

Best Practices in Modeling and Simulation

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Course description: The student will review the best practices and standards in modeling and simulation. The student will learn the requirements for development of best practices and standards in modeling and simulation. The student will apply requirements to key case studies. The student will learn VV&A reporting. The student will study the development and acquisition in M&S lifecycle. The student will learn how to manage and reuse existing models, data, and simulations appropriately and assure that new products developed are designed and prepared for reuse.

Module learning objectives:

- P8 Know and require the best practices and standards in modeling and simulation as developed in key case studies.
 - P8.1 Best Practices in M&S Planning (General Awareness)
 - P8.2 Best practices in M&S tool development (requirements, conceptual modeling) (General Awareness and Understanding)
 - P8.3 Best practices in M&S federation development (DIS, HLA, IEEE standards) (General Awareness)
 - P8.4 Best practices in software development as it applies to M&S (IEEE standards, configuration management, maturity model standards) (General Awareness and Understanding)
 - P8.5 Best practices in VV&A (maturity model, IEEE standards) (General Awareness, Understanding, and Application)
 - P8.6 Application of a sample M&S Support Plan to provide best use of M&S across all stages of the acquisition lifecycle (General Awareness and Application)
 - P8.7 Analysis of a sample V&V report for inclusion in best practices in VV&A. (General Awareness and Mastery)
 - P8.8 Analysis of the benefit of M&S best practices across all components of the M&S development lifecycle (General Awareness and Mastery)
 - P8.9 Analysis of the benefit of M&S best practices across all components of the acquisition lifecycle. (General Awareness and Mastery)
- P14 Manage and reuse existing models, data, and simulations appropriately and assure that new products developed are designed and prepared for reuse.
 - P14.1 Key concepts of M&S reuse, component-based, and distributed simulations (General Awareness and Understanding)
 - P14.2 Characteristics of new simulation development that make reuse more achievable (General Awareness)
 - P14.3 Sources for models that are available for reuse (General Awareness)

- P14.4 Cost versus the benefit for reuse of legacy simulations (Understanding and Mastery)
- P14.5 V&V necessary for reuse of a simulation with a new specific use (General Awareness and Understanding)
- P14.6 Models for reuse from a set of legacy models (Understanding and Mastery)
- P14.7 Cost effective options considering reuse of legacy simulations and new simulation development (Understanding and Mastery)

Course assessment plan: class participation and papers

Course Outline

Lesson 1 Introduction to M&S

Lesson 2 Structuring a Decision Problem

Lesson 3 Developing M&S Requirements

Lesson 4 Conceptual Modeling

Paper Review Review conceptual model papers and methods for documentation - see SISO-REF-017.01 for listing of sources available at www.sisostds.org

Lesson 5 Building a model

Paper Review Review Law & McComas (2001) How to Build Valid and Credible Simulation Models, In Proceedings of the 2001 Winter Simulation Conference, B.A. Peters, J.S. Smith, D.J. Medeiros, and M.W. Rohrer (editors) 22-29

Lesson 6 Developing Simulation Software

Lesson 7 Introduction to Software acquisition capability maturity model

Lesson 8 Interoperability protocols

Lesson 9 The composition of models

Example Review example from Weisel demonstrating that validity under composition under metric is not always true - discuss

Paper Review Review and discuss Emily Andrew, James F. Hartz, and Toni Shetler (1999) Wargame 2000 Verification, Validation, and Accreditation

Lesson 10 Introduction to Modeling and Simulation Support Planning

Discussion Discuss how M&S Planning throughout the development and acquisition lifecycle could have been used in one of the following two case studies (the Mars Lander or Hubble telescope):

“Mars Climate Orbiter Failure Board Releases Report”, Release: 99-134,
ftp://ftp.hq.nasa.gov/pub/pao/reports/1999/MCO_report.pdf

“Hubble Space Telescope Results in Planetary Science” (Introduction),
Reta Beebe, Astronomy Department, New Mexico State University, Las
Cruces, New Mexico,
<http://www.agu.org/revgeophys/beebe01/beebe01.html>

Lesson 11 Introduction to Risk Analysis and Management

Discussion Review and discuss role of simulation as provided in SAMPLE RISK MANAGEMENT PLAN FOR THE XYZ PROGRAM (ACAT I, II) found Defense Acquisition University (2003) Risk Management Guide for DoD Acquisition, 5th Edition, version 2.0, June 2003, Department of Defense, Defense Acquisition University Press, Fort Belvoir, VA, pages B-4-B-30

