FSP: Validation Program Planning

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FSP Kick-off Meeting

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A Plan for a Plan

- Refine our concept of what needs to be done
- Enumerate a concrete set of tasks and deliverables
  - Who does which tasks?
  - How will they be carried out?
  - Estimate resource requirements (for FSP definition phase)
- Define a preliminary schedule

Work Elements for FSP Validation Program Definition

- Build team
- Gap analysis
  - Outreach to fusion community
  - Assess and document lessons learned from other communities
- Define validation planning tasks
  - Detail tasks and roles for FSP validation
  - Define mechanisms for collaboration with experimental groups
  - Coordinate with code groups
- Plan and prototype documentation strategy
- Plan and execute pilot projects as needed

Team Building

- Successful validation program for FSP will require unprecedented level of collaboration between theory, modeling, experiments and diagnostics
- Approximately 1 FTE explicitly funded for project definition
- Will need to leverage other resources and build extended team from both inside and outside FSP
  - Define responsibilities for verification and validation within FSP
  - Identify and recruit collaborators from outside
  - Provide modes of communication, documentation
    - Web site, Wiki, etc.

Outreach Within MFE Community

- Questions:
  - Assess state of art and plans for validation in MFE
  - How does community view priorities?
  - How would they approach collaboration with FSP?
  - How to best marshal necessary resources (outside FSP)?
  - How to coordinate?
- Avenues for information gathering
  - BPO/TTF validation task force
  - ECC
  - Other topical groups?
  - ITER modeling team
  - International fusion programs
  - Informal get-togethers at meetings
  - Site visits
- Build formal and informal collaborations

Assess Lessons Learned from Other Communities

- Communities
  - Climate
  - Combustion
  - ASCII
  - Other CFD
  - Others?
- Approaches
  - Literature search
  - Contacts (especially team members with outside contacts)
  - Site visits?

Perform Gap Analysis

- Combine info from inside and outside MFE
- Identify critical gaps in capabilities or methodologies, for example
  - Post-processing and Visualization tools
  - Analysis and synthetic diagnostics
  - Other software requirements
  - Statistical techniques
  - Metrics
  - Experimental capabilities
  - Measurement capabilities
- Manpower and other resource estimates (for FSP itself)

Detail Tasks and Roles for FSP Validation

- Tasks would include
  - Definition of critical physics tests, priorities
  - Design of validation experiments including diagnostic/experimental requirements
  - Code predictions
  - Experiment execution
  - Analysis/tool development
  - Documentation
  - Feedback into code development effort
- Define roles for theory, code groups, analysts, experimentalists, diagnosticians
- Software support
- Coordination and management

Define Methodologies for FSP Validation

- Summarize best practices
- Elements include:
  - Roles and responsibilities
  - Jointly designed experiments – principles and practice
  - Hierarchy of experimental tests
  - Documentation of code predictions
  - Measurement and documentation requirements for experiments
  - Quantification of errors and uncertainties
  - Quantification of comparisons
  - Documentation methodologies

Critical Need: Analysts

- In “high-consequence” applications, V&V is led by dedicated analysts
  - Weather prediction and climate modeling
  - Turbomachinery
  - Airframe design
- Not tied to code development groups
- Can serve as honest brokers, providing unbiased and dispassionate assessments
- Requires specialized skills
- Analysts would have leading role in designing and analyzing validation experiments
  - Close collaboration with theorists, computationalists and experimentalists
  - Help marshal the computational and experimental resources
  - Help develop post-processors, synthetic diagnostics
- What is FSP role in developing/training?

Define Mechanisms for Collaboration with Experimental Groups

- How to marshal necessary resources and build engagement and commitment
- How to impact long term planning and development of capabilities
  - Machine operations (heating, fueling, current drive, etc)
  - Diagnostic development and deployment
- How to organize experimental programs and interact with experimental planning
- How to jointly design and execute validation experiments, including careful documentation
- Identify experimental time, manpower and other resources required
- Develop guidelines for publication and other IP issues
- Define approach for coordination and management

Coordination with Code Groups (Inside and Outside FSP)

- Identify critical physics for testing
  - Identify validation requirements at various “levels” of physics integration
- Define validation experiments and measurements required
- Coordinate with verification efforts
  - make sure this has sufficient priority and is carried out in timely manner
- “Regularize” interactions
  - Validation results should guide code development
  - Ensure adequate computational resources for verification and validation
- Common infrastructure
  - Documentation – approach, schema
  - Data structures, API
  - Post-processors, analysis tools, visualization tools and synthetic diagnostics

Embody V & V Planning Within FSP

- As FSP plan solidifies, map out research needs and directions in detail
- Ask some important questions
  - How will model predictions be used?
  - Which applications?
  - What are the impacts of predictions? of errors in predictions?
- Assess Status
  - Which areas are well understood? Where are they uncertain or controversial?
  - What new developments in physics or methodology are required?
- Define requirements for validation
  - When are models “ready”?
  - Which are the critical elements of each model? – **priorities for testing**
  - What are the experimental and diagnostic requirements?

