1.7 Standards in Modeling and Simulation: The Next Ten Years MODSIM World Paper 2010

Standards in Modeling and Simulation: The Next Ten Years MODSIM World Paper 2010

Andrew J. Collins, Saikou Diallo, Solomon R. Sherfey, Andreas Tolk, Charles D. Turnitsa
Virginia Modeling, Analysis and Simulation Center (VMASC), Old Dominion University
ajcollin@odu.edu sdiallo@odu.edu ssherfery@odu.edu atolk@odu.edu cturnits@odu.edu

Mikel Petty
University of Alabama in Huntsville
pettym@uah.edu

Eric Wiesel
WernerAnderson, Inc.
eweisel@werneranderson.com

Abstract. The world has moved on since the introduction of the Distributed Interactive Simulation (DIS) standard in the early 1980s. The cold-war maybe over but there is still a requirement to train for and analyze the next generation of threats that face the free world. With the emergence of new and more powerful computer technology and techniques means that modeling and simulation (M&S) has become an important, and growing, part in satisfying this requirement. As an industry grows, the benefits from standardization within that industry grow with it. For example, it is difficult to imagine what the USA would be like without the 110 volts standard for domestic electricity supply. This paper contains an overview of the outcomes from a recent workshop to investigate the possible future of M&S standards within the federal government.

1.0 INTRODUCTION

Determining the origins of Modeling and Simulation (M&S) is a difficult task. With a little imagination it is possible to envision the architects of the Egyptian's pyramids contemplating the momentous task ahead of them with the aid of a small scale model. Letting your mind wonder back in time a little further and it is not hard to image a caveman's children throwing some rocks at a boulder. The skills the children learnt from this training enabled them to help defend off an approaching predator, if the need arose. Thus this might have been the first training simulator.

Though it might be hard to determine the origins of M&S it is clear that its usage has increased over the last few decades due to the rise in computer technology. This increase in usage has enabled simulation to be applied in areas such as optimization, safety engineering, testing, training and education (Sokolowski and Banks, 2009). In the last decade, even computers games have been put to serious M&S applications (National Research Council, 1997).

With more and more applications of M&S being produced, M&S developers have a rich source of historical simulations to look at to help solve their problems. Some of these solutions will be consider better than others and soon the better solutions will become standards for the industry.

Sadly though the development of M&S standards is not that simple. There has been various issues with their development over the years. This paper explores some of the issues and challenges that are future M&S standards will have to face.

1.1 Workshop

This paper main source of information was from the outputs of the "Standards in Modeling and Simulation: The next 10 years" workshop which was held at the Virginia Modeling, Analysis and Simulation Center (VMASC) on March 31st 2010 until April 2nd 2010. The workshop had approximately 60 attendees over the three days which represented various interested parties from academia, industry and

government. Though the workshop was intended to be focused on military modeling and simulation (M&S) standards, there were individuals from groups outside this arena at the workshop including NASA and the Society for Simulation in Healthcare.

The purpose of the workshop was to give everyone involved an opportunity to think and discuss all aspects of M&S standards over the next 10 years. By conducting the meeting in a non-attributable environment, it allowed participants to engage in more 'out of the box' thinking without being concerned that their ideas would be attributable to themselves or their organization.

1.2 Overview

In the next section of this paper, the terminology and concepts of standards are introduced. Standards specific to M&S are then introduced in section 3.0. The issues and challenges for M&S standards are then discussed in section 4.0. Finally, conclusion to the paper is given in section 5.0.

2.0 STANDARDS

A formal definition of a standard is given by the Federal Office of Management and Budget circular (1998):

> " (1) Common and repeated use of rules, conditions, guidelines or characteristics for products or related processes and production methods, and related management systems practices.
>
> (2) The definition of terms; classification of components; delineation of procedures; specification of dimensions, materials, performance, designs, or operations; measurement of quality and quantity in describing materials, processes, products, systems, services, or practices; test methods and sampling procedures; or descriptions of fit and measurements of size or strength.
>
> The term "standard" does not include the following:
>
> (1) Professional standards of personal conduct.
>
> (2) Institutional codes of ethics."

This definition is no way definitive as there is dissatisfaction within the circle of those who it affects (Finkleman, 2007). As there was some ambiguity to the meaning of standards, the following list gives a more general indication of the different general types of standards.

• **De facto** – standards that have achieved dominant position by public acceptance or market forces i.e. VHS vs. Betamax. A more formal definition of this type of standard was given above in part (1) of the Federal Office of Management and Budget circular (1998).

• **Voluntary** – standards are formally proposed and accepted by a community of interest e.g. key furniture dimensions. In some cases, compliance to a voluntary standard might be necessary to successfully participate in a particular market, for example optional standards requirements on M&S grants.

• **De Dejure** – standards that are mandated by law i.e. residential building codes.

