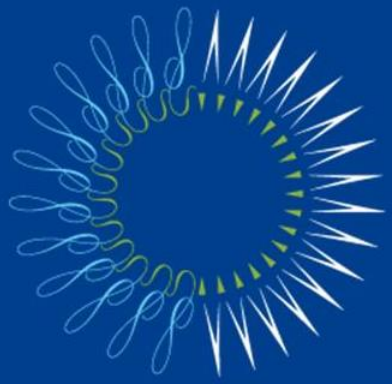

THE PEW CHARITABLE TRUSTS

Root cause analysis (RCA) of accidents

Lessons learned from 6 case studies

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Study design: the what, why and how

Three key research questions:

- How are other organizations conducting RCA?
  - How do they decide when to conduct a RCA?
  - How do they perform the RCA?
- How are the key findings disseminated and used?
- What is working & what is not?

Study approach:

- Review of public documents about the organization
  - Mandate, history, organizational structure, operations, budget, etc.
- Review of investigations by the organization
  - Investigation reports, congressional testimony, etc.
- Interviews with former members of the organizations

Case study selection: the who

Case studies were selected to cover various:

- Industries
- Organizational structures
- Mandates (regulatory, non-regulatory, non-governmental)

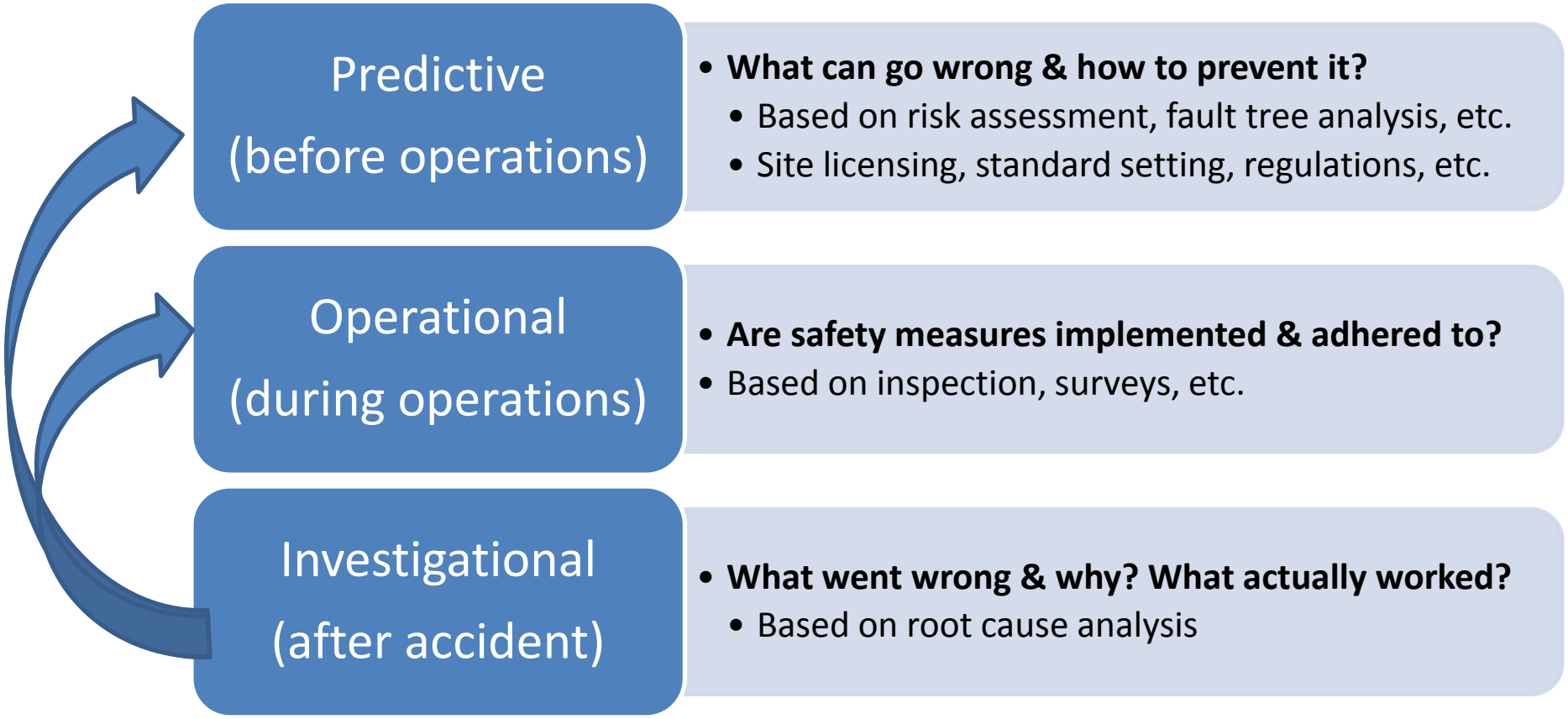
Organizations included in case study:

- National Transportation Safety Board (NTSB)
- Chemical Safety Board (CSB)
- Nuclear Regulatory Commission (NRC)
- Consumer Product Safety Commission (CPSC)
- Occupational Safety and Health Administration (OSHA)
- Divers Alert Network (DAN)*

*** DAN is a non-profit organization dedicated to the safety of recreational diving**

Finding I: not every investigation is a RCA

Three distinct but related types of investigations:



Finding II: responsibilities differ

Organizations with regulatory oversight function:

- Nuclear Regulatory Commission (NRC)
- Consumer Product Safety Commission (CPSC)
- Occupational Health and Safety Administration (OSHA)

Organizations without regulatory oversight function :

- National Transportation Safety Board (NTSB)
- Chemical Safety Board (CSB)
- Divers Alert Network (DAN)*

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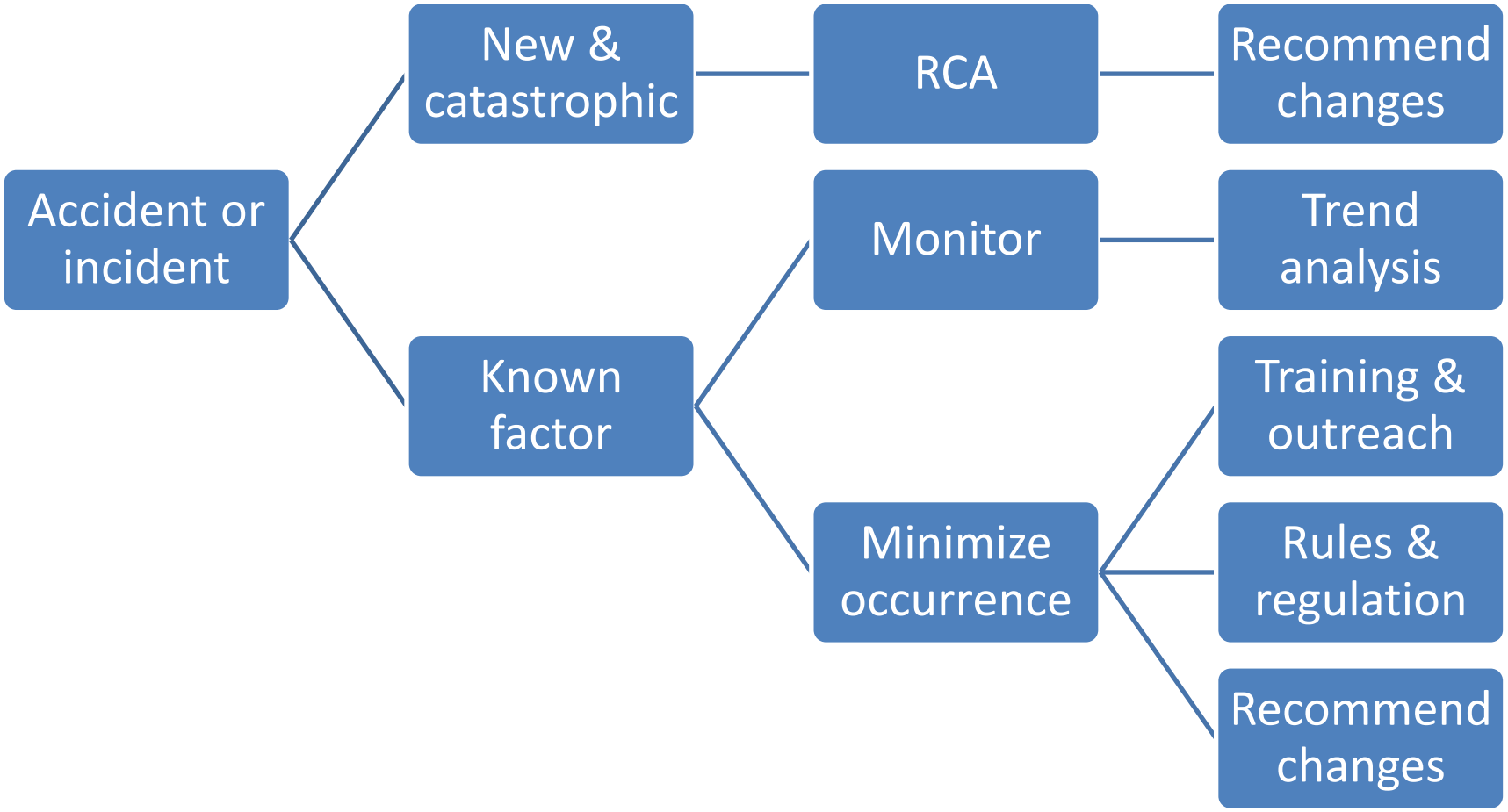
Finding III: not every accident requires RCA



