

(Revision K, July 2002) Terms of Reference (TOR) for a Workshop Foundations for V&V in the 21st Century

Short Title: Foundations '02 Workshop
Date: October 22-24, 2002
Location: Kossiakoff Conference and Education Center
Johns Hopkins University Applied Physics Laboratory
Laurel, Maryland, USA

Background

Briefing slides shown at the 8 September 2000 meeting of the DoD Verification, Validation, and Accreditation (V&V) Technical Working Group (TWG) suggested that a workshop on modeling and simulation (M&S) V&V be held in mid-2001 to increase information exchange among government, industry, and academic personnel. The TWG felt that the proposal was inadequately defined and that mid-2001 would not allow adequate time to prepare appropriately for such a workshop. The TWG requested that the proposal be more fully defined and presented at its next meeting, suggesting that the refined proposal contain the kinds of information typically found in terms of reference (TOR) for a special meeting of the Military Operations Research Society. An update presentation about the workshop was presented at the 11 May 2001 meeting of the TWG. These Terms of References (TOR) for the Foundations for V&V in the 21st Century Workshop, which will usually be referenced elsewhere within the TOR as the *Foundation '02 Workshop* or simply as the Workshop, evolved from those presented to the TWG in the first half of 2001.

The Need for the Foundations '02 Workshop

Advances in computational and networking capabilities during the past decade brought major increases in M&S capabilities. Significantly increased reliance is placed upon M&S for a wide variety of applications: in analysis and planning, in system design and engineering, in test and evaluation, in operational support and execution, as well as in training, education, and mission rehearsal. This increased reliance upon M&S in so many critical arenas, in the Defense community and other parts of government as well as in industry and academia, gives special importance to M&S V&V because V&V are the means by which M&S correctness is enhanced and ascertained so that appropriate credibility and confidence may be placed in M&S.

There were significant V&V advances during the 1990s. Progress was made on common V&V terminology. Advances in computer-aided software engineering (CASE) tools significantly enhanced verification capabilities for M&S. General improvements in software engineering practices helped new M&S developments and M&S modifications produce better quality software, as more organizations progressed in terms of the Software Engineering Institute's Capability Maturity Model (CMM). V&V policy was established for the Defense community at DoD, military Service, and Defense Agency levels. Guidance was provided within the Defense community through handbooks and the DoD recommended practices guide for V&V. The Department of Energy (DOE) initiated major endeavors to improve confidence in codes related to the nuclear stockpile as part of its Advanced Strategic Computing Initiative (ASCI) Program. Several professional societies developed guidance for V&V. And there were a significant number of V&V related articles, papers, and books published. These advances have continued into the new millennium. However, a number of serious V&V needs have not yet been met. These needs (deficiencies) will prevent advances required in M&S correctness and credibility for M&S to fully support DoD's Simulation Based Acquisition vision, DOE's ASCI Program, and comparable endeavors elsewhere within government and industry. These needs include the following:

- 1) Clear & comprehensive description of the state of the V&V art.
- 2) Current bibliography of critical and substantive V&V literature and resources.
- 3) Comprehensive and coherent statement of M&S V&V research needs.
- 4) Substantial and sustained information exchanges about V&V by various M&S communities (such as DoD, DOE, NASA, industry, professional societies, and academia) so that "best practices" may be employed by all and appropriate standard procedures become common throughout all M&S communities.

The Foundations '02 Workshop

A V&V workshop will be held in October 22-24, 2002 to meet these needs. This TOR document describes that workshop, defines its structure and sponsorship, identifies expected products from the workshop and how they are expected to be disseminated, and presents a tentative schedule and timeline for preparing for the workshop.

