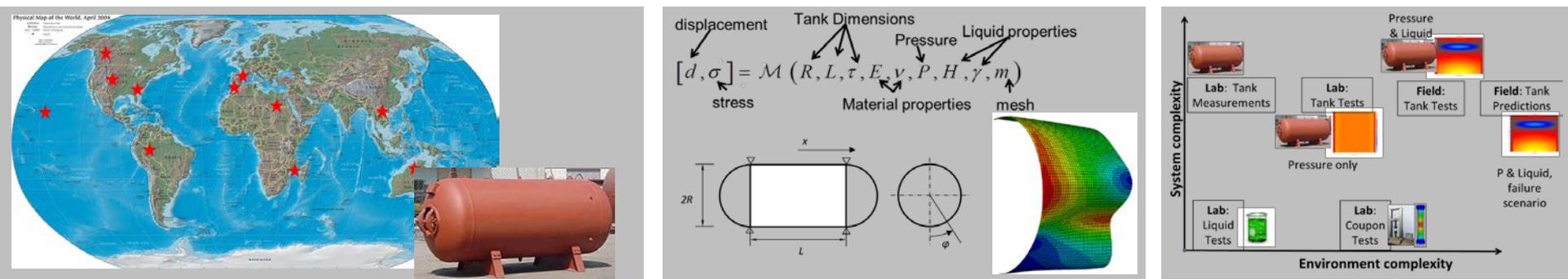


Exceptional service in the national interest



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

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Presented at the 2015 ASME V&V Symposium

SAND2015-3762 C



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Thanks up front

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

Should we have a workshop?

- Of course! But think about:
 - Why
 - Who
 - What = workshop with challenge problem
 - How
 - Where = ASME V&V Symposium
 - When = 2011~2014+
- 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 goal

Pick one?

Community
engagement

Education/
training

Methods
demonstration

Solve a real
world problem

Methods
development

Discuss an
open problem

Our goal evolved over two years of development

- Wanted to provoke questions about role of V&V
- The resulting challenge problem lacks focus
- Can apply almost any V&V related question

Be very clear on the goal

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Started in late 2011, same timeframe as this symposium

- Initial goal: highlight V&V topics of interest to Sandia
- How to differentiate from a conference?
- Build around a challenge problem

Be very clear on the goal

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Provide a venue for analysts to learn best practices

- Provide valuable experience
- Can be done without Sandia
- Ex: short courses, literature, standards committees

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Continue the tradition of challenge problems

- Check the state of the art in V&V methodology
- Focus on one V&V topic, ex: “aggregation”

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Crowdsource the solution to a real problem

- Ex: Netflix prize
- Not a good fit for this community
- Real problems too big, complex, proprietary

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Targeted development of methods or approaches

- Ex: extrapolation out of validation domain
- Needs time, funding

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Workshops are good for highlighting gaps

- Not many gaps on quantitative methods side
- Many open problems on qualitative process side
 - Ex: connection between V&V and credibility

Be very clear on the goals

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We ended up with several goals, large scope

- Attract wider audience – something for everyone
- Less focused, more difficult for participants

Who: the V&V community

- Community is segmented in many ways
- At ASME, separate physics disciplines/ business sectors
 - V&V 10 vs. 20, 30, 40
- Subfields: V vs. V vs. UQ
 - Can't be an expert in everything
- Different roles:

