

Experience in Developing the “AIAA Guide for the Verification and Validation of Computational Fluid Dynamics Simulations”

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Presentation for:
ad hoc Committee on Verification and Validation
United States Association for Computational Mechanics
Nashville, Tennessee
November 14, 1999



Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000

Outline of Presentation



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- **Background Information**
- **Elements for success**
- **Recommendations**

AIAA Standards Committees



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- **20 AIAA Committees on Standards**
- **Supervised by the AIAA Standards Executive Council**
- **AIAA Standards Program is accredited by the American National Standards Institute (ANSI)**
- **Three levels of standards documents:**
 - **Guide**
 - **Recommended Practice**
 - **Standard**
- **All documents are advisory only; not legally binding**
- **Standards documents are separate from journal and conference paper publication requirements**

AIAA Computational Fluid Dynamics Committee on Standards



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- **CFD COS was formed in 1987**
- **Committee membership:**
 - **15 - 20 members serve voluntarily**
 - **Members from industry, government, and academia**
- **Committee Chairs:**
 - **1987 - 1992: Shmuel Eidelman, Science Applications Inc.**
 - **1992 - 1998: John Porter, Sverdrup Technology**
 - **1999 - present: Raymond Cosner, Boeing/St. Louis**

CFD COS Project: Assessment of Accuracy of CFD Simulations



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- Project begun in 1992
- Purpose of project:
 - **To promote the establishment of basic terminology and methodology for assessment of accuracy of CFD simulations.**
- Debated issues from 1992 to 1996:
 - Terminology
 - Verification and validation methodology and procedures
 - Concerns of industry that document could be used as a “club”
- First draft of document: “Guide to the Assessment of Uncertainty in Computational Fluid Dynamics Simulations” (AIAA G-077-1997)
 - Prepared by: Unmeel Mehta, NASA/Ames Research Center
 - Failed committee vote in June 1997

CFD COS Project: (continued) Assessment of Accuracy of CFD Simulations



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- **New volunteer June 1997: Bill Oberkamp**
- **Asked two other committee members to put new draft together:**
 - **Munir Sindir, Boeing/Canoga Park**
 - **Terry Conlisk, Ohio State University**
- **New draft prepared and sent to members for vote in December 1997**
- **New draft passed committee in January 1998**
- **Incorporated committee comments and comments from others**
- **Published in June 1998:**

**“Guide for the Verification and Validation
of Computational Fluid Dynamics Simulations” (AIAA G-077-1998)”**

Elements for Success: Committee Membership



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- **Diverse representation is needed:**
 - **Industry, government, and academia**
 - **Computationalists and experimentalists**
 - **Researchers, applications analysts, and software developers**
 - **Engineering staff and management**
- **Experience in V&V is desirable, but not necessary**

Elements for Success: V&V Document Preparation



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- **Draft document should be prepared by a small team:**
 - 2 - 4 individuals
- **Team should be composed of diverse viewpoints:**
 - Industry, government, academia, analysts, experimentalist, code developer
- **Team members, especially the team leader, must be:**
 - Flexible in their viewpoint and willing to compromise
 - Willing to devote significant time and effort
- **A cohesive, resolute, team is critical**

**Comparable to writing an article for Annual Reviews,
but you must satisfy 25 reviewers.**

Elements for Success: Administrative



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- **Committee must be part of an ANSI approved Standards Program.**
- **Early drafts of the V&V document should be discussed and debated, but not voted on.**
- **At the appropriate time, a formal vote must be taken.**
- **Rules for voting:**
 - **A negative vote must be accompanied by detailed criticisms**
 - **A positive vote may include recommendations for changes**
 - **The vote of the committee must be near unanimous**

Recommendations: Technical



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- Using the AIAA Guide as a basis, expand to solid mechanics/dynamics
- Topics in need of debate/development/extension:
 - Terminology (e.g., uncertainty, error, prediction)
 - Detailed verification assessment procedures (e.g., quantification of numerical error, high accuracy solutions for solid mechanics/dynamics)
 - Detailed validation assessment procedures (e.g., construction of validation levels, statistical quantification of validation comparisons, design and execution of validation experiments)
 - Attain a good balance between solid mechanics and solid dynamics

CAUTION: Don't try to do everything!

Recommendations: Administrative



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- Have our *ad hoc* committee join/merge with the Standards Program committees of:
 - ASME or ASCE or AIAA
- Committee membership:
 - Expand to about 20 to 25 interested members
 - Improve the depth of representation of diverse viewpoints
 - Keep membership emphasis on solid mechanics and solid dynamics