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## **LEVERAGING THE DOD M&S EDUCATION PROJECT FOR SPECIALIZED ARMY M&S EDUCATION**

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### **ABSTRACT**

This paper describes our efforts to develop, deliver, and sustain two specialized courses, developed by faculty from Systems Engineering Department at the Naval Postgraduate School as part of a larger DoD M&S Education Project, on the topic of simulation for active Army and civilians. First, the “Advanced Simulation Course,” sponsored by the Simulation Proponent Division, office of the Army Modeling & Simulation Directorate, provides a non-technical M&S perspective that covers the significant M&S issues and M&S activities throughout the Acquisition Life Cycle. The second course is “M&S in Engineering Product Design and Development.” This course is intended for engineers at the Army Research Development and Engineering Center (ARDEC) and focuses on the role of M&S in the product development process. Students complete this course with a thorough understanding of the overall capabilities of M&S in supporting their product design from within the construct of an appropriate process that allows for problem formulation, analysis, and interpretation.

### **1 INTRODUCTION**

The scope of military operations, and the systems that conduct these operations, continue to grow immensely in terms of complexity. The US and allied military forces must be prepared for all phases of military conflict, as well as a variety of missions and scenarios within these phases. Clearly, our simulations must be able to represent these vastly divergent situations as realistically as possible. Additionally, our nation’s military and industry M&S professionals, as well as other Department of Defense (DoD) M&S consumers, must understand the role of M&S in training, acquisition, test and evaluation, experimentation, analysis, and planning.

In August 2007, the DoD Modeling and Simulation Steering Committee (MSCO) established and endorsed a strategic vision to “Empower DoD with modeling and simulation capabilities that effectively and efficiently support the full spectrum of the Department’s activities and operations” (Office of the Director of Defense Research and Engineering [ODDR&E], 2007). Similarly, the office of the Assistant Secretary of the Navy Research Development and Acquisition (2007) specified that the RDA community is comprised of those who “seek to improve M&S support to Navy and DoD acquisition by promoting coordination with M&S activities of the DoD components, foster widely-needed M&S capabilities and identifying new options to support widely-shared needs.” M&S education is a solution in line with the shared vision of many DoD leaders to effectively improve the use of M&S across all of DoD. It serves as the foundation for keeping the DoD workforce acquainted and rejuvenated on the availability and use of such valuable tools.

This paper describes our efforts to develop, deliver, and sustain two specialized courses, developed by faculty from Systems Engineering Department at the Naval Postgraduate School (NPS) as part of a larger DoD M&S Education Project, on the topic of simulation for active Army and civilians. While much of the inspiration of each course comes essentially from the DoD M&S Education project, the individual course content, as well as the target audiences, are vastly different. A description of each course follows, to include summary of course topics, identification of sponsors, the intended target audience, and the anticipated mode of delivery of the course.

### **2 DOD M&S EDUCATION PROJECT**

In 2006 the Systems Engineering Department of the Naval Postgraduate School was presented with the opportunity to cultivate and deliver an M&S educational program focused on the effective use of M&S for the Acquisition

professionals consuming these tools. The Naval Postgraduate School embraced this opportunity supported by the Modeling and Simulation Coordination Office (MSCO), Navy Modeling and Simulation Office (NMSO), and the Simulation Proponent Division, office of the Army Modeling and Simulation Directorate (DAMO).

A project roadmap was created to encompass all of the project's developmental milestones planned for the next three years. In 2007, NPS began their work by identifying the curriculum requirements, researching the existing nationwide M&S education opportunities, and developed a learning architecture consisting of courses and delivery methods to cover the educational gaps identified (Naval Postgraduate School, 2008); thus paving the way to ensure delivery of a solid and unconventional education package. NPS then partnered with six other US academic institutions recognized as experts in the field of M&S to complete the project task. These partners included the University of Alabama in Huntsville, the University of California San Diego, the University of Central Florida, George Mason University, Johns Hopkins University, and Old Dominion University.

Identifying the curriculum requirements involved NPS, the academic partners, and the project sponsors working together with stakeholders from within the acquisition and test and evaluation community and services. A set of Educational Skill Requirements (ESRs) for each of the nine market segments was identified, to include program managers, systems engineers, and test and evaluation professionals at advanced/senior, intermediate/journeyman, and basic/entry career levels. The ESRs are the basis for the instructional content for the program and were used as the key ingredient to the learning matrix and learning architecture products (Olwell, et al. 2008).