Finding IV: different definitions of root cause

NTSB:

- “probable cause” = explanation of event supported by facts & evidence
- recommendations not restricted to probable causes

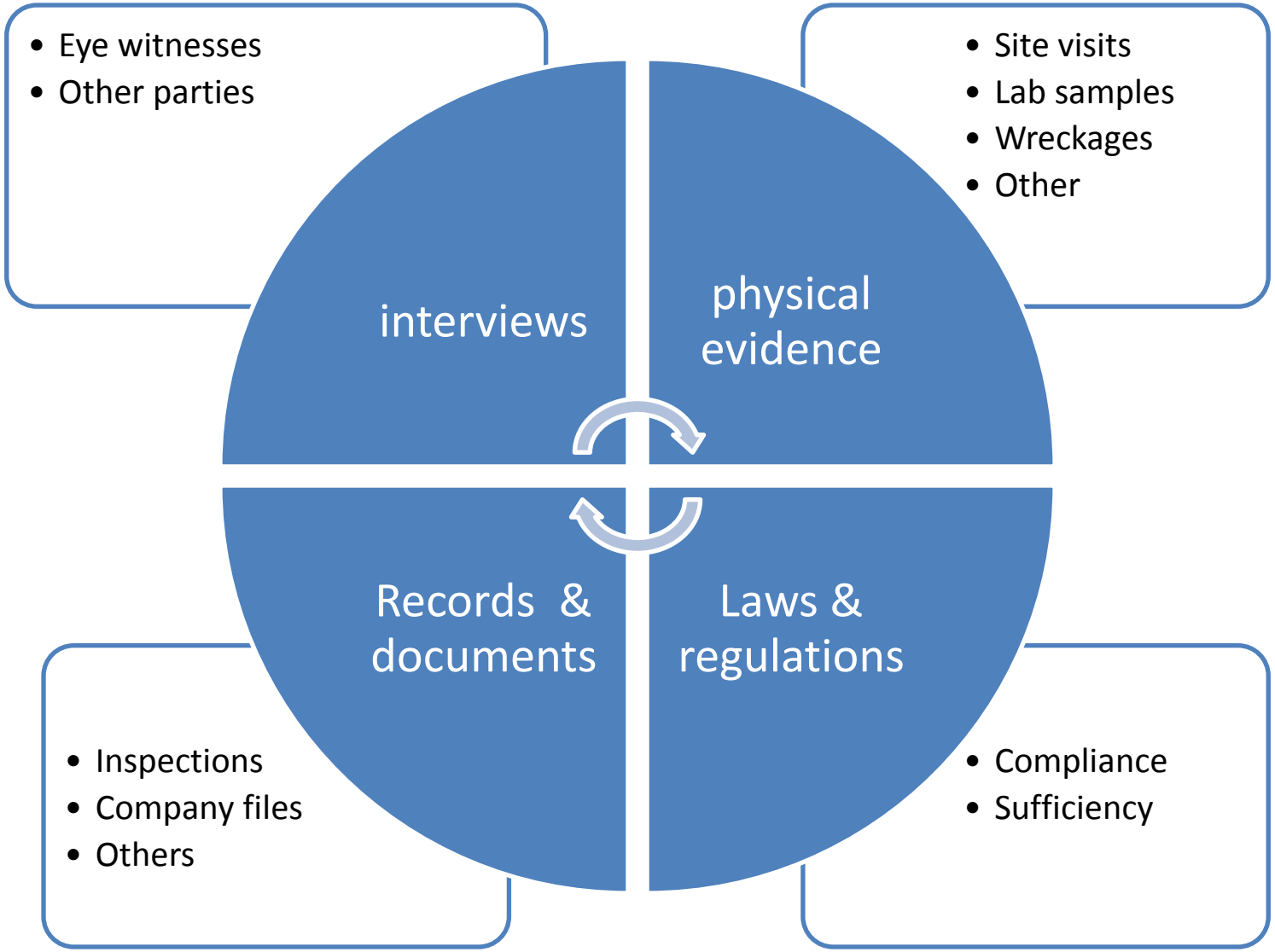
Chemical Safety Board:

- Any factor that would have prevented the accident if the factor had not occurred

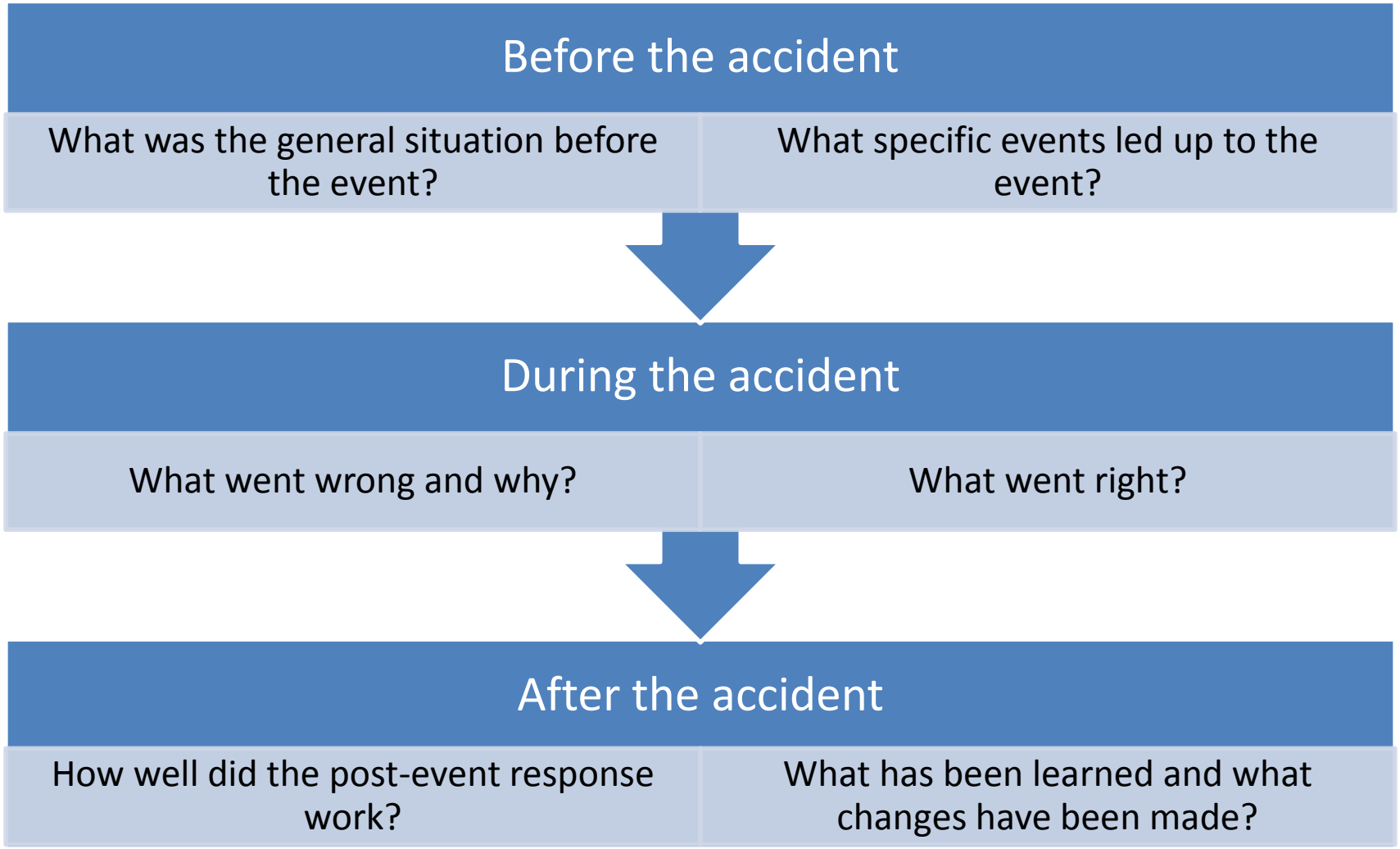
Nuclear Regulatory Commission:

- “direct cause” = the action or condition immediately preceding the event
- “probable cause” = preponderance of evidence for presence during event
- “possible cause” = may have been present, but insufficient evidence

Finding V: types of evidence are universal



Finding VI: Effective RCAs reconstruct event



Finding VII: Effective RCAs consider 4 factors

- **Physical factors, including:**
  - Structures & systems (e.g., buildings, automatic monitoring systems, etc.)
  - Impacts (e.g., survivability, injuries etc.)
- **Operational or 'human factors', including:**
  - Operator performance
  - Decision-marking (before, during and after the accident)
  - Communications
- **Organizational factors, including:**
  - Structures, policies, organizational culture, SOPs, etc.
- **External factors, including:**
  - Weather & external conditions during the event
  - Post-emergency response (e.g., first responders, regulators etc.)
  - Applicable rules & regulations

Finding VIII: Keys to an effective RCA

- **Timely investigations and frequent reporting**
  - Evidence can be secured, no ‘information void’, no misinformed public
- **Appropriate technical expertise**
  - E.g., through NTSB’s ‘party system’
- **Comprehensive & systematic investigation**
  - From before the event to after the post-event response, all relevant factors
- **Conclusions based on & driven by evidence**
  - Conclusions clearly follow from the facts; hypotheses portrayed as such
  - Potentially based on commissioned research or ruling out of other causes
- **Unbiased & transparent**
  - Sunshine provisions, party systems, etc.
- **Clearly & concisely reported**

Finding IX: Common challenges to RCA

- **Access**
  - To facilities, records, accident sites, interviewees etc.
- **Resource availability**
  - Specialized expertise, staffing issues, triaging of accidents, etc.
- **Privacy concerns**
  - Confidential or private data
- **Potential legal actions**
  - Liability in civil and/or criminal lawsuits
  - Sealing of records following litigation
- **Ability to translate findings & recommendations into practice**
  - Regulatory challenges (e.g., standard-setting process)
  - Other challenges (e.g., economics)

Finding X: additional 'food for thought'

Interviewees identified the following additional factors as central to success:

- The ability to issue recommendations at **any point** in the investigation
  - Recommendations do not have to relate to probable or root cause
    - Ability to learn from observations before they cause catastrophic event

- The ability to review **all** aspects of the accident without real/perceived COI
  - Failure to regulate (e.g., set or enforce regulations) common contributor
  - Access to specialized technical expertise, research etc. when needed

- A collaborative working relationship among all stakeholders
  - Access: to evidence, expertise, information etc.
  - Resources: utilize existing structures and systems where possible
  - Impact: ability to implement changes based on lessons learned

Conclusions: some common themes

- Vast differences across ‘case studies’
- Some ‘models’ work better than others
- Not everything is directly transferrable across industries
  - CSB modeled after NTSB, considerable differences in operations
- Yet, common challenges and approaches
- Some promising solutions
  - Transferrable to other sectors?
- Many aspects are scalable
  - Many industries grapple with scalability, some interesting approaches
- Translating findings into changes is perhaps the greatest challenge
  - It really does take a village…..