For the purpose of this paper this list is deem adequate definition of standards though the list does not capture every aspect of a standard. For example there are implicit and explicit standards. An example of an implicit standard is a computer game's action configuration on the buttons of a game consul controller, where the user would expect the 'fire' and 'jump' actions to be allocated to certain buttons.

2.1 Why Standards?

The key reason for having M&S standards are: cost savings, technical superiority and convergence. Cost savings come through standards enabling simulation reuse.

Technical superiority is gained by allowing existing technology to work more effectively i.e. simulations federations. Finally, standards allow for convergence of the M&S usage over the different application domains and thus promoting synergy between them.

2.1.1 Requirement for future M&S standards

With the rise of more powerful visualization tools for use within simulation, allowing M&S vendors to give a dazzling display of graphics to potential customers, there have been concerns about a charlatan aspect within the M&S industry. This concern was coined "Garbage in, Hollywood out" in Roman (2005). Thus Validation and Verification M&S standards have been proposed a means to counteract this trend.

There is a requirement for other possible M&S standards, especially relating to data. It should be noted that some data standards already exist (i.e. SEDRIS).

2.2 Standards Bodies

For standards, other than De Facto standards, to come into existence there needs to be an organization that manages their development. For M&S standards, the main body that does this work is the Simulation Interoperability Standards Organization (SISO). SISO was formed in 1989 and became a recognized standards development organization by the IEEE in 2003.

It is not surprising that M&S has its own standards organization, given the vast number of these organizations in the United States (U.S.). Figure 1 gives an overview of all these organizations. To give the reader an idea of scale of this chart, the box that has been circle in the lower-left corner is for Department of Defense standards.

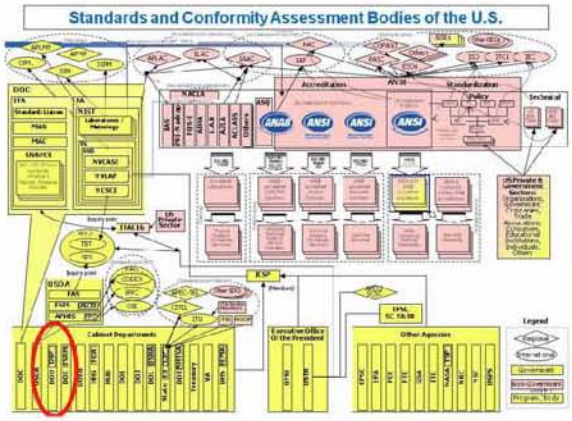

Figure 1: Organizational chart of standards organization with the U.S. (Bipes, 2007)

3.0 M&S STANDARDS

Even when the focus is narrowed from standards to M&S standards, there remain many standards to consider. The list includes both those standards developed specifically for military M&S (e.g., the Test and Training Enabling Architecture, or TENA, for test range-oriented distributed simulation) and those developed for broader applications that have been applied to military M&S (e.g., the Unified Modeling Language, or UML, for conceptual modeling). There are nearly as many governance mechanisms for these standards as there are standards, ranging from the highly formal (e.g., IEEE standards with explicitly defined community voting procedures for standards revisions) to the highly informal (e.g., some military standards with appointed panels of users, technical experts, and sponsors deciding on proposed revisions).

Beyond governance formality, M&S standards also vary by degree of technical specificity, defined as the extent to which a particular technical utilization or solution is mandated by the standard. In this attribute the standards range from very low specificity, such as broad guidelines to users (e.g., diagram formats in UML), to very high technical specificity, such as common software components required for all users (e.g., interoperability middleware in TENA). It has been conjectured that these

attributes of standards, governance formality and technical specificity, perhaps combined with other attributes can be shown to be correlated with or even predictive of the expected utility and ubiquity of standards for military M&S.

The DoD's Modeling and Simulation Coordination Office (MSCO) is currently engaged in a comprehensive survey of military M&S standards. An outcome of the survey will be the cataloging and characterization of military M&S standards on many attributes of interest. This effort will enable standards developers and users to understand what standards are available to support ongoing and planned military M&S development projects and to identify gaps where new standards might be beneficial. The mechanisms by which standards in general, and military M&S standards in particular are created and maintained vary widely. An understanding of the processes available can guide the selection of the appropriate venue and process for introducing a new proposed standard.

One of the most important and successful M&S standards of recent years is the High Level Architecture (HLA), which was derived from the Distributed Interactive Simulation (DIS) standard during the early nineties (Hollenbach, 2009).

4.0 DISCUSSION

During the workshop, several topic areas relating to standards were discussed. In this section, a review of some of the key topics is given.

4.1 Measuring M&S standards

The idea of considering standards success as a research question, and associating that success with specific standards attributes, was well received. Return on Investment (ROI) has been the type of measure of a standard's worth due to its implications on cost, as opposed to quality and reliability improvements. However, it is hard to define ROI for an M&S standard as it is difficult to know the impact if the standard was not implemented, therefore ROI should not be the only focus of a standards worth.

Other possible measures include the value that a standard brings to a simulation, the technology advancement it enables, the project risk it mitigates and the impact on the M&S community.

