

## SIMULATION-BASED TRAINING – BENEATH THE SHROUD

Michael L. Darby

**Abstract.** Modelling and Simulation (M&S) has had a profound impact on military training. Synthetic Environments replace the physical battlefield, equipment and environmental conditions. Semi-automated forces such as blue, red and white forces augment the interactive domains. While simulation-based training has been somewhat embraced as an acceptable alternative to utilising the real equipment or the conduct of major exercises, the underlying scientific principles of system abstraction, specification, development and validation have yet to be completely identified, defined and institutionalised as an engineering practice or academic discipline. This creates the essence of the shroud that covers this complex area of simulation. While we may possibly have faith in the entity the shroud covers, we need to reduce the semantic quagmire and the elevated expectations and underscore the faith with fact. This paper presents the current state of simulation as both a science and enabling technology for training.

### INTRODUCTION

Simulation has been used throughout history as a means of gaining insight into the behaviour of a real-world system. Initially, simulation was utilised as an analytical tool, providing a means to understand, optimise, or predict behaviour of systems of interest. Application areas such as building, planning, logistics, and management have used simulation techniques to support understanding of either current or proposed systems. For example, early simulation within the shipbuilding industry took the form of scaled physical models evaluated within a scaled ocean. These physical models were highly accurate replications to include the actual wood, rigging, ballast weights, and armament. Once validated as sea worthy the physical models became the “blueprint” for the actual ship.

Theoretical problems such as solving simultaneous linear equations were simulated using Monte Carlo methods [1], which used statistical sampling to estimate a desired result. Other types of problems utilised different mathematical techniques. With the advent of computers, symbolic models can now be developed that represent entities or objects and provide for the inclusion of stimuli. As computer technology improved, more application domains embraced simulation.

Over the last decade Instructional System designers have also been increasing their use of simulation to satisfy training requirements. Initially simulation was used to represent the system they were studying, thereby allowing students to “interact” within the basic parameters to understand better the system operational responses to stimuli or variance of the input variables. Today, training systems use simulated environments to immerse the student in an operational domain. Visual systems developers have added a perceptual realism by providing enabling technologies, which visually present a common virtual environment to the students. Visuals systems today allow each participant to experience a simulated environment as they would the real world. Entities can now be added through models or connected manned simulators as well as actual “live” equipment. Finally, systems are now able to interact over great distances with the advent of a common communication and architectural framework.

Given these advances in modern technology coupled with the shrinking defence budgets, the defence forces of many countries not only depend on simulation, but have mandated simulation as the enabling technology for training systems

that span individual task training to *mission rehearsal*<sup>1</sup> [2]. The use of simulation at all levels of the vertical training vector from individual tasks to large-scale joint exercises is now common practice. Given the increasing role which simulation can play with the advent of standards, technology and acceptance, knowledge about the domain called simulation is essential. As defence forces worldwide become more dependent on simulation to augment, if not replace, real-world training, simulation becomes a direct contributor to the overall preparedness of our forces. With that in mind, this article’s aim is to bridge the gap between the training manager, user and engineer so that a common understanding of the science of simulation and its current application space can be forged.

Therefore, this paper focuses on:

- the current state of the science of simulation;
- the legitimacy of simulation to support training;
- a description of simulation-based training systems; and
- an evaluation of areas of risk and associated problems, and future research.

### Background

“Simulation has always been a difficult issue to analyse because it is surrounded by a semantic quagmire, and obscured by a miasma of emotion, over-claims, and flawed analysis, unilluminated by dependable statistics on costs or effectiveness” [3]. Penned in 1994 within a study on the utility of simulation for training, much of the voiced and perceived frustration of then is still true today. As noted then, the miasma in part is self-generated and will take the combined effort of the simulation community to eliminate. But a path through the quagmire addressed in the cited quote may be a reasonable goal of this article.

The semantic quagmire itself is mainly the result of different facets of the simulation community creating their own vocabulary in reference to identical concepts and constructs. Terms such as, *Synthetic Battlespace*; *Common Synthetic Environment*; *Distributed Interactive Simulation (DIS)*; *Live, Virtual, and Constructive entities*; and *Virtual Reality*, serve to describe the application space. Terms such as *aggregation (disaggregation, deaggregation)*; *fidelity*; *resolution*; *real-*

<sup>1</sup> *Italicised phrase as used in this article is defined in the cited reference.*