Plan and Prototype Documentation Strategy (1)

- What needs to be saved?
  - (Everything)
  - Include both experimental and modeling data
    - Raw and processed data
    - All auxiliary data and inputs, calibrations, assumptions, geometry, boundary and initial conditions, etc.
    - Estimations of errors and uncertainties
  - Include metadata for every data item. Create a complete, coherent, self-descriptive structure
  - Results of all analysis
  - Textual information to describe methods, physics, commentary.
  - Everything time stamped and attributed.
- Make this list complete, specific then prototype

Plan and Prototype Documentation Strategy (2)

- Characteristics for data storage and access
  - Needs to be shareable, easy to use (API critical), archival
  - Dynamic and interactive – able to be updated, annotated, appended
  - Queryable - searchable by content or by address
  - Browsable
  - Linked to publications
  - ?
- Refine functional and non-functional requirements, define approach and prototype
- (With other groups) define data access rules

Plan and Execute Pilot Projects

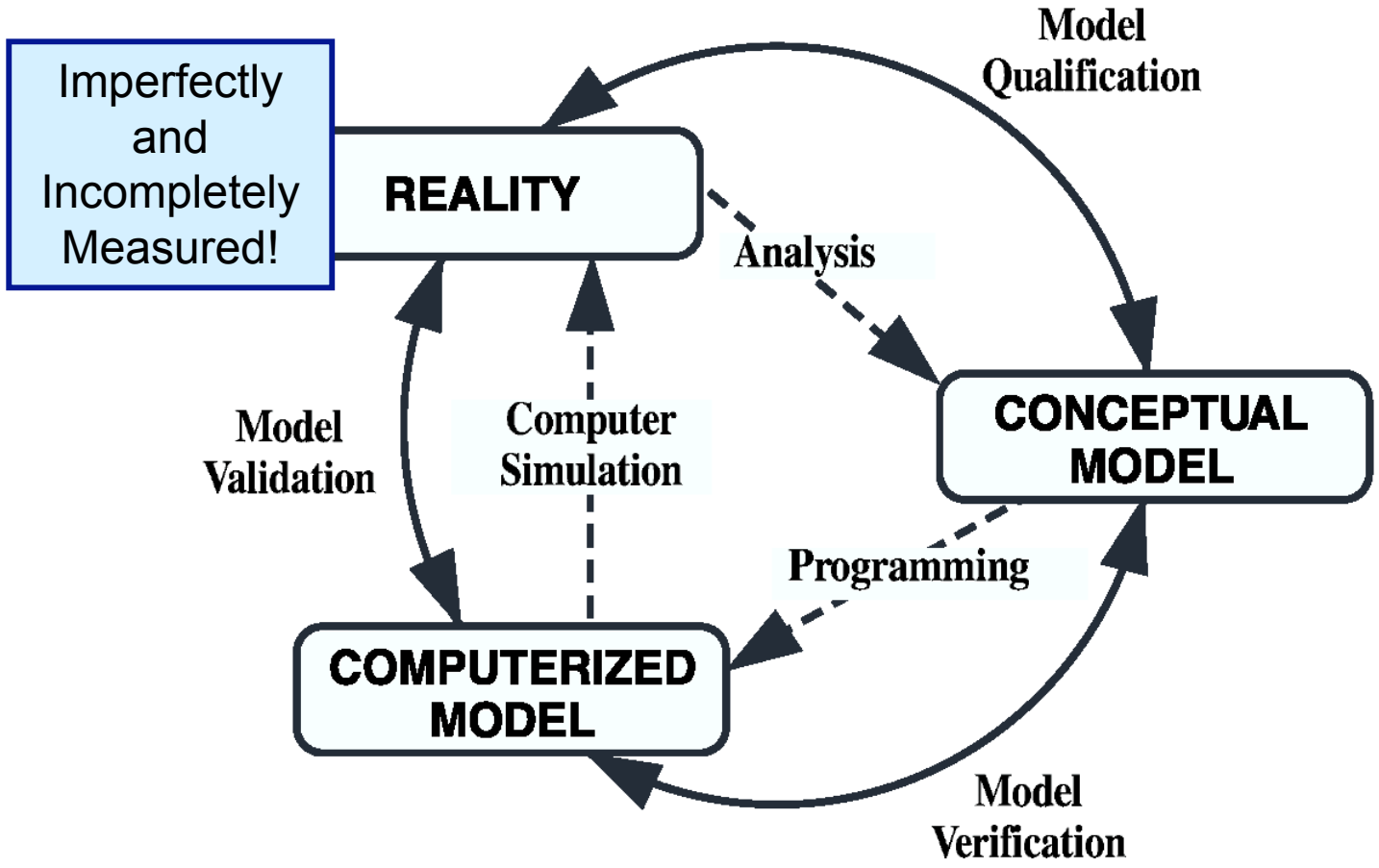
- How could pilot projects aid FSP? (more or less in order of importance)
  - Help address open issues or questions
  - Validate approaches and methodology
  - Start to build needed collaborations
  - Demonstrate ROI of FSP
- Pilot projects chosen to meet above criteria
- Workshops?
- Encourage and solicit proposals?

Some Short-Term Actions

- Build team and define roles
- Provide tools for collaboration and documentation (Should be FSP-wide, but structured?)
- Enumerate deliverables
- Define coordination with verification efforts
- Define preliminary schedule

End

Elements of Thrust: Relation of Processes



Schlesinger 1979