NACE INTERNATIONAL

THE CORROSION SOCIETY

Identifying Potential Threats

Oliver C. Moghissi, Ph.D.
President, NACE International

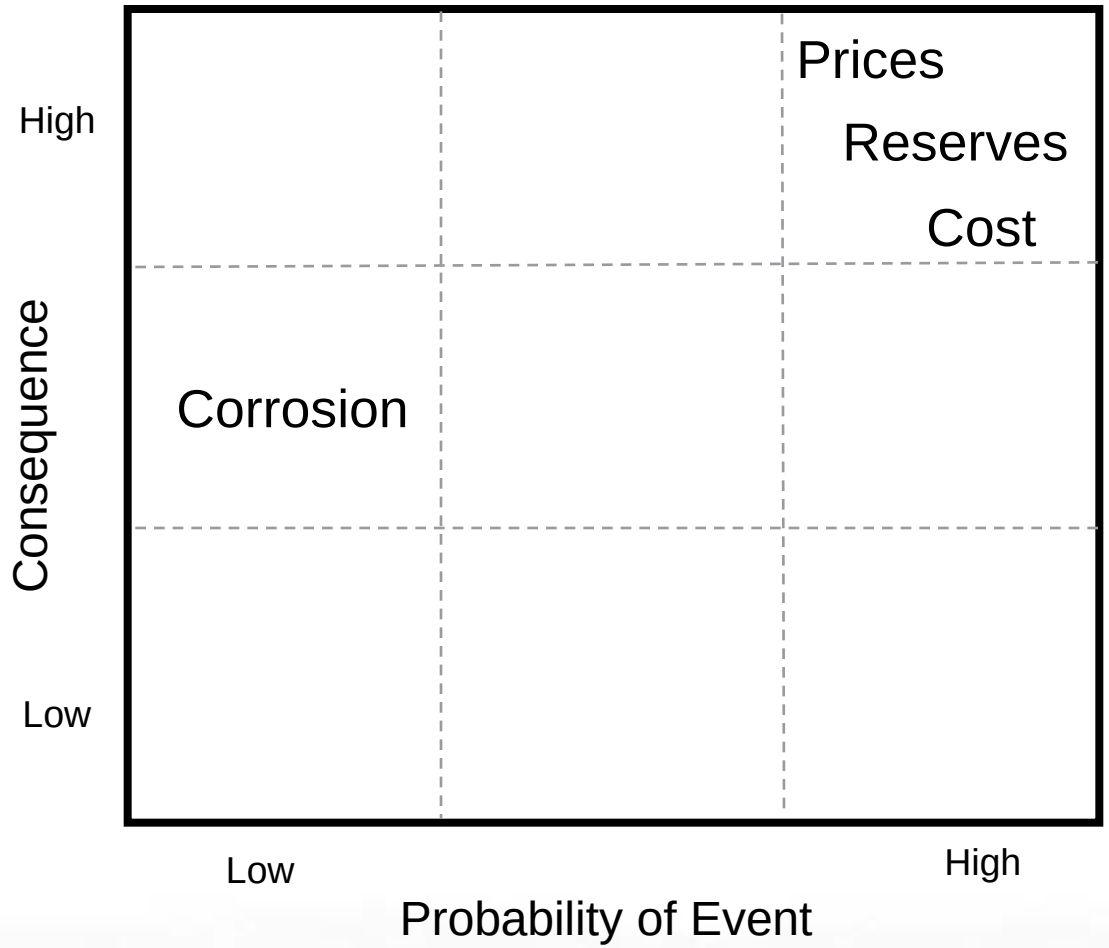
On the Average, Pipeline Risk is Low

- Most assets are safely operated & well preserved
- Mechanisms that degrade pipe are generally well managed
- Isolated incidents plague the industry
- We always seem surprised