Following stakeholder input, the ESRs were broken into five groups: process, program management, operations and logistics, test and evaluation, and engineering. The 'Process' group addressed common M&S issues for the acquisition community while the other four focused on the corresponding domains of application (Olwell, et al. 2008). The use of detailed ESRs, a segmentation of workforces into career fields and levels, and competency levels mapped to Blooms taxonomy were three key elements composed together to create the project's Learning Matrix. The learning matrix maps knowledge elements to desired proficiencies, or levels of competence, for each career field and level and presented a roadmap for the development of courses for each of the workforce segments (Olwell, et al. 2008).

By the end of 2007, NPS and the academic partners developed module syllabi for individual ESR addressed in the learning matrix and constructed a course syllabi for each of the academic courses proposed for development. By 2008, the project team combined the use of these work products and their own expertise to develop full and short academic courses, web-based modules, and engineering case studies to be used as supplemental materials. In conjunction with the M&S course development effort, the NPS Graduate School of Business and Public Policy assisted the Systems Engineering department to develop a Systems Acquisition Managers Guide for the Use of M&S as part of a supplementary tasking that would be part of the sponsor's final deliverable package.

By 2009, a total of 16 Courses were developed and packaged by NPS and five of the six academic partners (see Figure 1).

- M&S in the Acquisition Life Cycle, Part 1**
- M&S in the Acquisition Life Cycle, Part 2**
- M&S Strategy and Support Plans**
- M&S Requirements and Evaluating M&S Proposals**
- Contracting for M&S**
- Best Practices in M&S**
- M&S in Decision Risk Analysis and Mitigation**
- M&S Environments**
- M&S Data Strategies**
- M&S for Test and Evaluation, Introduction**
- M&S for Test and Evaluation, Advanced**
- Introduction to Engineering M&S Applications**
- Physics-based M&S**
- Basic Engineering Concepts in M&S, Part 1**
- Basic Engineering Concepts in M&S, Part 2**
- Selected Topics in the Application of Engineering M&S**

Figure 1: 16 M&S Courses

Each course listed in Figure 1 above will eventually become available in the public domain. This knowledge early on made it critical for each developer to create a course package that is user-friendly and adaptable for any US

instructor to incorporate into their own learning programs. Each course package includes PowerPoint slides with instructor notes, supplemental materials, reference lists, and exams. Ten of these courses were condensed into continuous learning modules for publication through the Defense Acquisition University.

To date, the DoD M&S Education project has not gridlocked its efforts after development and delivery, but instead given birth to newly established programs from within DoD and industry. Certificate programs and educational opportunities are among a few of the newly developed programs on the horizon. The rest of this paper will identify two cutting edge Army educational programs that have emerged from the Modeling and Simulation Education for the Acquisition and T&E Workforce project.

### **3 ADVANCED SIMULATION COURSE**

#### **3.1 Overview**

The “Advanced Simulation Course,” sponsored by the Simulation Proponent Division, office of the Army Modeling & Simulation Directorate, provides a non-technical M&S perspective that covers the significant M&S issues and M&S activities throughout the Acquisition Life Cycle. This intense two week course, first offered at NPS from 11-22 May 2009, is intended for annual delivery to selected senior leaders. Students are expected to leave the course better equipped to manage major M&S activities at the level of Direct Reporting Units (DRU) and Program Executive Office (PEO). The primary student population for the course include field grade officers (Major and above) from the Functional Area (FA) 57s, or Simulation Operations, and senior Army civilian simulation professionals.

The actual execution and delivery of the course is conducted by a collection of faculty members from various NPS departments, as well as M&S contributors from outside of NPS. These very talented instructors, most with years of military and M&S experience, are the key to a high quality educational product.

#### **3.2 Intent**

Currently, Army officers in FA 57 focus their efforts in the area of M&S in Training. This includes the planning and execution of training events, using a variety of M&S tools, for soldiers and command staffs. However, these simulation professionals will have broader responsibilities as they become more senior, such as advising program managers or testers on the use of M&S. The intent of this course therefore, is to give the students an appreciation for these expanding roles of the simulation professional in the areas of acquisition, analysis, testing, and even contracting, as well as providing an overview of emerging M&S focus areas.