Workshop Sponsorship. In order to develop clear & comprehensive descriptions of the state of the V&V art in major areas of VV&A and to initiate substantial interaction about V&V among various M&S communities, it is important that broad sponsorship from M&S leaders be sought for the Workshop. That sponsorship would endorse the need for the Workshop and its basic approach, plus encourage appropriate participation in the Workshop by those under the purview of that sponsor (this encouragement in some cases may include assistance from the Sponsor to those invited to produce a paper for the Workshop as well as support for attending the Workshop). Each sponsoring organization or activity will have a representative on the Workshop's Advisory Committee. Each sponsoring organization or activity is expected to announce the Workshop in its publication of information about such events. Each sponsoring organization or activity will benefit from recognition as an M&S leader helping to overcome the V&V deficiencies identified above. Sponsorship is open to any M&S-related organization or activity which wants to endorse the need for this workshop and participate in it. Neither sponsorship of or participation in the Workshop will be restricted to US organizations.

There are two special sponsors of the Workshop: the *initiating sponsor* and the *hosting sponsor*. The first *Initiating Sponsor* (the Defense Modeling and Simulation Office, DMSO) approved the original version of this TOR, will provide support for it, and will facilitate dissemination of the Workshop's products (such as posting them on the DMSO website, this includes posting of the evolving bibliography of V&V materials). The Modeling and Simulation Subcommittee of the Joint Army-Navy-NASA-Air Force (JANNAF) Interagency Propulsion Committee is also an Initiating Sponsor for Foundations '02. The *Hosting Sponsor* (National Training Systems Association, NTSA) is the organization which administers the Workshop. The other sponsors of Foundations '02 are known as *general sponsors*. They have no financial responsibilities for Foundations '02. Appendix B identifies those who have committed as General Sponsors for Foundations '02 as of mid-September 2001.

Workshop Structure. The Workshop will have five elements. These are briefly described below. Details about them are presented in Appendix A at the end of this TOR.

- 1) **Plenary Keynote Session** (3 speakers on Day 1 morning [Tuesday, October 22] addressing the importance of the Workshop; a senior leader from DoD, another from the DOE ASCI Program or NASA, and the third from industry or academia – this approach will demonstrate the importance of the Workshop for many communities)
- 2) **State of the Art Topic Sessions** (up to 6 sessions on Day 1 afternoon [Tuesday, October 22] and again on Day 2 morning [Wednesday, October 23] of 3 ½ hour duration; each with a major invited paper presented in the session for about 90 minutes on where V&V is in a particular area, key literature, standard practices, research needs, and issues – with 90 minutes for the audience in the session to present counter views, other perspectives, etc.: clear & comprehensive description of the state of the V&V art in the topic area will be the combination of the paper and the balancing and enhancing reaction discussion)
- 3) **Topics of Special Interest Sessions** (8 sessions held in parallel with the State of the Art Sessions)
- 4) **Plenary Synopsis Session** Day 2 afternoon [Wednesday, October 23] (reports the high lights from the state of the art sessions and makes an initial synopsis of research implications from such; a closing keynote points the way ahead to implement research suggestions) – this concludes the Workshop for most participants
- 5) **Workshop Report Production** (on Day 3, [Thursday, October 24] Workshop leaders will draft Workshop products

A social event (mixer) is planned for Day 1 [Tuesday, October 22] evening to encourage interaction among people from different M&S communities.

Organizational Structure. The organizational structure planned for the Workshop is:

Advisory Committee: consists of a representative from each Foundations '02 Sponsor. The Advisory Committee will be chaired by the Foundations '02 General Chair. The Advisory Committee will be kept informed of plans for the Workshop (including identification of personnel for various roles) and is expected to

provide input about all aspects of the Workshop; communication about the Workshop and voting by the Advisory Committee on issues will be via email. It is not expected that the Advisory Committee will meet at a specific location at any time, although there may be supplementary Advisory Committee interactions by teleconferences and meetings among some members of the Advisory Committee to encourage fuller understanding of issues and topics addressed. Advisory Committee members are expected to make recommendations to the General Chair and Program Co-Chairs about candidates for various roles (invited paper authors, session leaders, etc.) in Foundations '02.

General Chair: This person will be appointed by the original Initiating Sponsor and will provide overall management for Foundations '02.

Program Co-Chairs: These two individuals appointed by the original Initiating Sponsor and will provide overall guidance in planning and execution of the Workshop.