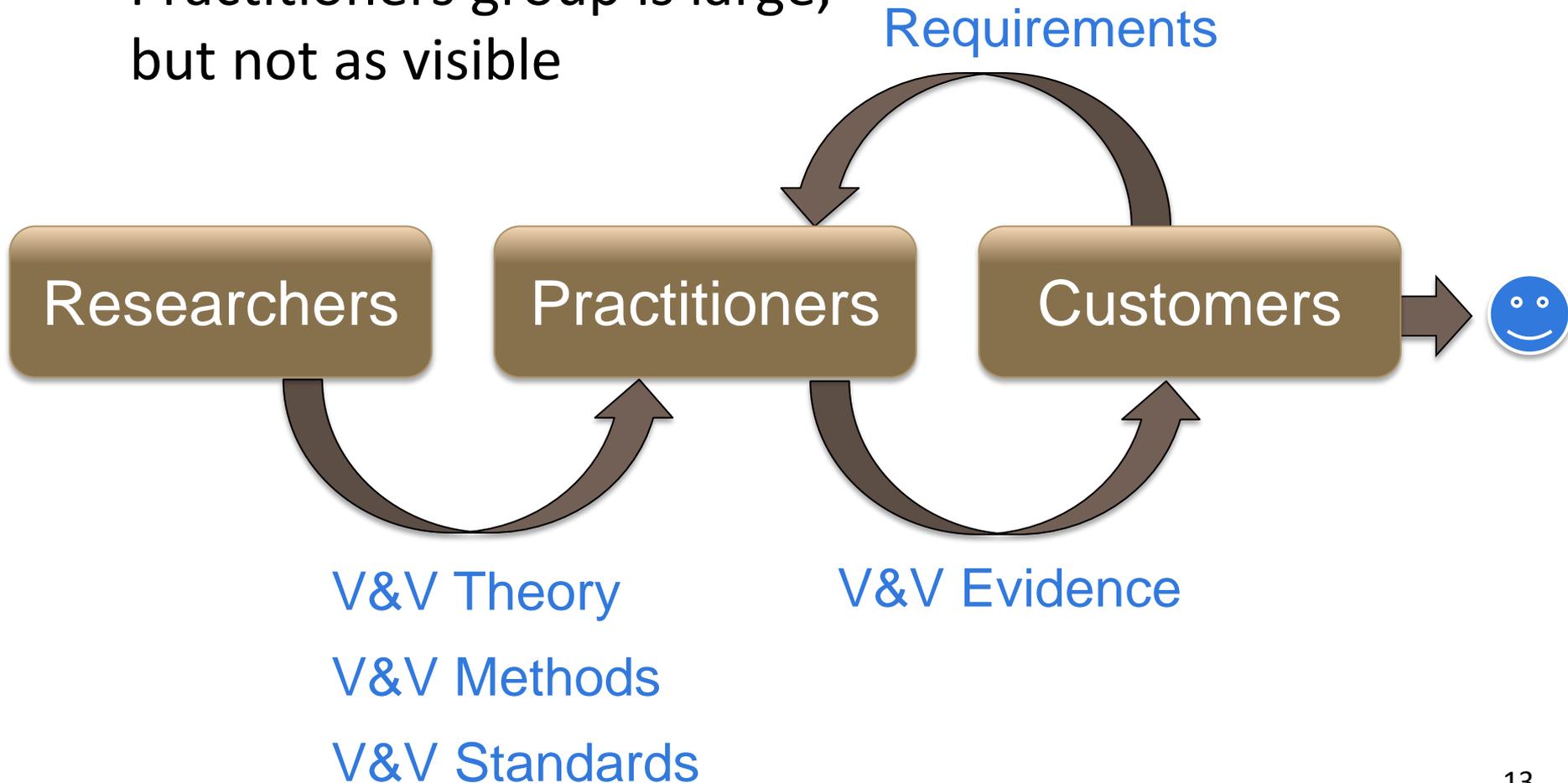
Researchers

Practitioners

Customers

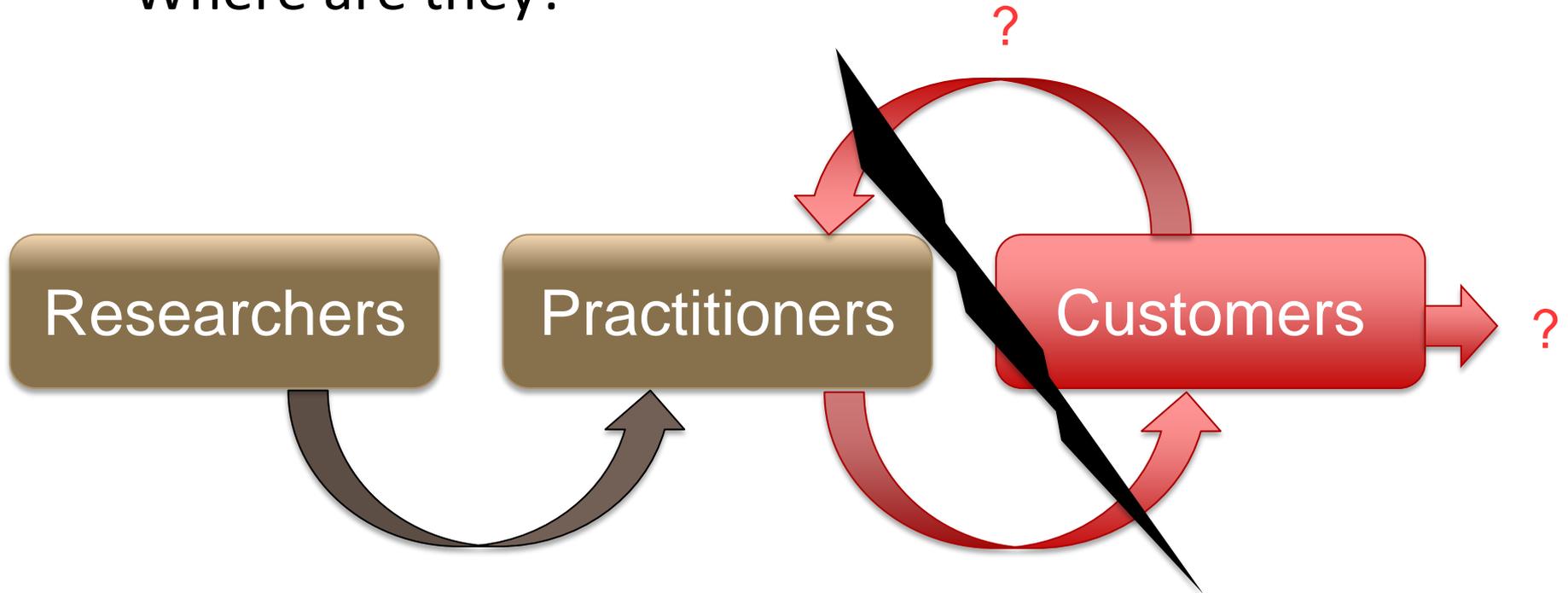
V&V community: Roles viewpoint

- R&D presence is strong
- Practitioners group is large, but not as visible



