Data and Analytical Needs for Incorporating Extreme Weather Risks in Asset Management

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Linking Climate Change to Asset Management Plans and Systems

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Overview

- The Challenge and the Opportunity
- Relating TAM and Extreme Weather/Climate Risk Management
- Adaptive Management Framework
- Informing Vulnerability Assessments and Risk Management
- Conclusion

The Challenge: Managing Climate and Extreme Weather Risks

- The intensity, frequency, and duration of climate and extreme weather events requires agencies' use of different analytical approaches to develop actionable information
  - What is the maximum rainfall event? When will it occur? Could it happen today?
  - Even when the sign of the impact is known with confidence, some uncertainties still exist
    - Magnitude: What is the worst case/planning design scenario? When should the worst case be used?
    - Timing: When will it occur?
- Transportation agencies can no longer rely on analyses of past events to accurately inform future conditions that transportation systems will face; however past information is a start
- Transportation agencies aiming to utilize forecasts and projections must "right-size" analyses and risk mitigation measures to fit the assets and decisions underway

With this in mind, how can asset management be used to increase transportation system resilience?

The Opportunity: Adaptive Management

- **Adaptive Management:**
  - *Flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become understood. Careful monitoring of these outcomes both advance scientific understanding and help adjust policies or operations as part of an iterative learning process* (National Research Council, 2014)
- **Key elements**:
  - Flexibility
  - Uncertainty
  - Adjustments in decision making
  - Monitoring
- **Without functional asset management systems, transportation agencies cannot implement adaptive management**

Transportation Asset Management (TAM) and Vulnerability and Risk Assessment

- **Strong asset management systems underpin effective vulnerability assessment**
- **Vulnerability assessment and extreme weather risk management can inform and reinforce effective transportation asset management**

Strong TAMs Underpin Effective Vulnerability Assessments

1. **Provide data to understand criticality (e.g., traffic volume)**

2. **House information on asset vulnerability and risk, for example:**
   - Proximity to the floodplain
   - Elevation
   - Interdependencies (e.g., power)
   - Existing risk mitigation measures (e.g., flood protection)

3. **Provide a means to track disparate information across complex organizations**
   - Costs of past extreme weather events
   - Weather-related maintenance records
   - Repeated weather-related repairs
   - Documentation of failure thresholds
   - Documentation of institutional knowledge