4.2 Confusion

Within the M&S world, there is a lot of confusion relating the terminology used. For instance, the terms 'modeling' and 'simulation' are often used interchangeably even though they are distinct concepts. Some definitions for these terms is given below:

• **Model** - A physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process. [DOD, 1998]

• **Simulation** - A method for implementing a model over time. Also, a technique for testing, analysis, or training in which real world systems are used, or where a model reproduces real world and conceptual systems. [DOD, 1998]

Other terms that are confused include Fidelity (the accuracy of model's representation or simulation's results) and resolution (the degree of detail with which the real-world is simulated). An example of a high resolution but low fidelity simulation would be Microsoft flight simulator.

Another example is composability and interoperability. Composability is different from interoperability as it implies models working together to produce a valid whole meta-model. Interoperability simply implies that two simulations are able to communicate with each other.

To understand this difference, consider a 'fish tank' simulation and a combat simulation. Both simulations might have an object within them called 'tank', and they might be able to interoperate by passing the

'tank' object to each other. However, the concept of the 'tank' object is completely different in each model and thus the models are not composable.

The challenge of composability brings to M&S are some of the most difficult ones that M&S research have faced in recent years.

4.3 Education

The complexity of M&S is likely to increase in the coming years and this will increase the need for more education of M&S and standards as well. Given the confusion associated with M&S terminology, this education should apply to customers of M&S as well as the next generation of professionals.

It is, however, important to remember that users are not interested in M&S standards; they are interested in the functionality that happens because of standards.

Standards themselves are not a new concept and they already impact on every aspect of our lives. There was no consensus within the workshop whether it was appropriate to compare M&S standards to other existing standards though several useful standards analogies were given. It was clear that standards do have a lifecycle and it was suggested that we should focus our efforts on the standards that are likely to have the longest lifecycles. This focus might help mitigate some of the 'lag effect' that standards tend to have compared to cutting edge technology.

5.0 CONCLUSION

The future of M&S will see a changing shift from construction simulation to live and virtual simulation. With this shift come lots of standards requirements from new problems and areas that are appearing i.e. VV&A standards and data standards. The future also holds many challenges for M&S including composability and determining the ROI from M&S standards.

Though M&S is an emerging new discipline, stagnation of its development can and has occurred. Therefore, it is difficult to say what M&S will be like in 10 years, it might be similar to the situation of today or a completely unimaginable area.

The workshop did not cover all aspects of standards and there are many more discussion areas that need to be addressed. The next workshop in the series was held on, which will be on M&S standards governance, was held on August 4th to 6th 2010.

Return your imagination back to the caveman's children and their throwing of stones at the boulder, which was discussed at the start of this paper. After a while of the playing this game, the children would, no doubt, impose a limit on how close you were allowed to get to the boulder before throwing stone because otherwise the game would become too easy. This would have been the first M&S standard to be developed as it is part of human nature to organize things. Thus the question of future M&S standards should not be about 'if' they are going to occur but instead it should be about 'when they will occur', 'by whom' and 'how'.

6.0 REFERENCES

[1] Sokolowski, J.A., and Banks, C.M. (2009); "Principles of Modeling and Simulation"; John Wiley and Sons.

[2] National Research Council (1997); "Modeling and Simulation: Linking Entertainment and Defense"; National Academic Press.

[3] Office of Management and Budget (1998); "Federal Participation in the development and use of voluntary consensus standards in conformity assessment activities"; Circular No. A-119 Revised; www.whitehouse.gov/omb/rewrite/circulars/a119/a119.html (accessed on May 26th, 2010).

[4] Finkleman, D. (2007); "A call to action"; Aerospace America 45, no. 11.

[5] Roman, P.A. (2005); "Garbage in, Hollywood out!"; In SimTecT 2005, SimTecT, Sydney, Australia.

[6] Steven Bipes (2007); "Standards and Conformity Assessment Bodies of the United States"; American National Standards Institute (ANSI) Public Document Library, version 2006-07-21.

[7] Hollenbach, J.W. (2009); "Inconsistency, Neglect, and Confusion: A Historical Review of DoD Distributed Simulation Architecture Policies"; In Joint 2009 Spring Simulation Interoperability Workshop (SIW), Joint 2009 Spring Simulation Interoperability Workshop (SIW), San Diego-Mission Valley, CA: Simulation Interoperability Standards Organization.

[8] Department of Defence (1998);, "DoD Modeling and Simulation (M&S) Glossary"; DoD Directive 5000.59-M.

7.0 ACKNOWLEDGMENT(S)

Many thanks must be given to all the workshop participants. Without their wisdom and insights, there would be nothing to report in this paper. As participants were told that the workshop was non-attainable, it would be inappropriate to give individual credit and thanks though there are many how deserve it.

The workshop was conducted as part of a federally funded three year study entitled 'Standards in Modeling and Simulation', which is being lead by VMASC.