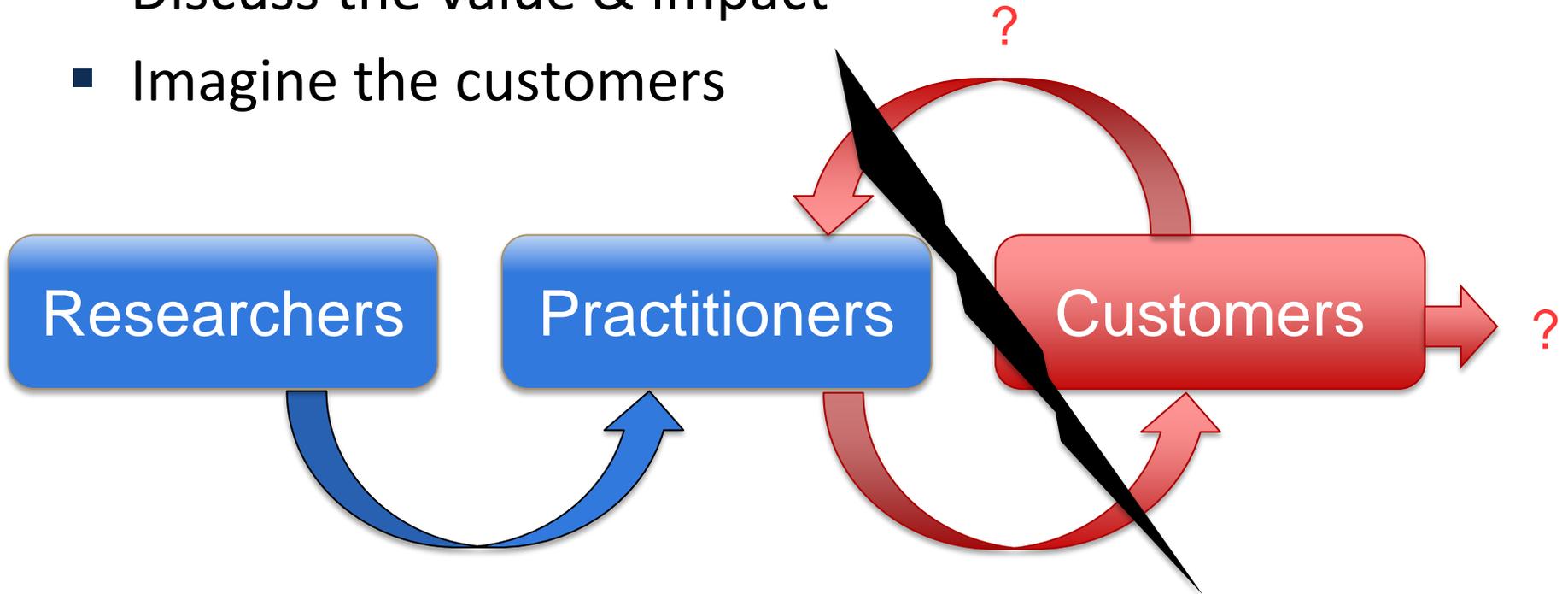
V&V community: “Roles viewpoint”

- Who are the customers?
- Where are they?



Who is the Workshop for

- Highlight what we can do
- Discuss the value & impact