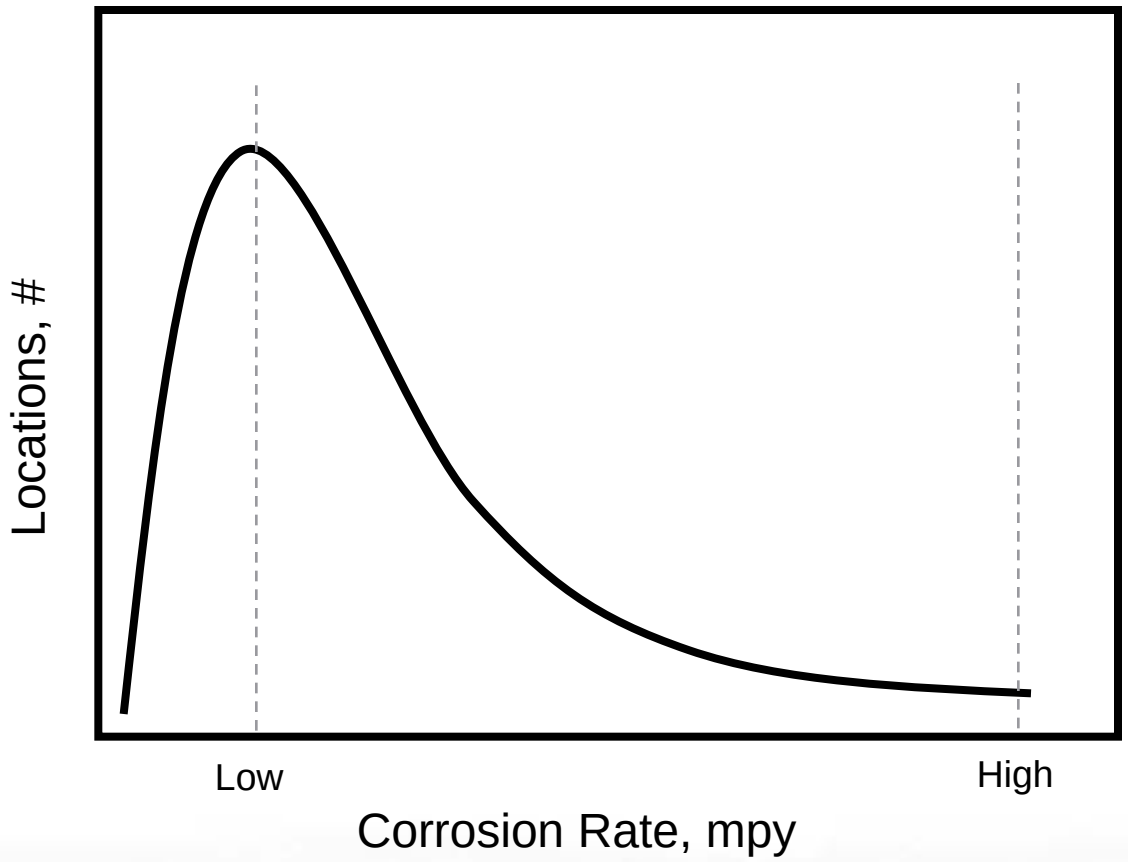
Isolated Incidents Plague the Industry

- Infrastructure is large
  - i.e., there is much degradable area
  - (1e-6/mile/y) is significant for 1e6 miles of pipe
  - Interactive threats (birthday game)
- Infrastructure is aging
  - Previous maintenance more important than age
  - Historical damage
- Growth rates are distributed over time and space
  - Stochastic nature of corrosion & cracking
  - Environmental differences

