Making the Business Case for Risk-Based Asset Management

TRB 11th National Conference on Transportation Asset Management

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Presentation Agenda

- **Setting the stage**
  - Why do we care?
  - What is required?
  - How does this help you?
- **Costs and benefits of resilience**
- **Case studies**
- **Lessons learned**

Image credit: NHS wellbeing

Setting the Stage

Setting the Stage

What you want

- To justify and prioritize investments in resilience to protect assets from low probability, high damage events

Why it's hard

- Inability to make a data-driven business case for the investments

What you need

- Good data that can be used to understand the benefits of investment

Where the data should live

- In your risk-based asset management system!

Purpose of Asset Management

- Asset management is a strategic and systematic process of **operating, maintaining, and improving** physical assets, with a focus on both engineering and economic analysis based on quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will **achieve and sustain a desired state of good repair over the life cycle of the assets at minimum practicable cost**.

- Asset management plans help agencies answer five core questions:

1. What is the *current status* of our assets?
2. What is the *required condition and performance* of those assets?
3. Are there *critical risks* that must be managed?
4. What are the best *investment options available* for managing the assets?
5. What is the best *long-term funding strategy*?

Source: FHWA Asset Management Plan NPRM

Life Cycle Cost Analysis Requirements

- Life cycle cost analysis is used to develop a strategic treatment plan for the whole life of assets.
- This strategic treatment plan is used not only to make the assets serviceable, but to extend the service life of assets beyond their design life.
- This approach produces cost savings, a benefit of asset management.
  - **Business Case:** Invest a small amount of funding now to counter future needs for larger spending.

Source: FHWA Asset Management Plan NPRM

Risk-Based Management Requirements

- **Establish a process** for undertaking an asset risk management analysis.
- **Identify and assess risks** (*e.g.,* extreme weather) that can affect asset condition or the effectiveness of the NHS as it relates to physical assets.
- **Address the risks** associated with:
  - current and future environmental conditions,
  - extreme weather events,
  - climate change, and
  - seismic activity,

Photo credit: Forbes.com

- **Inform how to** minimize impacts and increase asset and system resiliency.
- **Take into account repeatedly required repair or reconstruction due to emergency events.**

Source: FHWA Asset Management Plan NPRM

How can these requirements help you?

- **Effective asset management helps you make smarter decisions which, in turn, saves money over the long run**
  - Identify where investing some money today will reduce life cycle costs
  - Identify the impact of events outside of everyday occurrence

- **Final goal:** Prioritizing investments to minimize costs, increase reliability

Photo credit: Bankrate

Helpful Information in Risk-Based Lifecycle Assessment Analysis

What do you need to know?

- **Risk = likelihood x costs**
- **Likelihood –** what is the probability of the future event?
  - Seismic – annual probability of various magnitudes
  - Weather events – based on historical events
  - Climate change – modeled climate change projections *or* scenario based planning
- **Cost –** what future damage costs can be estimated?
  - Direct costs of repairing the asset
  - Social costs – traveler time/distance/safety
  - Economic costs – cancelation of leisure tips, freight costs
- **Can factor risk into lifecycle costs or use to inform individual investment programs**
- **Risk can be documented in the asset management system *or* in a system that "speaks to" the asset management system**

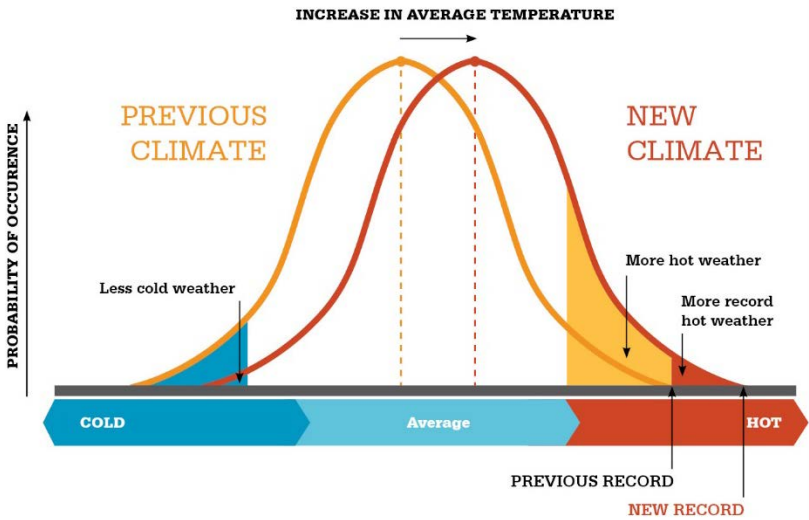


Photo credit: Modified from IPCC 2007

Case Studies

Typical Case Study - Pavement

- **Generally understood that there are benefits to conducting maintenance at the "right time" so pavement doesn't degrade too far**
- **Asset management helps determine when it's the right time**
- **But what about events outside of routine wear-and-tear? How can asset management inform cost-effective decision-making around low-probability but high impact threats?**
  - Flooding
  - Hurricanes/tropical storms
  - High wind events
  - Ice storms
  - Extreme temperatures
  - Seismic risks

