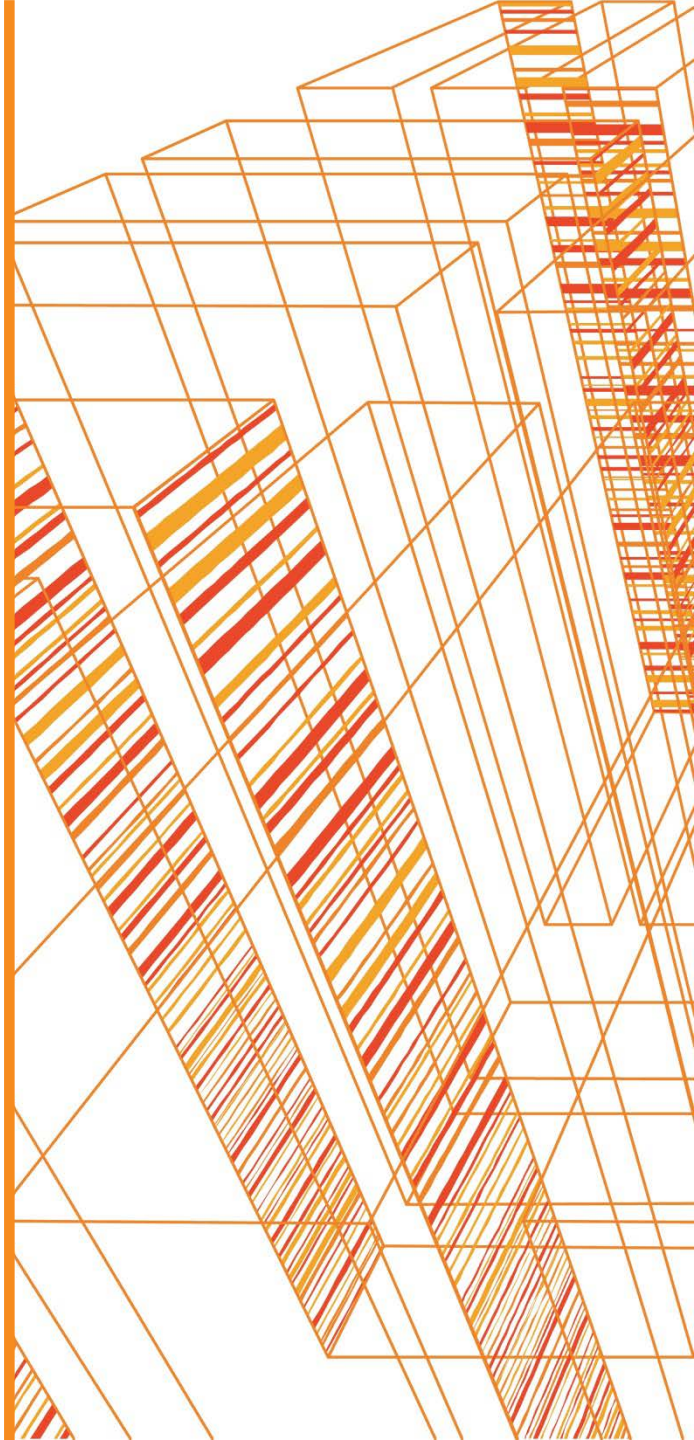
EVRAZ
making the world stronger



The National Academies of Sciences · Engineering · Medicine

Transportation Research Board

Committee of Transportation Resilience Metrics

David Ferryman PE, VP Sales, Evraz NA
former VP Engineering, CN Railway

September 14, 2020

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David Ferryman – who am I?

- 4th Generation Railroad

- Burlington Northern / BNSF
  - Started as a surveyor, Burlington Northern, 1988
  - Intern, Fargo, ND 1989-1990
  - Management Trainee, Lincoln, NE – 1992
  - Project Manager & Roadmaster, Alliance, NE 1995

- Illinois Central
  - Superintendent Engineering, Jackson, MS 1997

- Canadian National Railway (1/3 in United States)
  - Division Engineer, Jackson, MS 1999
  - General Manager, Troy, MI 2000
  - Chief Engineer – US, Chicago, IL 2003
  - VP Engineer – Edmonton & Chicago, 2005 – 2017

- Education:
  - BS Civil Engineering, Colorado State University, 1992
  - MBA, Kellogg School of Management, Northwestern University, 2012
  - Professional Engineer, State of Mississippi, 2000

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The Challenges Mother Nature presents!