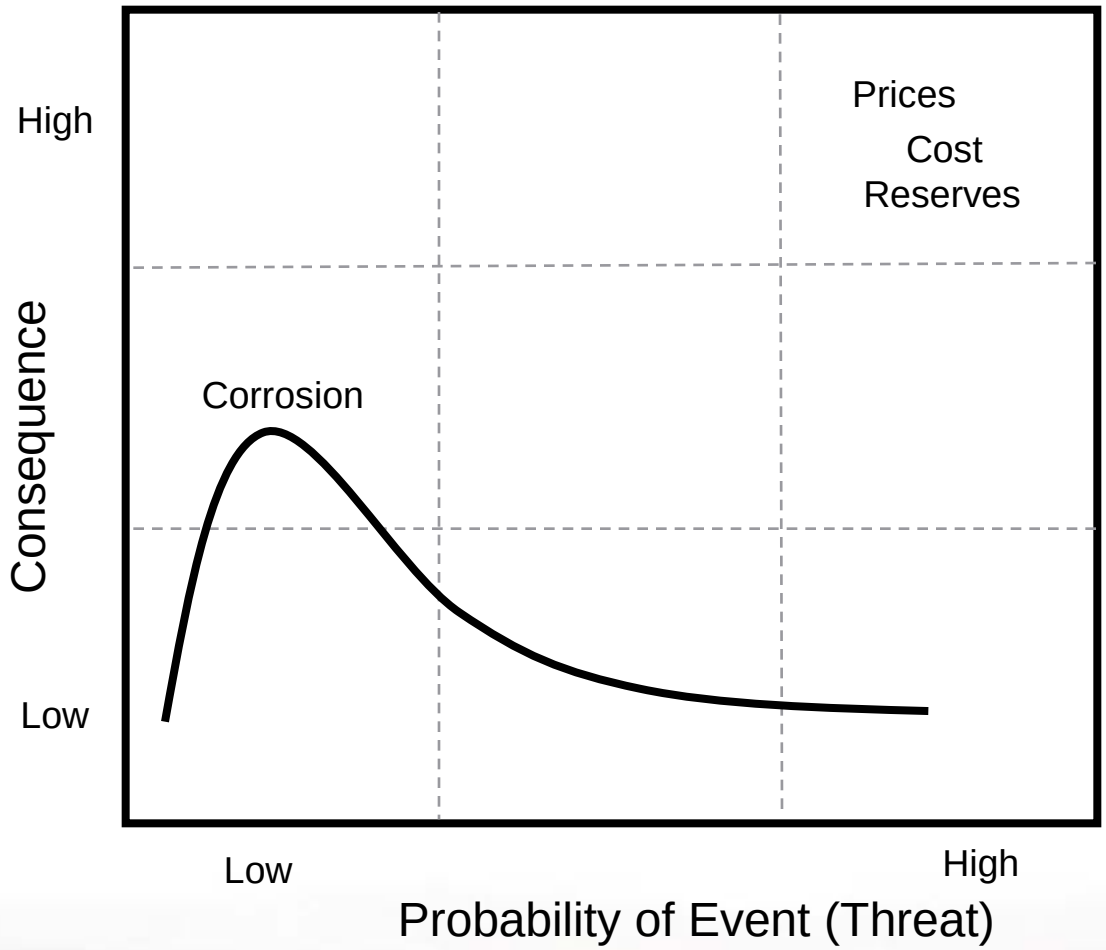
On the Average…



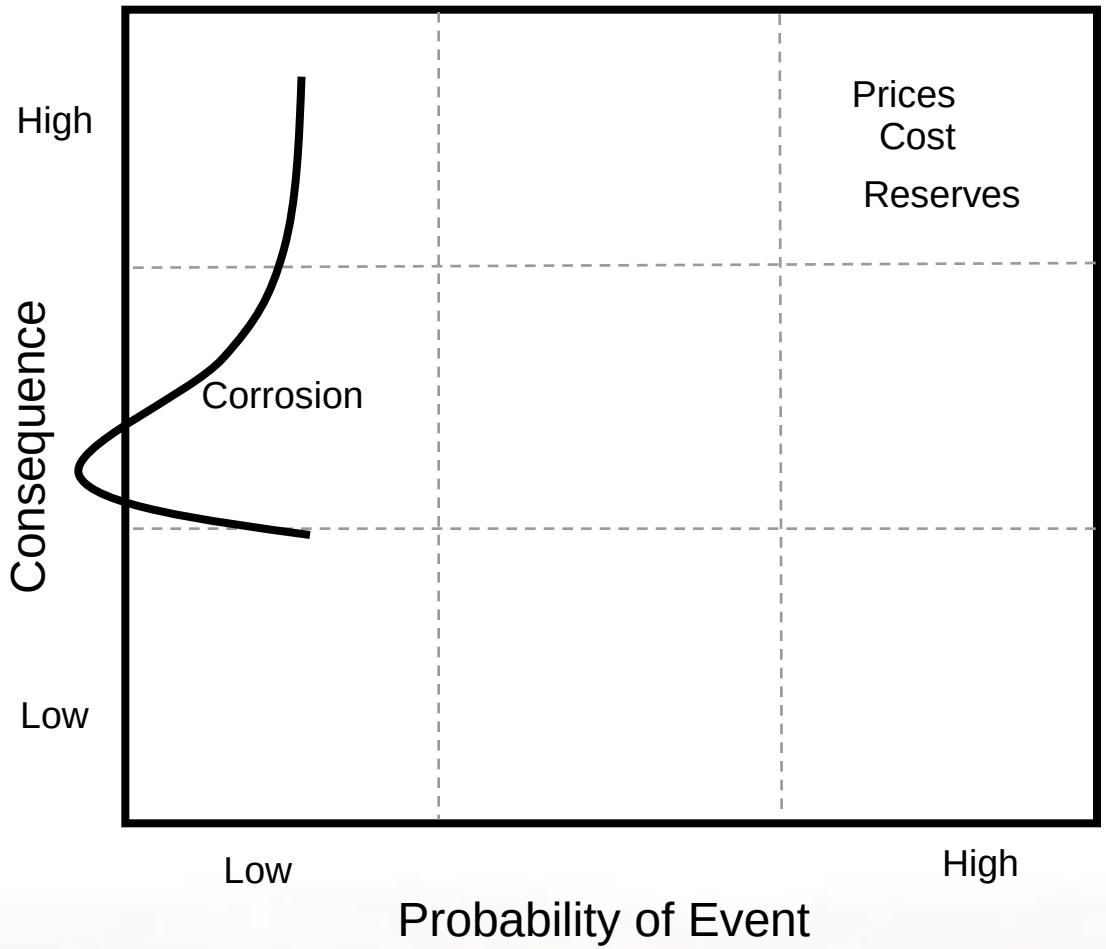
Corrosion is Not Average



Consider Growth Rate Distribution

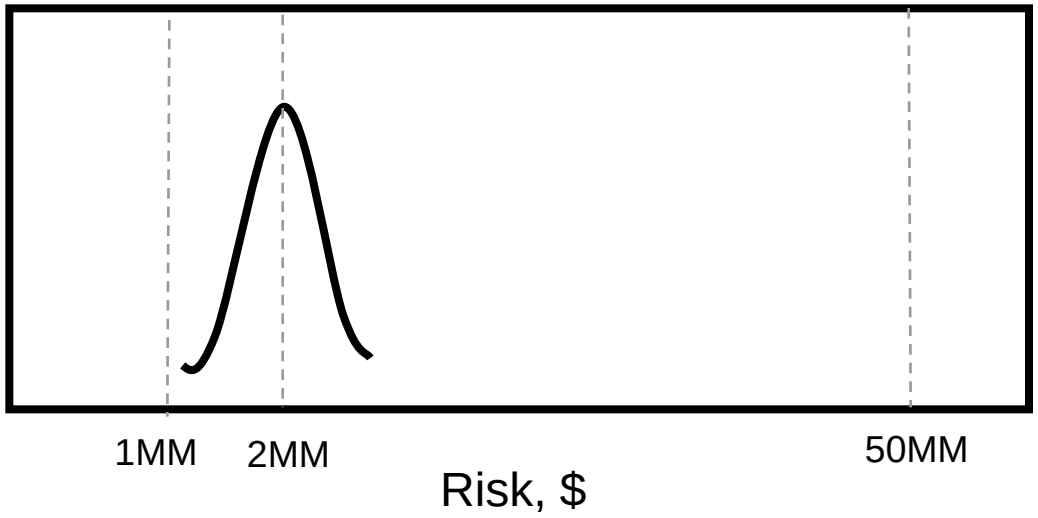