Organizing Committee: The 3-6 people of this Committee will be drawn from various M&S communities. They will be nominated by the General Chair and reviewed by the Advisory Committee. The Organizing Committee is to help identify and recruit appropriate people to author invited papers and for the invited paper session leaders

Session Leaders: Three people will be required to lead each State of the Art Topic session (2 co-chairs and a recorder). The Session Leaders are to ensure that ideas expressed during the reaction discussion after the invited paper presentation in a State of the Art Topic session are fully captured and appropriately summarized for publication with the invited paper. Session leaders will be expected to stay an extra day after the Workshop in order to prepare publication versions of the reactions to invited papers. The written item from each session will include identification of participants in the session. In addition, session leaders will be asked to contribute to development of the proposed research statement, Workshop synopsis, and its associated briefing. Session Leaders will be nominated by the Program Co-chairs and reviewed by the Advisory Committee.

Synthesis Committee: The 3-5 people of this Committee will draft the coherent statement or V&V research needs and help the Workshop Chairs & Session Leaders develop Workshop products. They will be nominated by the General Chair and reviewed by the Advisory Committee.

Invited Paper Authors (re State of the Art Topics): An author (or team of authors) will be invited to prepare a paper on each of the State of the Art Topics that will be addressed by Foundations '02. Each author will be recognized as a knowledgeable expert relative to the topic to be addressed. Suggestions about possible candidates to author invited papers will be requested from the Advisory Committee and others. The Program Co-Chairs will develop a list of prospective nominees (qualified individuals who have expressed a willingness to produce papers in accord with established guidelines for the invited papers) and present them for review by the Advisory Committee. An initial tentative list of State of the Art Topics is presented in Appendix A, which also has a suggested outline that the invited papers are expected to follow. Each invited paper will be expected to provide a review of the more significant literature related to the topic, to describe current best V&V practices relative to that topic, to identify and discuss pertinent critical issues, and to identify major research needs pertinent to that topic. The invited paper on "V&V for CFD" for the AIAA conference, *Fluids 2000*, is an example of a paper with the scope, depth, and content expected in the invited papers for State of the Art Topics. Invited paper authors are expected to comply with a production schedule for the paper which will ensure that the paper is available to Workshop participants prior to the Workshop. **Any invited paper author who is not able to meet the production schedule for the paper will be replaced. The Program Co-chairs are responsible for overseeing invited paper progress.**

Topic of Special Interest Authors. An author (or team of authors) will be invited to prepare a paper on a Topic of Special Interest that will be addressed by Foundations '02. Each author will be recognized as a knowledgeable expert relative to the topic to be addressed. Suggestions about possible candidates to author such papers will be requested from the Advisory Committee and others. The Program Co-Chairs will develop a list of prospective nominees (qualified individuals who have expressed a willingness to produce papers in accord with established guidelines for papers on Topics of Special Interest) and present them for review by the Advisory Committee

Workshop Products. The *Foundations '02 Workshop* will have several products in addition to the insights gained by its participants. The Workshop's final report will have four parts and is expected to be available within 60 days after the Workshop is completed.

- First will be comprehensive descriptions of the state of the V&V art in V&V areas addressed by Foundations '02. These descriptions will include invited papers, briefing visuals used with them, and the synopses of reactions to them (those reactions may include white papers submitted by Foundations '02 participants).
- The second part will be an updated V&V bibliography that will be largely based upon sources identified in the Workshop's invited papers and items recommended by Workshop participants et al (using an EXCEL spreadsheet template), but which will not be limited to them and which will include identification of various kinds of V&V resources (web sites, software packages, templates, etc.). This bibliography will not be exhaustive, but it will contain the more significant contemporary V&V literature. It is expected that the bibliography will be available for Workshop participants at the Workshop since sources identified by invited paper authors will have been available for weeks before the Workshop, and contributions from others received more than a month before the Workshop can be included in it also. An evolving version of the bibliography is available on the DMSO web site. The January 2002 version contains over 300 entries, most since the mid-1990s.
- The third part will be a coherent statement of critical research that is required for advancement in V&V.
- The fourth part of the Workshop's final report will be an annotated briefing summarizing Workshop findings that is suitable for presentation to leaders and others in various M&S communities. The report will be distributed directly electronically to all *Foundations '02 Workshop* sponsors and the various parts of it will be distributed electronically to workshop participants who request such. One or more articles about the workshop suitable for future publication in *SIMULATION*, *Computing in Science and Engineering*, and elsewhere are expected. Volunteers will be requested from Workshop participants to write such. A major book on M&S V&V practice, technology, and research using the findings of the of the Foundations '02 is also expected as a follow-on to the Workshop.

