Making the Business Case for Risk-Based 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,

- **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
Helpful Information in Risk-Based Lifecycle Assessment Analysis
What do you need to know?

- **Risk** = likelihood \( \times \) 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)

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?

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 Hazard-Mitigation Cost Effectiveness (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