#### **3.3 Course Topics**

The two week schedule of instruction consists of eight different advanced level M&S topics with 11 different instructors from within NPS and industry. The topics are:

- **M&S Education:** this includes focused class discussion on a proposed M&S Body of Knowledge (BoK), and an in class exercise on the development of a graduate level M&S curriculum.
- **M&S Overview & Requirements:** this includes review of M&S basics, an overview of a systems engineering design process, and application of this process to the generation of M&S requirements.
- **M&S in Testing:** this includes the role of M&S in testing, an overview of test design, and an in class exercise on how M&S is used in testing to assist the decision maker.
- **M&S in Analysis & Experiments:** this includes an overview of how to conduct useful M&S for analysis, the essence of experimental design and its relationship to good simulation analysis, with several demonstrations of recent research projects in this area.
- **M&S in Acquisition:** this includes an overview of DoD acquisition process, a discussion of how M&S is used in the various phases of the process, an overview of contracting, and several recent case studies where M&S was used in support of program manager and major program decisions.
- **Future of M&S:** this includes an overview of several significant areas of development in M&S, to include simulation interoperability, agent-based models, and military applications for gaming.

## 4 M&S IN ENGINEERING PRODUCT DESIGN

### 4.1 Overview

The second course is “M&S in Engineering Product Design and Development.” This course is intended for engineers at the Army Research Development and Engineering Center (ARDEC) and focuses on the role of M&S in the product development process. It links the capabilities of ARDEC M&S tools, as well as other M&S tools used by ARDEC engineers, with the methods and artifacts that are generated from this process, with an emphasis on overall integration. Students will complete this course with a thorough understanding of the overall capabilities of M&S in supporting their product design from within the construct of an appropriate process that allows for problem formulation, analysis, and interpretation. This one week course is scheduled for its initial delivery at ARDEC facility in Picatinny Arsenal, NJ in the fall of 2009.

### 4.2 Intent

The intent of this 40 hour course is to give ARDEC engineers an understanding of applying M&S tools and analysis techniques (such as design of experiments) to weapons and munitions design, testing, development, and production activities throughout the life cycle. The curriculum includes

1. An introduction to DoD M&S, as well as an introduction to the DoD Acquisition process (kind of a maturity level/application of M&S at various stages in the life-cycle)
2. How to apply M&S tools to product design (what tools to use, how much, etc.), tying basic engineering, test and evaluation concepts, with SE principles, to physics based and operational models
3. How to apply M&S in various phases of the acquisition process with emphasis on decision analysis and design of experiments.
4. A class room assignment/experiment from requirements to validating requirements in a M&S environment and how hardware/software testing will support the tools through product development.

### 4.3 Course Topics

This one week course, to be delivered on site at Picatinny Arsenal, is to be taught by a single instructor with the inclusion of subject matter experts from ARDEC. The topics are:

1. **M&S Basics:** this includes M&S definitions, M&S Categories, such as Live, Virtual, Constructive, M&S Reuse, Fidelity, Resolution, Interoperability, Validation, Verification, and Accreditation (VVA), and an overview of ARDEC M&S capabilities and tools.
2. **M&S and the Product Development Life-Cycle:** this includes an overview of DoD Acquisition Framework and other life cycle models, the use of M&S through stages of life cycle, Simulation Based Acquisition, and M&S Strategy and simulation support plans and simulation support matrix (SSM).
3. **Three Steps of Product Development: Formulation, Analysis, and Interpretation:** this includes an overview of product development processes, M&S tools available and appropriate during each phase, linkage of M&S planning (SSM) to conducting useful M&S for analysis, the essence of experimental design and its relationship to good simulation analysis.
4. **In class exercise: Early and Late Life-Cycle Product Development:** Discuss, review M&S tools available and appropriate (CASFORM, JCATS, etc...) during this phase, discuss specifics of case study development, conduct engineering design and conduct group presentations.

## 5 WHAT IS NEXT

The two specialty courses we developed, Advanced Simulation Course, and M&S in Engineering Product Design, reflect our support of the Army and DoD commitment to M&S education. We will continue to offer these two courses, and update them as necessary based on the input of our customers, who include both the sponsors and the targeted students. Additionally, we are in the process of designing and developing a new course in support of the

Simulation Proponent Division, office of the Army Modeling & Simulation Directorate. This course will focus on M&S in Analysis and Testing, with the target audience tentatively to include Army civilian M&S professionals, as well as FA 57s. These courses, together with 16 courses developed for the DoD M&S Education project, demonstrate our dedicated support at NPS of the broader DoD M&S education mission.

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