- Hurricanes
- Wild Fires
- Flooding
- Tornadoes
- Earthquakes
- Ground Instability

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My Experiences managing Major Disruptions due to Natural Hazards to illustrate the impacts faced and actions taken:

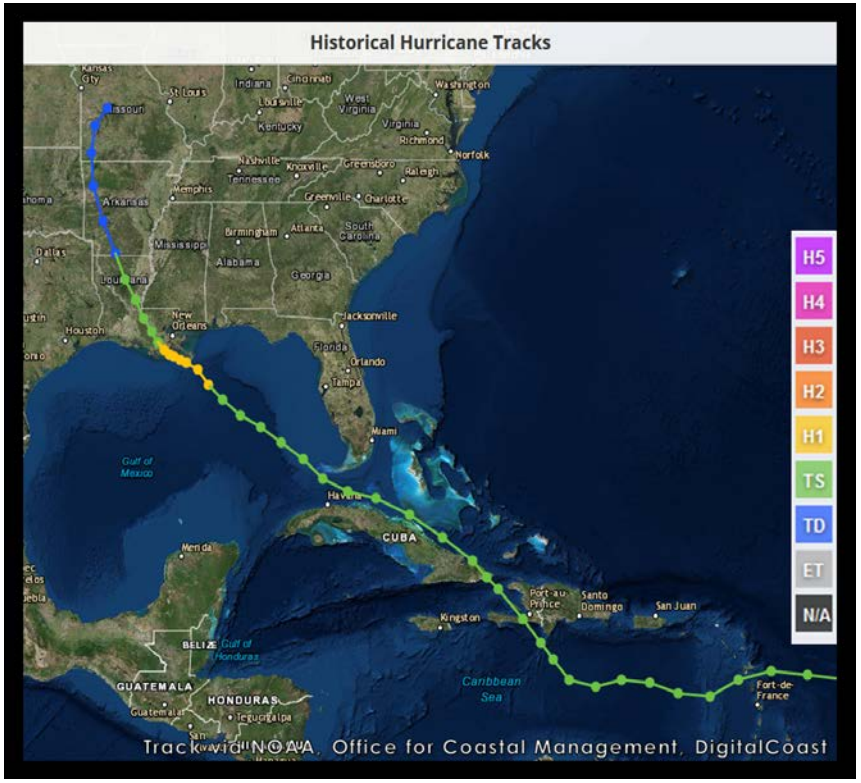
- Louisiana Hurricanes – Katrina 2005, Issac 2012 – 10 since 2005
  - Storm Surge Track lifted into the Swamp, Bridges removed
  - Installation of Concrete Ties, box culverts
  - 3rd Party Response & Equipment

- Rock Slides in BC – Freeze/Thaw Conditions
  - Heavy duty Rock Sheds
  - Slide Fencing
  - Inspection & Mitigation

- Unstable Subgrade
  - Shear Failures of Subgrade – GPR
  - Mapping Locations & Conditions

- Broken Rails & Trackbuckles
  - Anchor Every Tie where large temperature swings
  - Investment in Safer Rails – K1C Fracture Toughness

- ERA (Engineering Reliability Analytics) – GPS based Heat Mapping



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How does the railroad measure its ability to respond to unexpected disruptions – metrics and data?

- Train Delays – minutes
- Slow Orders - minutes
- Service Outage time and Recovery Time
- Alternate Routing
  - Bottle Neck Management
- Cost & Loss of Revenue

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When making investment decisions, how does the railroad consider the effect of those investments on the ability of the railroad to respond to future unplanned disruptions? Factors, forecasts & data considered?

- Annual Impact of Weather Related Outages – In the Millions
  - Focus on Sustainability
  - Global Warming?
  - Predictive Modeling?
- Appeal to Finance
  - A greater than Normal Investment, ROI?
  - Data & Trend Analysis
    - Largely historic costs

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What other information would I have like to have in making decisions about investing in resilience, but unavailable?

- Relative condition of Infrastructure versus Peers
  - Rail Condition
    - Life Cycle; Defects & Wear Rates
    - Broken Rails/Mile
    - Defects/Mile
    - Avg Curve Wear– mm
  - Tie Condition - % Defective; Life Cycle
  - Ballast & Subgrade
    - Ballast Management Program
    - Performance versus Investment
    - Slow Orders/Mile by Class

- A technology driven regulator
  - Improved Inspection & Monitoring
  - Centralize Monitoring – AI?

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THANK YOU!

QUESTIONS?