Workshop's products will be made available to those interested via the DMSO website and may also be published in paper or CD format (either as the proceedings or as a book based upon Workshop results) as long as such does not limit public access to Workshop materials and products via the DMSO website. It is recognized and will be stated on all Workshop products that the Workshop leaders have sought to ensure that the materials are a fair and comprehensive collection of ideas from the Workshop, but that the ideas should not be construed as necessarily representing the position of any organization or person unless explicitly stated as such – even if the materials are published by a particular organization or hosted on an organization's website so that they can be publicly available.

Workshop Participants. It is expected that the *Foundations '02 Workshop* will have major impact far beyond its participants, but its success depends upon the right people participating. In order for the state of the V&V art to be clearly and comprehensively described, it is vital that not only the invited papers be prepared by very knowledgeable V&V experts, but also the sessions where the papers are presented involve a broad spectrum of experienced and knowledgeable personnel so that the reactions to the papers can ensure a comprehensive and balanced point of view results. As shown in Appendix A, the topics to be addressed by these papers cover much of the V&V spectrum. Therefore, Foundations '02 needs participants who perform V&V on all kinds of M&S and for all kinds of applications. Foundations '02 needs participants who manage M&S developments and who manage V&V endeavors. Foundations '02 needs participants who teach V&V and those who advance its theory and practice. Foundations '02 needs participants who use M&S so that the kinds of V&V that are most useful to them is appropriately understood. The entire M&S community should appreciate the importance to it of this Workshop being successful.

The plenary sessions and Topic of Special Interest sessions will have no limits on participants other than that imposed by the facilities in which Foundations '02 will be held; but participation in the State of the Art Topic sessions at which invited papers are to be presented needs to be limited to 25-30 people per session (both by room size and by consideration of the meeting dynamics) in order for the reaction discussion to have the potential to fully explore and plumb counter views and alternative perspectives (not only will the invited papers be available a month or so prior to the Workshop, but white papers, comments, etc. about it and other views can be posted on Foundations '02 reflectors during that month before Foundations '02 so that the topic can be more fully explored and discussed during the session). A larger group in such a session would make it difficult for the audience to be canvassed appropriately in the 90 minutes allowed for discussion of the topic. This

will require a selection/assignment process for State of the Art Topic session participation to ensure that these sessions can achieve their objectives.

Because of the participation limit noted above, the application for participation in the Workshop will ask for an indication of 1st, 2nd, and 3rd State of the Art Topic and Special Interest session preferences for Day 1 afternoon and for Day 2 morning sessions. The application will request information from the applicant about qualifications which make that person appropriate for a particular session.

Workshop Timeline. This section lays out a timeline of preparation for and execution of the *Foundations '02 Workshop*. The basic time reference (Day 0) is 1 October 2001. Slippage in the date for commitment to the Workshop will cause equal slippage in all subsequent dates in the timeline. The Workshop timeline will be modified as needed.

Before Day 0: Finalize the TOR proposal

Day 0: after TOR formally approved by DMSO

Day 15: All who have formally requested to be general sponsors for Foundations '02 will be contacted to confirm the identify of their representatives to the Advisory Committee

Day 30 (~ 1 November 2001): Appointment or Approval of General Chair, Program Co-chairs, and Organizing Committee members

Day 60 (~ 1 December 2001): Selection of Hosting Sponsor, Identification of the core set of general sponsors for the Foundations '02 (others may be added later)

Day 75 (~15 December 2001): Finalization of Start of the Art Session Topics for Invited Papers & Identification of the Organizing Committee and Synthesis Committee Members

Day 100 (~ mid-January 2002): Preliminary publicity and notices about Foundations '02