Photo credit: Virginia Asphalt Association

Oregon Seismic Risks

- **Objective: Prioritize bridges for retrofit based on:**
  - Seismic risk (6 scenarios)
  - Economic costs of damage
    - Structural repair
    - Travel time delays
    - Foregone trips
  - Potential retrofit costs

- **Compare: Retrofit costs with maximum earthquake costs**
- **By considering the risk of various seismic events and comparing it to the costs to retrofit, Oregon could:**
  - Identify when retrofitting made financial sense
  - Identify priorities for retrofits based on the benefit-cost ratio

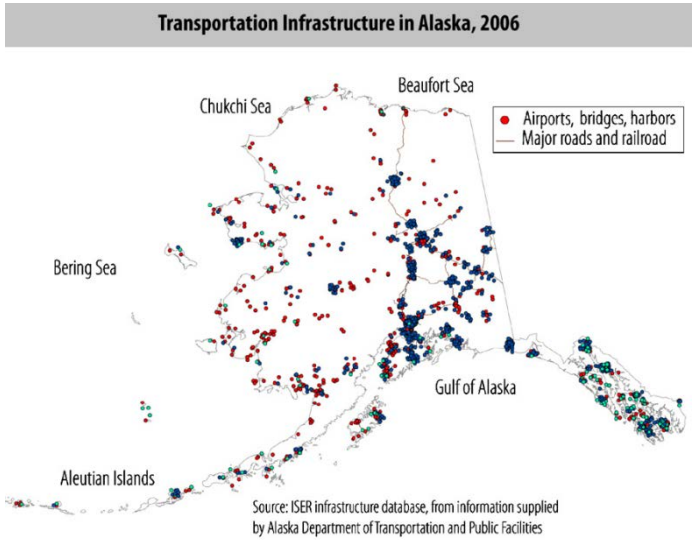
Oregon DOT (2009), Seismic Vulnerability of Oregon State Highway Bridges: Mitigation Strategies to Reduce Major Mobility Risks.

Colorado Rebuilding Roads for Resilience

- **September 2013 – Historic flood event caused over $1 B in damages**
- **Characterized threat from**
  - Flooding
  - Rockfalls
  - Mudslide/debris flow
  - Landslides
- **Alternatives analysis**
  - Full replacement
  - Restore in-kind
  - Replace to standard
  - Identify design alternatives

- **Determined the long-term most cost-effective action to take**
- **In some cases, made the case for FHWA Emergency Relief betterment funding**

Alaska Climate Change Risks



- **Risks:**
  - Changing temperatures
  - Permafrost melt
  - Sea level rise
  - Precipitation
- **Assumptions:**
  - Developed reduction of life percentages for assets near the coast, rivers, and on permafrost.
  - Increased maintenance costs from more frequent repair and a shorter useful life
- **Results:**
  - Climate change could add 10-20% to infrastructure costs
  - Adaptations could reduce the costs related to climate change by 10-45% (including accounting for the adaptation costs)

Larsen, P.H., et al., *Estimating future costs for Alaska public infrastructure at risk from climate change.* Global Environmental Change (2008), doi:10.1016/j.gloenvcha.2008.03.005

SEPTA Vulnerability and Risk Study

- **What types of weather events lead to service disruptions?**
- **What is the magnitude and duration of disruption for different types of weather events?**
- **How frequently do disruptive weather events occur?**
- **What are the costs of different types of disruptive weather events?**
- **Are there any "thresholds" for temperature or precipitation for which service disruptions consistently occur? If so, how often are such thresholds exceeded?**

ICF International, 2013. *A Vulnerability and Risk Assessment of SEPTA's Regional Rail: A Transit Climate Change Adaptation Assessment Pilot.* FTA Report No. 0071

SEPTA Hazard-Mitigation Cost Effectiveness

- **Analyzed weather-related train delays to determine the most disruptive types of events**
  - Extreme heat
  - Heavy rain
  - Snow – most significant delays
  - Severe storms – most train cancelations