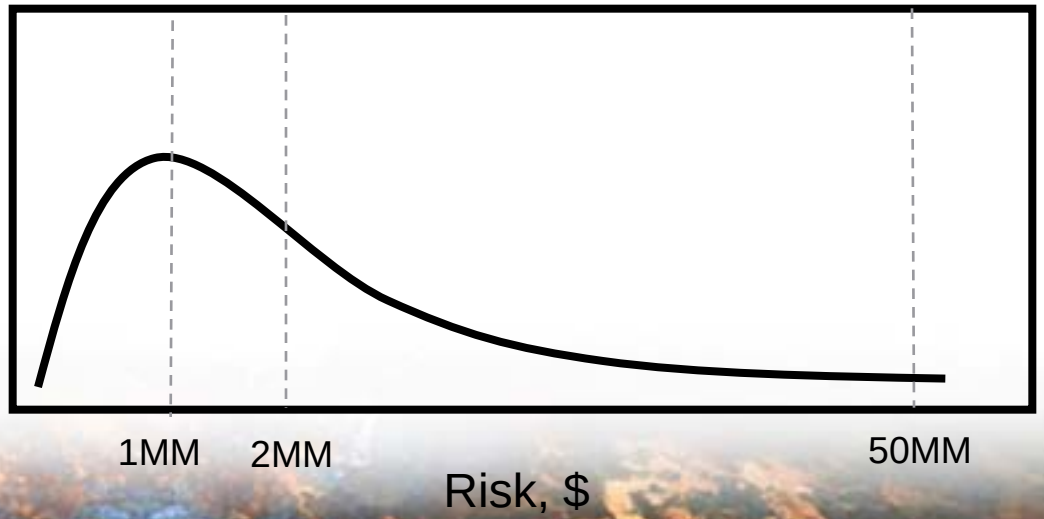
Consider Consequence Distribution



Which Risk is More Acceptable?

- Average vs. Distribution
- Consider absolute risk tolerance
- Consider safety tolerance regardless of $





Managing Threats We Don’t Know About

- “……..But there are also unknown unknowns, the ones we don't know we don't know.”
  - Donald Rumsfeld

