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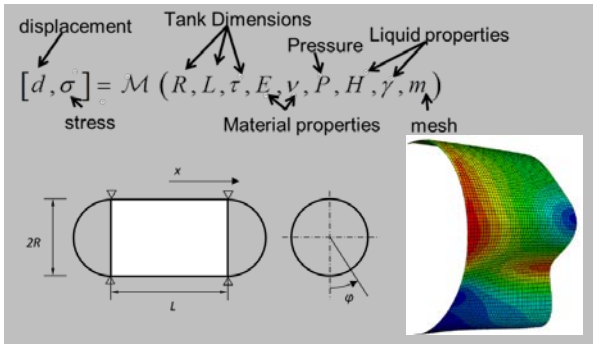

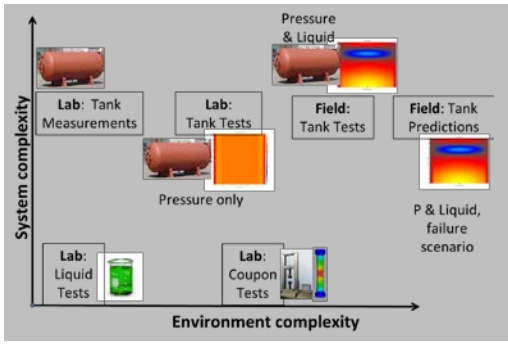

The 2014 Sandia V&V Challenge Workshop and the ASME VV&UQ Journal

Ken Hu

VERIFICATION™ VALIDATION

V&V, UQ, and Credibility Processes Dept.

Sandia National Laboratories

Presented at the 2015 ASME V&V Symposium

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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Thanks up front

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- Challenge workshop participants
- V&V department and Dakota team at Sandia
- ASME committees
- V&V community
- Symposium organizers

Should we have a workshop?

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- Of course! But think about:
  - Why?
  - Who?
  - What = workshop with challenge problem
  - How?
  - Where = ASME V&V Symposium
- Start with why: be very clear on the goals
  - but you also need participants to come.
  - and they must be able to complete the problem

Be very clear on the goals

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Pick one??

Community engagement	Education/ training	Methods demonstration
Solve a real world problem	Methods development	Attack an open problem

The goals evolved over two years of development

- The resulting challenge problem lacks focus
- Built to ask high level questions about role of V&V

V&V community divided by interests

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People, Products:

V&V R&D	V&V Practice	V&V Users
Academics	Model Developers	Customers?
Committees	Code Developers	People outside community?
V&V Theory	Analysts	
V&V Methods	Experimentalists?	Product?
V&V Standards	Product?	

Are we too divided by physics discipline / business sector?

- V&V 10 vs. 20, 30, 40?
- Can we/ should we talk more?
- Why have different standards?

What? How?

- Pose a challenge problem, host a workshop
- Why and who → define the challenge problem

1. Aggregation of uncertainty
   → need many sources of uncertainty
2. Investigate the role of V&V
   → need "real world" context
3. Accessible to many
   → multiple points of interest
   → wide range of possible approaches
   → limit barriers to entry

The Story of Mystery Liquid Company

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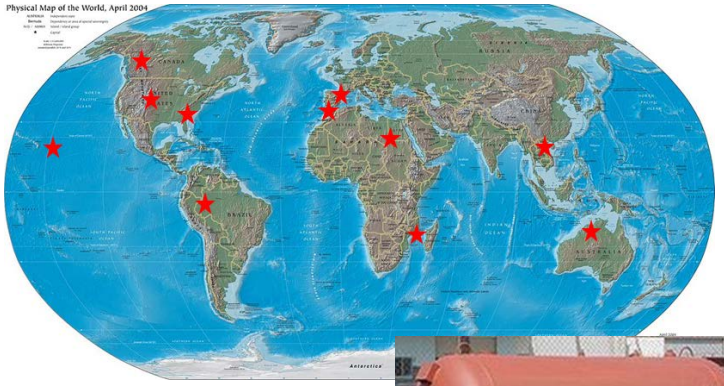
Have many storage tanks, holding Mystery Liquid under pressure

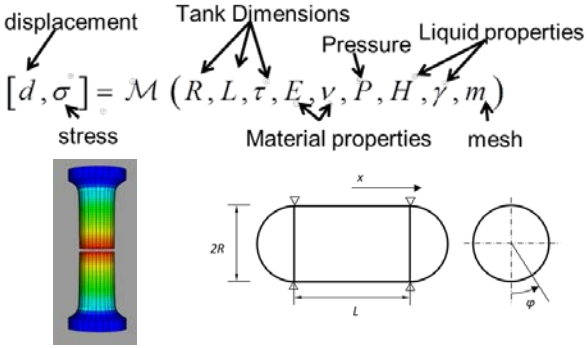


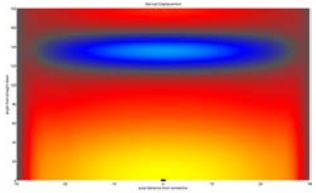
During standard safety testing,
one tank's measurements
exceeded a safety specification

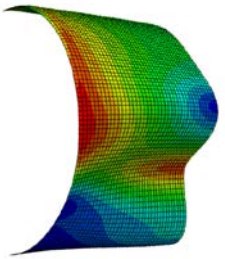
How should we respond?