Day 120 (~ 1 February 2002): Initial Identification of Keynote Speakers (and alternatives), of State of the Art Topic Session Invited Paper Authors, and of Authors for Topic of Special Interest Sessions; Identification of Session Leaders & Synthesis Committee members

Day 175 (~ 15 April 2002): Detailed outline of invited papers on State of the Art Topics due (response/comments from the General Chair and Program Co-chairs and the pertinent session Co-chairs, required within 30 days; comments from members of the Advisory Committee are also desired)

Day 240 (~ 1 June 2002): Initial draft of invited papers on State of the Art Topics due (response/comments from the General Chair and Program Co-chairs and the pertinent session Co-chairs, required within 30 days; comments from members of the Advisory Committee are also desired); First issue of call for applications for Foundations '02 participants – this call for applications can be issued with specific knowledge of what topics will be addressed during the Workshop

Day 300 (~ 1 August 2002): Final version of invited papers on State of the Art Topics due

Day 345 (~ mid-September 2002): Invited papers on State of the Art Topics posted on a website for Workshop participants to access them prior to the Workshop – Workshop participants can post comments related to the invited papers and their topics on Workshop reflectors from this time until the Workshop, and even after the Workshop; Papers and presentation materials for Topics of Special Interest are due; Foundations '02 participants notified of participation acceptance and session assignments; preliminary program available; Cutoff date for submissions for VV&A bibliography

Day 370 Foundations '02 workshop: 22-24 October 2002 at the JHU/APL Kossiakoff Conference Center

Workshop & 30 Days: Workshop Report Finalized

Workshop & 60 Days: Workshop Report Provided for Sponsors & participants as requested

Workshop & 60 Days: Workshop Product available on an appropriate website

Miscellaneous Items

The TOR may be modified as needed with approval by the Initiating Sponsor, General Chair, and Program Co-Chairs.

Appendix A contains detailed information about the Workshop structure, including a tentative list of topics for the sessions in which state of the V&V art is to be established, and a tentative list of topics of special interest.

Appendix H identifies those who have agreed to be general sponsors for Foundations '02 as of March 2002.

Appendix A

Foundations '02 Workshop Schedule and Proposed Topics

Miscellaneous Workshop Schedule Items

(program details available in Events Calendar at: <http://www.trainingsystems.org>)

The structure for Foundations '02 makes it a two-day event for most participants, a three-day event for Workshop leaders.

Registration/Workshop Support: 8 am – 6 pm Days 1-2, with primary registration on Day 1 & Day 2 mornings

Refreshments (morning, mid-morning, and mid-afternoon)

Mixer/Social Event (Day 1 5-7 pm), opportunity for participants to interact with those providing software/V&V resources

Read Ahead Materials

Read ahead materials will include the invited papers so that discussions in the track sessions can focus on issues and disputed points. Some read-ahead materials will be sent to participants; other materials may be accessible via a web site.

Opening Plenary Session

Opening Plenary Session (Day 1, Tuesday, October 22, 8:15 am – 11 pm)

- a. Welcome, general administrative information, and overview (should include a summary of issues and concerns, the workshop's objectives, and the agenda): 15 minutes.
 - b. Keynote Speaker 1: 40 minutes (30 minutes presentation, 10 minutes questions & comments)
 - c. Keynote Speaker 2: 40 minutes (30 minutes presentation, 10 minutes questions & comments)
 - d. Keynote Speaker 3: 40 minutes (30 minutes presentation, 10 minutes questions & comments)
- Attributes of Keynote Speakers. Each one must be someone who counts.

DoD keynoter

DOE/ASCI keynoter

Industry or academic keynoter

Keynote speakers will be expected to address Issues of economic and industrial loss due to faulty science, engineering, and simulations. Issues of national defense in DoD/DOE as well as stress the importance of the Workshop and its product.

- e. Closing Comments (admin/etc.): 15 minutes

First Day Wrap Up Session (Day 1, Tuesday, October 22, 4-5 pm)

This session will provide an opportunity for process issues to be raised/addressed and for key insights from the different State of the Art Topic Sessions to be shared so that those insights can help discussions in State of the Art Sessions on the following morning.