N. Sridhar, ‘NACE Plenary Lecture’

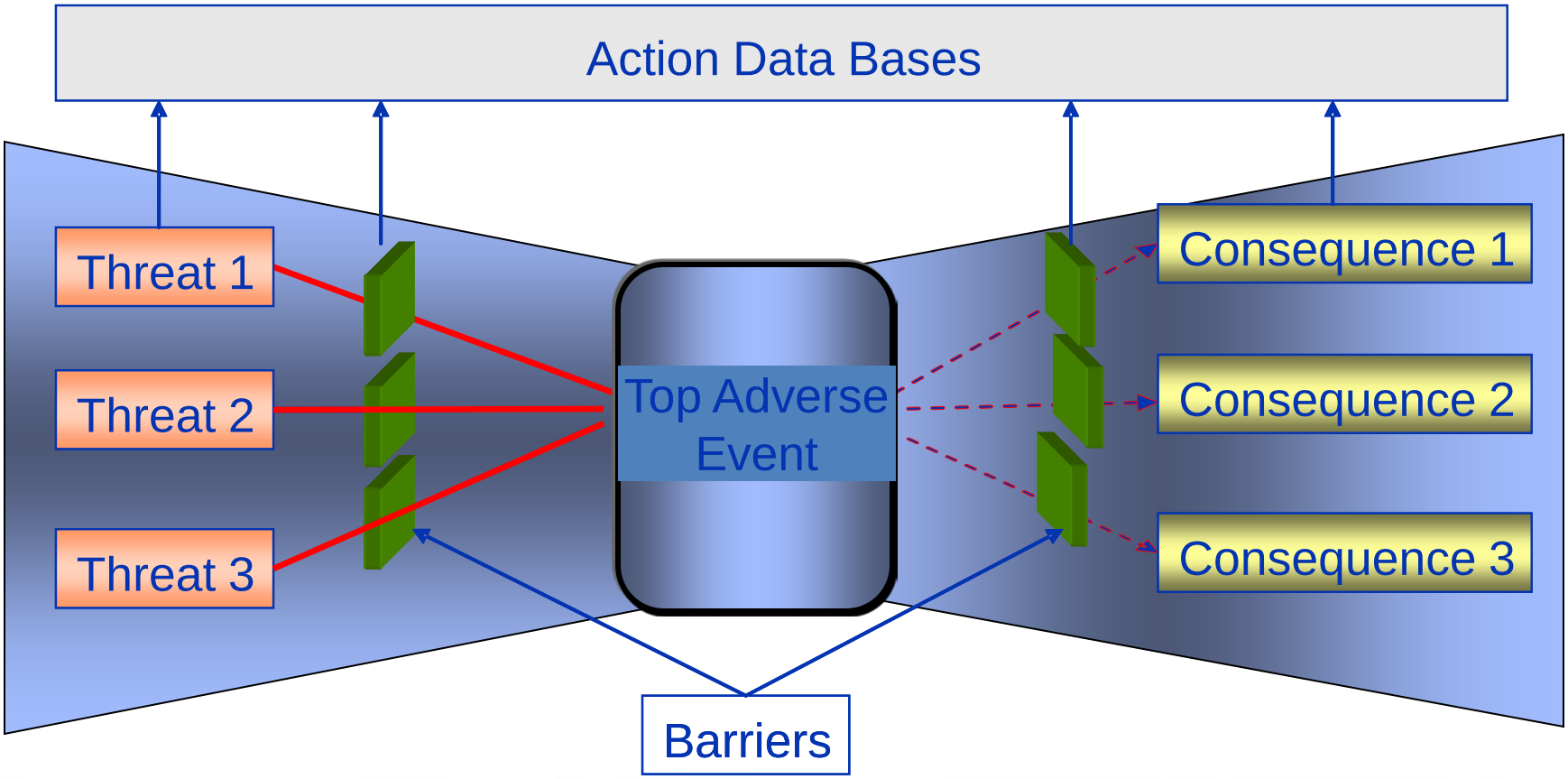
Near-Neutral pH SCC

- Before 1980's, SCC was an alkaline (passive film) mechanism or acidic corrosion hydrogen damage mechanism
- Much research by PRCI and others
- Incorporated in technical standards
- Routinely recognized threat

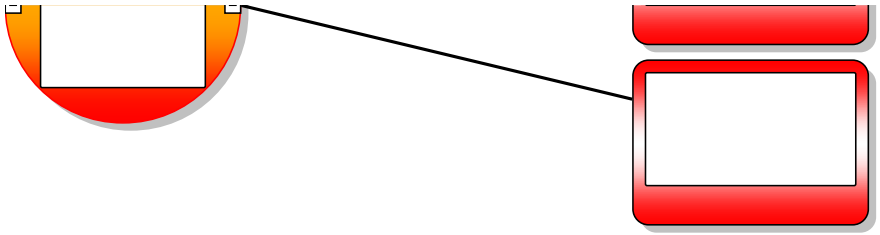
SCC by Fuel-Grade Ethanol

- Before 1990's, SCC in pipelines from ethanol was unrecognized
- PHMSA R&D leadership
  - PRCI/API/Operators → DNV/SwRI/Georgia Tech
  - Understand threat and develop mitigation
  - Transfer technology through standards
  - Outcome helps 'protect people and the environment from the risks inherent in transportation of hazardous materials'

Bow-tie approach



Example: Ethanol Pipeline - Threats



Technology to Address Unlikely Threats

- Needle in a haystack
  - No one-size-fits-all approach
  - Is it practical to examine every piece of hay?
  - Understand mechanisms of exceptions
  - Apply technology to identify and mitigate exceptions
  - The DA example
    - Innovate with existing technology

Conclusions

- Known threats generally well-managed
- Further improvement possible through focus on unlikely threats
  - More attention on the average does not address the exceptions
  - Overly prescriptive solutions are ineffective or inefficient
    - Need flexibility to use new technology or innovate with existing technology
    - Need incentive to create new technology

NACE International
1440 South Creek Drive
Houston, TX 77084
+1 281 228 6200
www.nace.org