&S Standards. This concept, depicted in Figure 5.2-1, shows that the Government and Industry contribute as both producers and consumers of M&S.

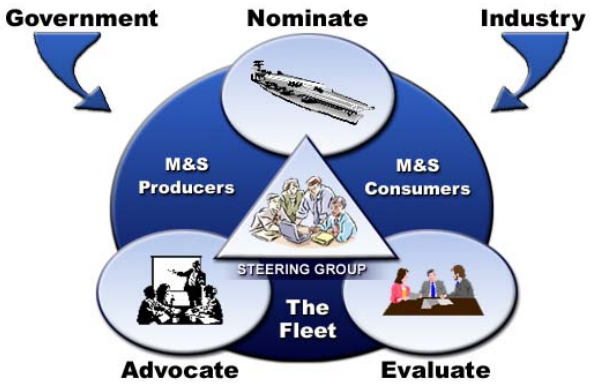

Figure 5.2-1 Navy M&S Standards Concept

The nomination process provides the Navy M&S Community and Industry the ability to define and identify the need and justification for Navy M&S Standard(s) and Best Practice(s).

The evaluation process includes a technical review by a team of M&S experts as well as an internal review by the Standards Steering Group and the posting of the draft standard to the Web Site for review by the M&S Community. These reviews lead toward a vote on the standard and a final posting of the approved standard. The evaluation process also includes a feedback sub-process that provides feedback to the author of the nomination.

In addition to posting the proposed standard to the Web for feedback and final publishing, the Navy M&S Standards Project is establishing an M&S Community outreach program to advocate standards. This outreach includes education in support of standards as well as collaboration with other standards projects.

5.3 Process Flow Diagram

The steps within the Navy M&S Standards Development Process Flow Diagram reflect the three key activities to Nominate, Evaluate and Advocate Standards. Figure 5.3-1 provides an overview of the Navy M&S Standards Development process.

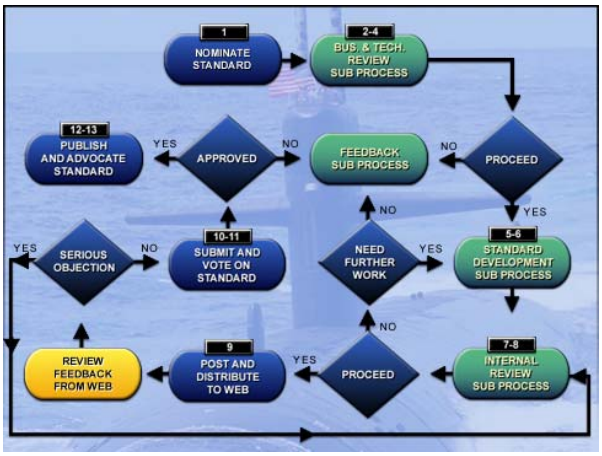

Figure 5.3-1 Navy M&S Standards Development Process

There are several decision points in the process that provide opportunities for feedback to the submitter of the nominated standard. There are a total of 13 steps that are numbered in the diagram above. For clarity's sake, some of the steps have been combined in the diagram (noted by hyphenated step numbers, e.g. 2-4).

For a more rigorous description of the process, please visit the Navy M&S Standards Web Site available through the NAVMSMO Home Page at http://navmsmo.hq.navy.mil/ .

The process begins with the submission of a nominated standard through the on-line nomination form by the submitter. This capability will be available through the Navy M&S Standards Web Site. This allows the nominated standard to be identified and the requirement documented by the submitter. (Step 1)

The nominated standard then undergoes a series of initial reviews (Steps 2-4). These reviews include a technical review by the appropriate Technical Subgroup as well as a business case review by a team composed of members from the Navy M&S Standards Steering Group and the associated Technical Subgroup.

Once the initial Business and Technical Reviews (Steps 2-4) are complete, a decision to proceed is made based on feedback from these reviews.

During a development sub-process (Steps 5-6) the requirement for the nominated standard is researched and either a new standard is developed or an existing standard is leveraged. The resulting standard is then documented.

Once the nominated standard is documented, it undergoes an Internal Review (Steps 7-8) by the entire Standards Steering Group. The nominated standard is provided to the Standards Steering Group through the Standards Steering Group reflector, and feedback from the review is then distributed to the Standards Steering Group for their consideration on a decision to proceed with the nominated standard.

If the Standards Steering Group determines that the nominated standard meets specified criteria it proceeds to the next step of posting to the Navy M&S Standards Web Site for public review and comment (Step 9). Note that this step provides the opportunity for the entire SISO world to participate.

Once additional feedback is reviewed for any serious objections from the M&S community, the nominated standard is submitted back to the Standards Steering Group for a vote. (Steps 10-11)

Once the nominated standard is approved by the Standards Steering Group, the standard is made available to the M&S Community through the Navy M&S Standards Web Site. Other activities in this series of steps (Steps 12-13) include an on-going outreach program to work with other standards activities to educate personnel on Navy M&S published standards, and provide collaborative opportunities.

6. Collaborative Opportunities

6.1 DoD-Wide Coordination

As noted in the introductory material, the Navy M&S Standards Project has established a collaborative partnership with the Army M&S Standards Program sponsored by the Army Model and Simulation Office. The Army lead has participated in Navy M&S Standards Steering Group meetings and has shared aspects of the Army M&S Standards Program, including their standards development process and lessons learned.

Collaboration with the Army's M&S Standards Program includes: applying common M&S standards category definitions when appropriate; cross-referencing M&S standards development process steps; gaining insight through their lessons learned; considering Army M&S Standards for Navy applicability; and coordination on a common Web M&S Standards application.

The Air Force Agency for Modeling and Simulation (AFAMS) is joining the M&S standards effort to develop and leverage M&S standards in their M&S community.

We look forward to the continued collaborative opportunities with other DoD agencies, as well as commercial and industrial partners in the development and adoption of standards.

There are many opportunities to strengthen our individual Service activities by building on lessons learned; applying common terms and definitions; and leveraging standards already reviewed or approved.

Our long-term goal for the future includes linkage to other Service's standards repositories.

6.2 Professional Organizations

In addition to promoting the use of standards in the Navy M&S Community through the SISO Simulation Interoperability Workshop (SIW) Navy night, we plan to support other SIW forums whenever possible.

The heart of SISO is standards development; this Navy effort is clearly a supporting, parallel effort. We are endorsing this effort to ensure strong and active Navy participation in SISO activities. With respect to our Navy M&S Standards work, we will keep the M&S community informed on our progress. We welcome any assistance in standards nomination, evaluation, and eventual adoption. As we continue with this effort, readers can participate by logging onto our Web site through the link available through the NAVMSMO Home Page at http://navmsmo.hq.navy.mil/ .

In addition to keeping closely tied to the SISO standards development process, we will retain a technical connection with the Defense Modeling and Simulation Office (DMSO) technical groups, such as the VV&A Technical Working Group, the Environmental Representation Technical Working Group, and other similar activities.

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Author Biographies

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