State of the Art Topic Sessions

Day 1 Afternoon (Tuesday, October 22, 12:15-3:30 pm) – Track A with up to 6 parallel sessions -- participants should attend their assigned sessions (rooms used by these sessions have other commitments after 3:30 pm)

Day 2 Morning (Wednesday, October 23, 8:30 – noon) – Track B with up to 6 parallel sessions -- participants should attend their assigned sessions

In each session, an invited paper will be presented on the topic for that session – participants expected for a session will have had access to the paper (either via a website or from materials sent to participants) for about a month prior to Foundations '02 and will be expected to have read the paper prior to the Workshop and can share comments about the topic with other expected participants via Workshop reflectors – they can share white papers about the topic and other materials in this way as well as less substantial comments. The invited paper author(s) will have 75-90 minutes to present the paper. In general, the paper should contain the kinds of information shown below, organized in the most appropriate way for the topic. It is expected that most of these papers will be 20-70 pages long.

- a. Clear delineation of the topic/domain which the paper is addressing (such as V&V for CFD applications, validation of simulations with humans in the loop, etc.)
- b. Identification of the primary pertinent literature and resources (applicable and pertinent standards, guides, and recommended practices; key articles, papers, book portions, and books directly dealing with the subject – most of these should be current, i.e., within the past 5 [or at most 10] years, except for classic and primary guidance sources; key available tools and technologies; and resources such as information repositories, sources of pertinent experts, etc.) – *in addition to listing these in the paper, the invited paper author will be expected to provide the list of resources in the specified EXCEL spreadsheet format for easy inclusion in the VV&A bibliography that is expected to be a product of the Workshop*
- c. Identification (and where appropriate description) of key V&V-related processes, techniques, and technologies currently employed in the domain with explicit discussion of capabilities, limitations, issues, and resource requirements
- d. Identification of major issues related to V&V in this domain
- e. Major research areas required for significant V&V progress in this domain
- f. General recommendations, suggestions, etc.
- g. Conclusions

The invited paper presentation will be followed by 75-90 minutes in which any controversial or omitted points will be identified, issues raised, and conclusions drawn by session participants. The session co-chairs will moderate this discussion, and they with the session recorder will capture the key ideas. The final 15-20 minutes of the session will allow the session co-chairs to summarize what they believe that the session has concluded about the state of the V&V art on that topic, and hopefully obtain concurrence from session participants.

The person or team of people assigned to produce an invited paper are expected to have recognized stature in the M&S VV&A community as evidenced by prior publications, leadership roles in various VV&A activities, etc. Invited paper author nominees will be approved by the Advisory Committee. If an appropriate plan for developing an invited paper for a topic cannot be developed in a timely manner, that topic will be dropped from Foundations '02. *If a sufficient number of invited papers are not planned for Foundations '02 (this is will be known about Day 120 in the timeline for the Workshop), then the plans for the Foundations '02 will be cancelled.*

Track A Topics (the focus is on validation when V&V is used below):

- A1: Verification Technology Potential with Different M&S Development & Implementation Paradigms.** Verification technology includes the full spectrum of CASE tools and automated requirements/specification/test/code generation capabilities as well as formal methods, model checking, and related techniques. Development paradigms include both the traditional waterfall (serial development) and interactive development methods such as rapid prototyping, spiral development, etc. Implementation paradigms include heterogeneous legacy codes which may be close to a black box, object-oriented (O-O), formal systems, adaptive processing techniques (such as AI, fuzzy sets, genetic algorithms, etc.), distributed simulation reuse of existing simulation components.
- A2. Selected V&V (especially validation) Methods and Technologies.** This session will address requirements V&V, statistical techniques in V&V, V&V in testing/T&E, and fundamental and theoretical limits on V&V. This topic is related to current research on validation metrics.
- A3. M&S Assessment.** Assessment requires identification of sources of uncertainty and potential error both for the M&S and in the knowledge (referents used, such as experimental data and observations) of the subject represented, specification of fidelity required to satisfy intended applications, and quantification of M&S fidelity with identification of fidelity and validation referents. Processes, techniques, and technologies employed for such assessment.
- A4. Subject Matter Expert (SME)/Peer Use in M&S V&V.** Review is a primary validation technique. How reviewers are selected, managed, and used is very important as are how reviews are conducted and responses to them.
- A5. Use of Formal Methods in V&V (especially validation).** Formal methods which have potential to create mathematically-provable correctness provide hope for improvements in the quality of M&S

software. Identifications of where such is appropriate, personnel requirements to develop such, and personnel requirements to perform V&V on such is of particular interest and importance.