- Imagine the customers

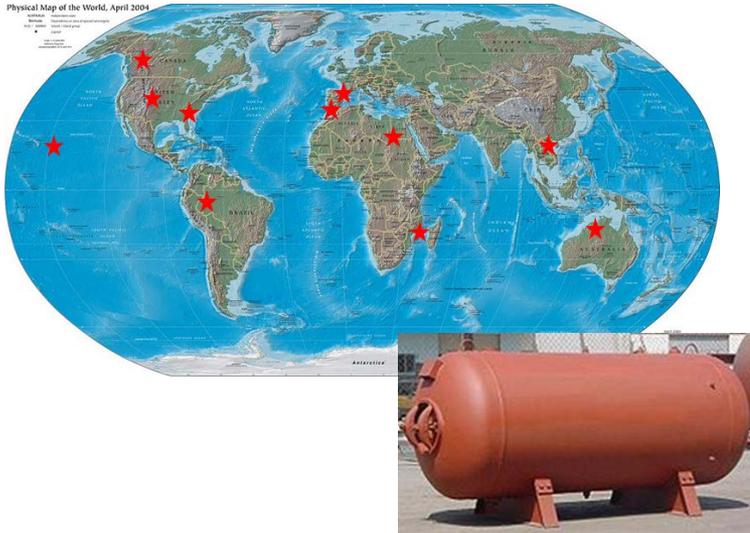


What? How?

- 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 V&V evidence to evaluate
 - 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