Discussion Review and discuss one of the two case studies:

J.R.W.Merrick, J. Rene van Dorp, V. Dinesh (2005). “Assessing Uncertainty in Simulation Based Maritime Risk Assessment”, Risk Analysis, Vol. 25 (3), pp. 731-743. [available at
<http://www.seas.gwu.edu/~dorpjr/Publications/JournalPapers/RA2005.pdf>]

Hye-jin Kim, Moonjin Lee and In-young Gong (2008) Building Geographic Database for Risk Assessment in Coastal Area, In Proceedings of the Tenth International Conference for Spatial Data Infrastructure, GSDI-10, St. Augustine, Trinidad, February 25-29, 2008 [available at <http://www.gsdi.org/GSDI10/papers/TS28.4paper.pdf>]

Discussion Read and discuss

Douglas J. Bragdon (2007) First things first: The importance of Risk Identification, Defense AT&L, May-June 2007, 13-16 [available at
<https://acc.dau.mil/CommunityBrowser.aspx?id=17755&lang=en-US>]

Philip E. Coyle III (2000) Evolutionary Acquisition: Seven Ways to Know If You Are Placing Your Program at Unnecessary Risk, PM, November-December 2000, 2-5 [available at
<https://acc.dau.mil/CommunityBrowser.aspx?id=17755&lang=en-US>]

Lesson 12 VV&A Key Concepts

Lesson 13 VV&A Basic Process

Discussion Review and discuss 99S-SIW-167: SISO-REF-002-1999: Fidelity Implementation Study Group report available at <http://www.sisostds.org/>

Lesson 14 Conceptual Model Validation

Discussion Review and discuss Robinson (2006) ISSUES IN CONCEPTUAL MODELLING FOR SIMULATION: SETTING A RESEARCH AGENDA

Lesson 15 Introduction to Results Validation

Discussion Review and discuss Harmon (2005) RESEARCH INTO SIMULATION CAPABILITIES DESCRIPTION AND RESULTS SAMPLING available at <http://www.msco.mil> VV&A RPG evolving technical concepts

Lesson 16 Introduction to Validation Planning and Accreditation

Discussion Review validation and accreditation reports and Discuss:

Daniel E. Carroll, Eugene S. Hertel, Jr., and Timothy G. Trucano (1997) Simulation of Armor Penetration by Tungsten Rods: ALEGRA Validation Report, SAND97-2765, November 1997, Sandia National Laboratories, Albuquerque, NM [available at <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.38.1836>]

Validation Report for the Fading Simulator SOFI05 Revision 3: Part 1 – Integration into the 2G Test System TS8916B, version 17.05.2001 [available at <http://www.sofimation.com/download/SOFI05validation.pdf>]

C.S. McDonald, (2006) Verification and Validation Report for the Synthetic Environment for Analysis and Simulation (SEAS), NSAD-R-2006-020, March 2006, The Johns Hopkins University Applied Physics Laboratory, Laurel, MD [available at <http://orsagouge.pbwiki.com/f/20060405+JHU-APL+VV+Report+for+SEAS.pdf>]

National Simulation Center (1994) Accreditation Report for the Use of the Confederation of Models in General Headquarters 94 (Phase 3), A528982, 24 Jun 1994, Fort Leavenworth, KS [available at <http://www.stormingmedia.us/52/5289/A528982.html>]

Page, E. H., Canova, B. S., and Tufarolo, J. A. 1997. A case study of verification, validation, and accreditation for advanced distributed simulation. ACM Trans. Model. Comput. Simul. 7, 3 (Jul. 1997), 393-424. [available at <http://portal.acm.org/citation.cfm?doid=259207.259375#>]

Review Common VV&A Product Templates and review available at <http://msco.mil> VV&A documentation templates - discuss development and content

Lesson 17 Simulation Reuse

Paper Review Review and Discuss POST, E. (2003): Designing and implementing computer simulation models for portability and reuse, MODSIM 2003, Townsville, Australia,
<http://www.mssanz.org.au/modsim03/Media/Articles/Vol%204%20Articles/1751-1756.pdf>, Accessed 24 November 2006.

References

See reference list in separate document