- A6. Implications of M&S Foundations (i.e., Basic M&S Characteristics) for V&V.** This contribution makes the point that effective enablers for V&V are derived from the foundations of M&S as characterized by general and special theories and methodologies. Modeling concepts, theories, and methods provide the underlying basis for model specification, homomorphism, and validation. Formal simulation approaches (e.g., parallel/distributed in logical/real time) provide the means to examine simulation correctness and their applicability. Combined model and simulator specifications provide the basic means necessary to model and simulate families of models and assess their self-consistency as a whole in isolation and their validity in relation to real-world phenomena.

Track B Topics (the focus is on validation when V&V is used below):

- B1. V&V (especially validation) for M&S in Computational Science and Engineering Applications.** Computational mechanics, computational fluid dynamics (CFD), etc. and other simulation applications pose particular V&V challenges.
- B2. V&V for M&S with hardware or systems in the loop (including all manifestations of distributed simulations).** Interfaces and interoperability with hardware, systems, and/or other simulations pose special V&V challenges.
- B3. V&V (especially validation) for M&S with Human Behavior Representation or People in the Loop, both M&S which require high fidelity and those which do not require high fidelity.** The first kind of M&S may be used in aircraft and nuclear power plant simulators and other safety critical kinds of M&S. The second kind of M&S may be used in war games, entertainment, and other simulations which do not have safety critical implications.
- B4. Estimating V&V Resource Requirements and Schedule Impact.** Methods used to predict the level of V&V resources required for various levels of M&S credibility and the impact of such V&V activities on M&S development and use schedule is a matter of great interest.
- B5. V&V (especially validation) for M&S which employ Adaptive Processing** such as AI, neural nets, genetic algorithms, fuzzy sets, etc. Adaptive processing poses special validation problems since sometimes M&S processes will change as the adaptive processing element “learns” and since it may not be possible to have an explicit understanding of why the M&S acted as it did.
- B6. V&V (especially validation) for M&S which employ significant aggregation.** M&S which employ significant aggregations (such as found in campaign models, many economic and logistical models, etc.) pose special V&V problems.

Topics of Special Interest for Sessions in Parallel with State of the Art Topic Sessions

These sessions will be 3-3 ½ hours long. Each session will have one or more papers, and may involve panels or other means to address the topic of the session. It is expected that four Topic of Special Interest Sessions will be held in parallel on Day1 (Tuesday) afternoon (T1, T2, T4, and T7) and on Day 2 (Wednesday) morning (T3, T5, T6, and T8).

- T1: V&V Education in Academia** (items that should be covered, possible lesson plans, resources, where to insert V&V materials in computer science, engineering, science, and other curricula)
- T2: Managing V&V** (addresses issues peculiar to V&V – such as SME selection and use, role of IV&V in M&S development, V&V for legacy and distributed simulations, etc.)
- T3: V&V Research**
- T4: V&V Issues and Implications for M&S Reuse**
- T5: Formal Systems and Their V&V Utility**
- T6: V&V Tools, Templates, and other Resources**
- T7: V&V policies, guides, handbooks, and standards** (within the Defense community and from other authorities such as DOE/ASCI program, professional societies, etc. The purpose is to identify what these alternative agencies are, where they apply, how they differ, etc.)
- T8: V&V Education the Workplace** (on the job training, short courses, resource materials, etc.)

Wrap-up Plenary Session (Day 2, Wednesday, October 23, 1:30-5 pm)

A plenary session will be held in which leaders from each track will present the conclusions reached within the tracks. Tentative recommendations for the workshop will be presented and discussed. A closing keynote will point the way ahead for implementing research suggestions from the workshop. The workshop will be concluded with appreciation to all participants, especially to invited speakers, and a reminder about expected workshop products.