Are the tanks at risk of failure?
No tanks have actually failed, ever.

Experimental and modeling efforts are begun



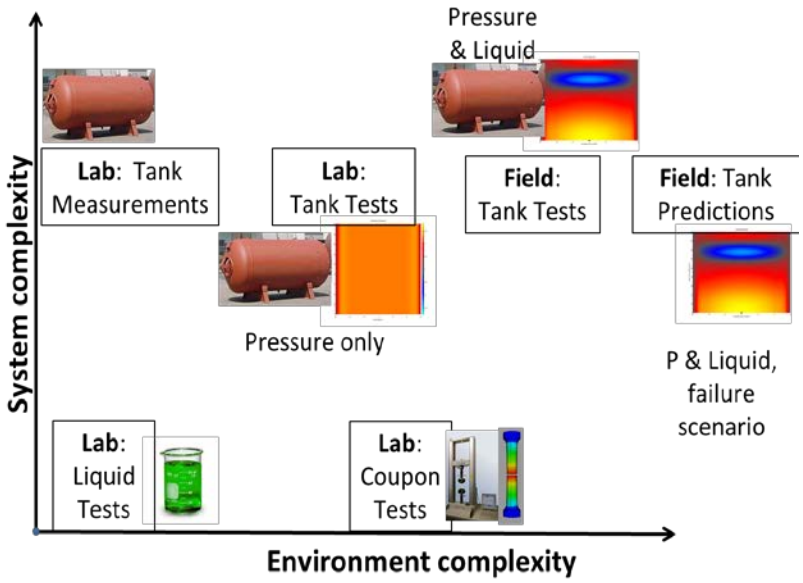




Supply a prediction – is it credible?

The challenge:

- How will evidence from experiments and simulations be integrated and used to support the final decision?



What analyses?

1) Characterize uncertainty from data
2) Treat epistemic vs. aleatoric uncertainty
3) Calibrate model parameters
4) Sensitivity analysis, Uncertainty quantification
5) Solution verification
6) Validation
7) Aggregation of uncertainty
8) Assess relevancy from hierarchy of information
9) Credibility assessment

Supply a prediction – is it credible?

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Participants should:

1) Develop and communicate a strategy to use experimental data and models
2) Predict failure probability at max load and account for uncertainty
3) Assess prediction credibility

ASME VV&UQ Journal

First issue will be dedicated to the challenge workshop

- Aniruddha Choudhary, I. Voyles, C. Roy, M. Patil (Virginia Tech), B. Oberkampf (Consultant)
- Zhimin Xi (University of Michigan – Dearborn), R. Yang (Ford)
- Lauren Beghini, P. Hough (Sandia National Labs)
- Tom Paez, P. Paez, T. Hasselman (Consultants, V&V10)
- Wei Chen, W. Li, S. Chen, Z. Jiang (Northwestern)
- Josh Mullins, S. Mahadevan (Vanderbilt)
- Michael Shields* (Johns Hopkins)
- Additional papers: intro, problem statement, truth model description, conclusion

Responses and reactions

- Challenge problem mimics an engineering project
- Groups applied different V&V strategies, methods
  - Reflects different priorities, time commitments
- P(fail) results for groups A-E
  - (A) 0.0075, (B) 0.0068, w/ high uncertainty
  - (C) Bounded by [0, 0.0034]
  - (D) 5e-16, with 99% confidence
  - (E) 0, with low simulation credibility
  - (F) N/A, data too poor to provide a prediction

Responses and reactions

- There is no “right” answer
  - Six “valid” responses to the same challenge
  - Diversity in methods and strategies
  - Different ideas of what the V&V product looks like
- Next questions
  - How to evaluate these results? How to assess credibility, influence decisions? Etc.
- We must continue the conversation
- **Soliciting discussion papers for a later issue of the ASME VV&UQ Journal**

Did we achieve our goals?

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Community engagement	Education/ training	Methods demonstration
Solve a real world problem	Methods development	Attack an open problem

Thanks!

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- I left out:
  - Sandia's mission → unique V&V perspective and workshop motivation
  - Why Symposium was a good fit for the workshop
  - History of V&V/UQ challenge problems
  - Details of the 2014 challenge problem
  - Results & lessons from the workshop
    → Another talk, later today
- To learn more about the problem, workshop
  - https://share.sandia.gov/vvcw
  - Email us: vvcw@sandia.gov