Preface

This book is concerned with assuring that simulations are appropriate representations of the real-world systems being studied. After following the methodology provided in this book, one can determine the degree of confidence that can be placed in the behavior and outputs of the simulation. The words methodology and confidence are italicized to stress their importance in the design of this book. This is a guide that can be applied to a variety of simulations. It is systematic, procedural, and practical. We will differentiate between the assessment of a simulation tool and the verification and validation of general software products. Accordingly, we break from the strict V&V terminology and will refer to the confidence assessment of a simulation.

While we are concerned about good software development and quality assurance practices, we do not explicitly cover these topics. There are many excellent references on these subjects. In general, we also do not explicitly cover the design, development, or application of simulations. However, cognizance of the assessment methodology will mitigate risks involved with these areas.

Who can use this book?

This book is written for several audiences, including technicians and managers engaged in industry or government. It should also appeal to computer science, operations research, and operations management students and educators. The methods addressed here are presented primarily with large-scale simulation models in mind, but can be useful for the validation of smaller-scale models as well. We tried to bridge the gap between academic and pragmatic concepts on simulation assessment. Thus, this book is written to be used in three ways.

- A guide for practicing professionals who are concerned with the credibility of their simulation models. They can establish methodologies and procedures to perform confidence assessments that will suit their needs.

- A reference book and road map for software developers and quality assurance experts. Our thorough listing of assessment procedures is a handy guide to aid in the unit, integration, and system testing of new or revised software. An understanding of our process will provide a vision of how to continuously assess the simulation tools throughout the software development life cycle.

- A reference for simulation methodology and software engineering courses offered at the undergraduate or graduate levels. Students should benefit from the structured approach provided in this monograph. Some experience with statistics will provide useful insights to the assessment methodology.

This book is divided into three blocks: concepts, methodologies, and special topics. We annotated each chapter heading with a box that notes the block for that chapter, a capsule comment on the content, and a recommendation on the audience that would be most interested in the contents.

Practical experience

The practical aspects of this book are based on our experience assessing large-scale simulations. The models we examined in the past had a variety of applications including discrete-event simulations of complex systems; specialized tool sets to generate data for other simulations; and simulations that supported interactive gaming involving human players. Some models had hundreds of modules, simulating
the interaction of thousands of entities. Obviously, these assessments required a team effort and considerable planning, which is reflected in the content and organization of this book. The numerous procedures and phases may seem overwhelming to apply; however, we took care to provide ways to tailor our methodology for particular situations and objectives. We also tried to provide numerous assessment aids along the way. One such aid, a road map of the phases and activities of a complete assessment, can be found at the back of the book.

We also understand the need for close coordination between the technical team assessing the simulation, the model developers, and managers. In fact, managers are very interested parties in the assessment of a simulation. They must have full confidence in a simulation before it can be used as an analysis tool or decision aid. They also must decide on the resources that they can afford to devote to a confidence assessment. Our methodology prescribes the active involvement of both managers and model developers in a simulation assessment during each phase.

Finally, we observed that the work of a simulation model developer is never done. As long as there are time, money, and personnel, there are more details and features to build into the simulation. Thus, an assessment can be a continuous activity over the life cycle of the software. Improvements in software engineering, such as structured coding, graphical modeling tools, animation, object-oriented design, module reusability, use of automated code analysis tools, and computer aided software engineering (CASE) tools are making it easier to maintain confidence in a tool as it grows in complexity and sophistication. However, without a methodology that supports ongoing model assessment, an initial assessment could be doomed to obsolescence as a one-shot effort. Accordingly, this book addresses a full range of assessment activities over the life cycle of the model.

Acknowledgments

The inspiration for writing this book came from a working group created to advise the managers and technicians working at the National Test Bed. The NTB was established by the Strategic Defense Initiative Organization to provide hardware and software to support simulations and experiments conducted on strategic defense concepts. The Simulation Evaluation Methodology Technical Group (SEMTG) was conceived by Nelson Pacheco of MITRE Corporation in 1988 to advise the NTB on how to systematically evaluate simulation models and how to wisely apply them. He and Mort Metersky, from the Naval Air Development Center, cochaired this unique group of experts in the field. The foremost technical advisor was Robert G. Sargent whose framework provides the structure underlying the confidence assessment methodology. Ronald Gados, also of MITRE, wrote a summary of the activities and recommendations of the SEMTG.1

The SEMTG recommended creation of the Confidence Methodology Guide.2 This document came to fruition after the arduous efforts of an NTB team, whose most notable members were Wayne Graybeal and Pat Sandoz, both from Geodynamics Corporation and Curt Frankenfeld, from Logicon Corporation. The Confidence Methodology Guide3 and its ultimate application to the assessment of more than 10 simulation tools at the NTB form the foundation of this book. We would like to thank our supervisors and colleagues, Ray Kolibaba, Ron Jacobsen, Dick Matsi, Jim Hardy, and Don Brand, for their support, patience, and assistance in the production of this book.

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