Workshop Product Production (Day 3, Thursday, October 24)

Session on Day 3 will last as long as needed. Session leaders will finalize the synopses of discussion in their sessions using a common basic format – it is recommended that Session leaders prepare drafts of the synopses prior to the Workshop, based upon invited paper contents and comments on the topic reflector by expected participants to facilitate development of the synopsis. This material will be published in conjunction with the invited papers. Synthesis Committee members will draft the conclusions of the Workshop and the statement of proposed research needs. In doing this, the Synthesis Committee will draw upon material from the different sessions and from the invited papers, and from audience response to the presentations and comments during the Day 2 afternoon session. Program Co-Chairs will review material from session leaders and the Synthesis Committee to ensure that everything which needs to be completed at the Workshop is accomplished before session leaders and Synthesis Committee members depart. If time permits, the Program Co-Chairs will create an initial draft of portions of the Workshop report, such as the briefing for sponsors et al.

Post Workshop Activities

Workshop & 30 Days: Workshop Report Finalized (Program Co-chairs responsibility)

Workshop & 60 Days: Workshop Report Provided for Sponsors & participants as requested
Briefings to the Initiating Sponsor et al (General Chair responsibility)

Workshop & 60 Days: Workshop Product available on an appropriate website

Possible book publication based upon the Workshop (responsibility TBD if this is to be done)

Miscellaneous

Lunch, break refreshments, and the Day 1 Mixer will be provided in the Kossiakoff Education and Conference Center. It is expected that cost of these will be included as part of the registration fee.

Initial planning for Foundations '02 indicates that a registration fee of \$150 will be adequate to cover costs of conducting the workshop (\$200 after mid-September). One free registration will be allowed for each invited paper and special topic. The lead author for each will decide how that gratis registration is used (for which author of the team for that paper/topic, or whether it should be spread equally among the authors of the team).

Appendix B

Foundations '02 Workshop Sponsors (as of July, 2002, listed alphabetically)

- Association for Computational Machinery (ACM) Transactions on Modeling and Computer Simulation (TOMACS)
- Aegis Technology Group, Inc.
- American Society of Mechanical Engineers (ASME) Applied Mechanics Division (AMD)
- Arizona Center for Integrative Modeling & Simulation (ACIMS)
- Boeing Phantom Works
- Center for Economic Research (CentER), Tilburg University (Netherlands)
- Clemson University
- **Defense Modeling and Simulation Office (DMSO)**
- Federal Aviation Administration (FAA) Flight Standards Service
- Gesellschaft für Informatik (Bonn, Germany)
- Illgen Simulation Technologies
- Innovative Management Concepts, Inc. (IMC)
- Johns Hopkins University/Applied Physics Laboratory (JHU/APL)
- Joint Accreditation Support Activity (JASA)
- **Modeling and Simulation Subcommittee of the Joint Army Navy NASA Air Force (JANNAF) Interagency Propulsion Committee**
- McLeod Institute of Simulation Sciences -- California State University (CSU), Chico
- Ministry of Defence (UK) Synthetic Environment Coordination Office
- Modeling & Simulation Information Analysis Center (MSIAC)
- NASA Ames Research Center
- National Institute of Standards and Technology (NIST)
- *National Training Systems Association (NTSA)*
- Office of Naval Research (ONR)
- Shodor Education Foundation, Inc.
- Simulation Interoperability Standards Organization (SISO)
- Survivability/Vulnerability Information Analysis Center (SURVIAC)
- The Society for Modeling and Simulation International (SCS)
- United States Association for Computational Mechanics (USACM)
- University of Central Florida Institute for Simulation and Training (UCF/IST)

Bold entries are initiating sponsors.

Italics entry indicates the hosting sponsor.

“Expected” indicates a leader of the organization has stated that it would like to become a sponsor but the formal paperwork has yet to be received.

Other organizations may choose to become sponsors of Foundations '02. They will be added to the list of sponsors maintained on the DMSO web site page about Foundations '02.