- **Used accumulated data to determine:**
  - Frequency and duration of delays and annulments
  - Costs for each type of event
    - Repair costs (i.e., reimbursable expenses)
    - Staff labor costs
  - Supplemented with staff interviews/review because not everything is captured
- **Identified sensitive portions of their system**
  - Thresholds above which disruption/damage likely to occur
  - Associated risk of disruption (probability of event x damages)
    - Include current and future weather risks
- **Monetized the risk value to inform how/where to focus investments to reduce risks**

SEPTA

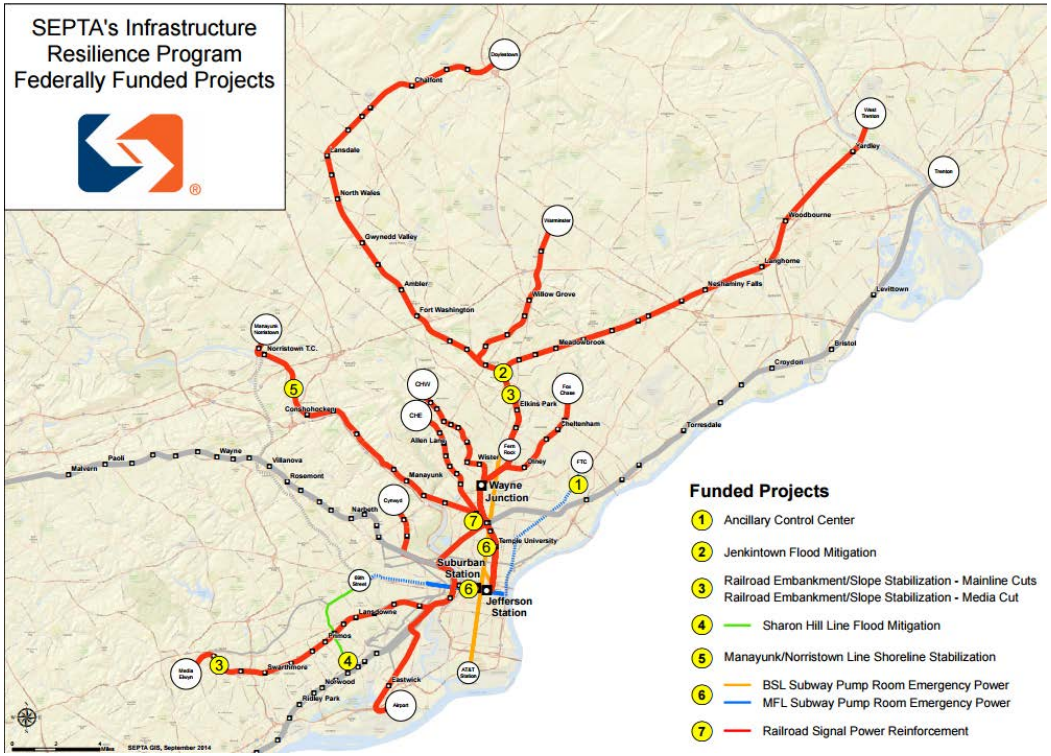
SEPTA Hazard-Mitigation Cost Effectivness (HMCE) Follow-Up

- **Conducted hazard-mitigation cost-effectiveness studies to help SEPTA compete for grant-based Sandy recovery/resilience funding**
  - It is probable that more funding will require this type of analysis

- **Useful data:**
  - Risk of future events
  - Damage associated with past events
    - Customer costs (time)
    - Labor costs
    - Repair costs
    - Emergency response costs

- **Types of projects:**
  - Pump room emergency power
  - Moving a maintenance facility
  - Shoreline stabilization
  - Ancillary control center

- **Results: $87 million in funding**



- **Lessons: Track all costs and (if possible) customer impacts related to extreme weather events**

Lessons Learned

Overall Lessons Learned

- **Tracking costs of extreme weather events over time can build a useful database of information for informing lifecycle costs**
- **If you have the cost data from experience, you can likely justify resilience strategies (where needed)**
- **Input values (e.g., event probabilities, extent of damage) can be varied to gain an understanding of sensitivity**
- **Different resilience strategies could be preferred depending on whether or not social costs are included in the analysis**
  - Including socio-economic effects and impacts beyond highway rights-of-way bolsters the case for resilience actions
- **The discount rate can highly impact the outcome of the analysis**
  - Consider conducting sensitivity testing around this variable
- **Relatively simple calculations of risk can help inform investment decisions and reduce future expenditures**

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