Have many storage tanks, holding Mystery Liquid under pressure



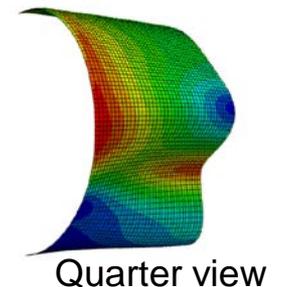
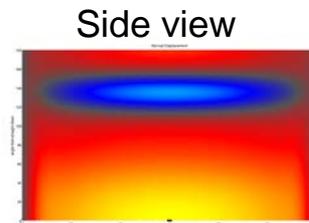
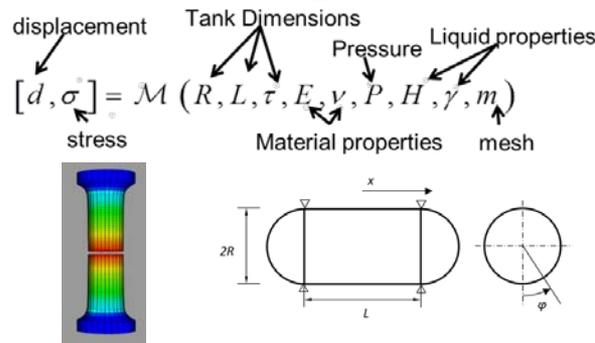
During standard safety testing, one tank's measurements **exceeded a safety specification**

How should we respond?

Are the tanks at risk of failure?

No tanks have actually failed, ever.

Experimental and modeling efforts are begun

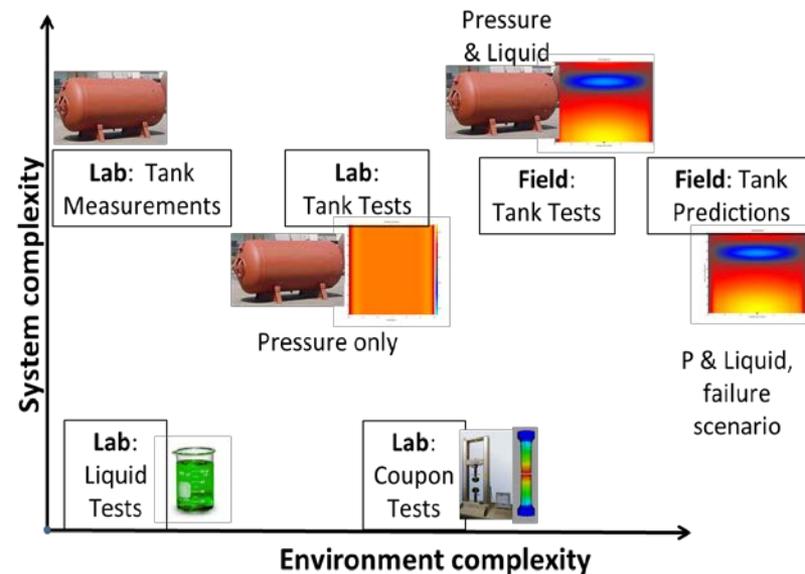


Supply a prediction – is it credible?

- 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,
- 5) Parametric uncertainty quantification
- 6) Solution verification
- 7) Validation
- 8) Aggregation of uncertainty
- 9) Assess relevancy on a hierarchy of info
- 10) Assess credibility



The Challenge:

- 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

- Groups applied different V&V strategies, methods
 - Reflects different priorities, time commitments
 - 6 from the R&D side, 1 group of practitioners
- P(fail) target is < 0.001
- Results for groups A-F
 - (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

- Very pleased with the responses
- Large audience, great discussions at the workshop
- 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
 - Very different results
- Completed part 1 – methods demonstration

What's Next

- How to evaluate / compare these results?
 - To each other & to the “truth” model
- Implications of very different results?
- How to choose a V&V strategy?
- How to assess credibility? Is it discipline dependent?
- What are the roles of V&V analyst and customer?
- How does V&V evidence influence decisions?
- **We are now soliciting discussion papers for a later issue of the ASME VV&UQ Journal**

Did we achieve our goals

Community
engagement

Education/
training

Methods
demonstration

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world problem

Methods
development

Discuss an
open problem

Did we reach the right people

Researchers

Practitioners

Customers

Halfway there

Thanks!

- I left out:
 - Sandia's mission → unique V&V perspective and workshop motivation
 - Why Symposium was a good fit for the workshop
 - When (the timeline)
 - History of V&V/UQ challenge problems
 - Responses to the problem
→ Another talk, later today
- To learn more about the problem, workshop
 - <https://share.sandia.gov/vvcw>
 - Email us: vvcw@sandia.gov