Vulnerability Assessments Can Inform *and Reinforce* Effective TAM

vulnerability and risk assessment

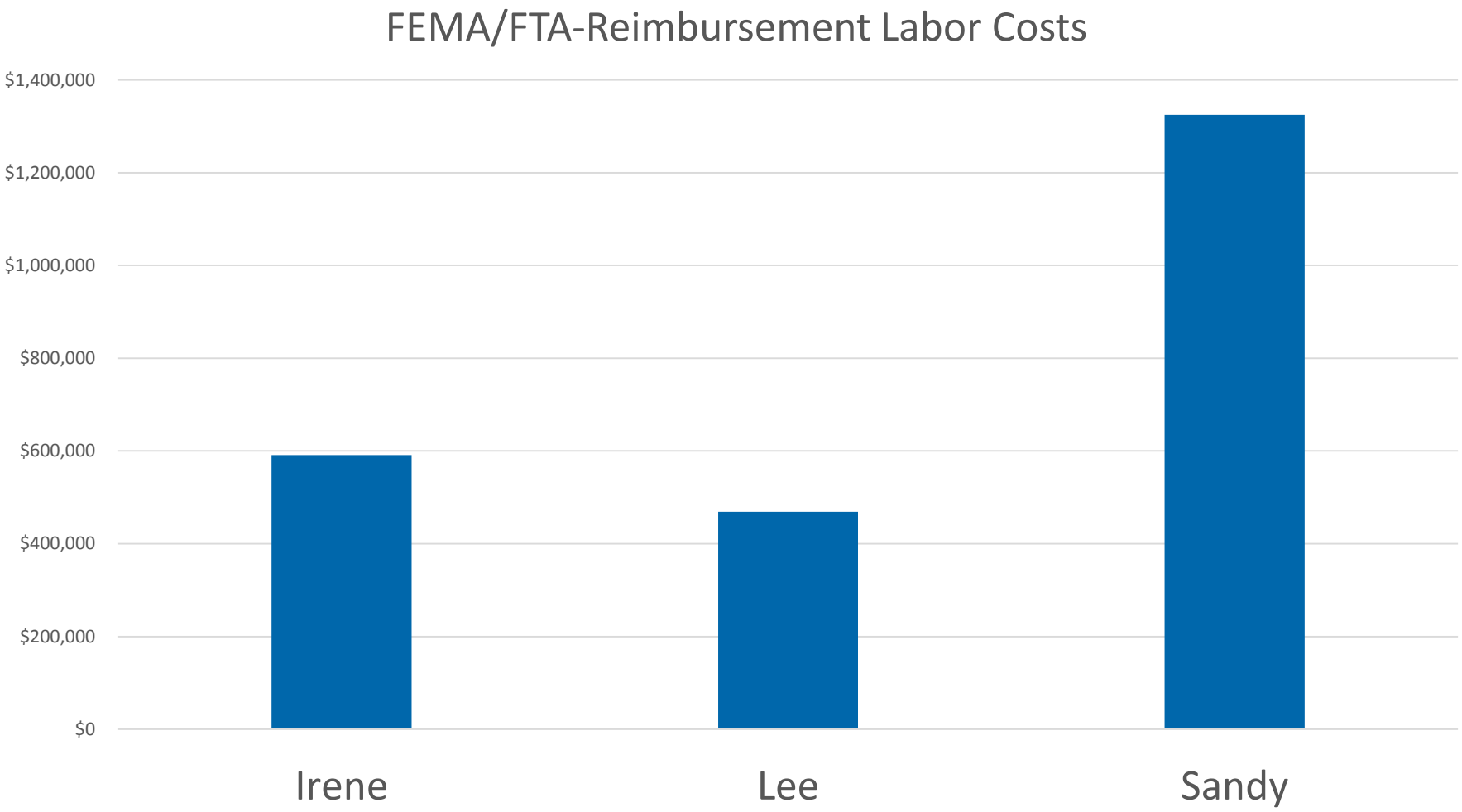
1. **Vulnerability assessments and extreme weather risk management require solid TAM information; any information not in systems is requested of staff**

2. **Funding for resiliency investments and extreme weather-related damages requires detailed, asset-specific information**

3. **When employed to support vulnerability assessments, seemingly administrative data collection demonstrates value; data survives staff turnover and succession**

4. **Operations and maintenance activities, often overlooked in TAM, become more important when TAM is informing extreme weather risk management**

SEPTA Example: Vulnerability Assessment Drove Better Data



Sandy Damage

Photo source: SEPTA

Irene Damage

Photo source: SEPTA

Lee Damage

Photo source: SEPTA

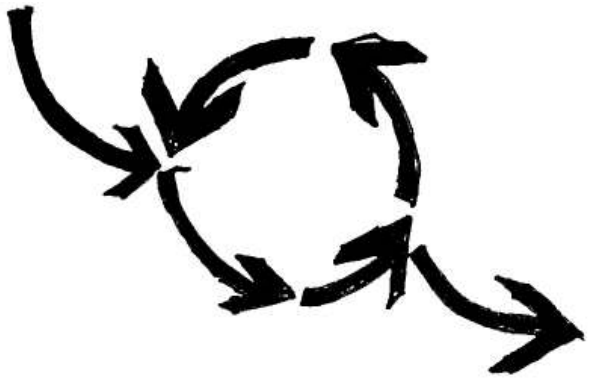
TAMs and Effective Risk Management are Inextricably Linked

- **Asset management systems – and any decisions derived from asset management systems – are only as strong as the underlying data and analytical techniques**
  - If asset management systems aren't collecting the necessary data, they can't inform decisions
  - If transportation staff are not bought into the importance of tracking and maintaining the system, the system will not be very useful
- **Incentives are strong for lasting decisions**
  - Infrastructure often has long design lifetime
  - "Being wrong" has financial consequences
  - Flexible designs are increasingly desirable
  - Operational improvements could buy time
  - Prioritization of limited resources is key

A flooded road in Fort Lauderdale.
Photo credit: Art Seitz.

Asset Management and Adaptive Management

- **Key elements**
  - Flexibility given uncertainties about the future
  - Monitoring and evaluation
  - Adjustments in decision making



- **Apply asset management data to:**
  - Identify versatile, scalable adaptation strategies
  - Continually monitor changes in climate, other conditions, and impacts
  - Evaluate progress toward resilience
  - Inform incremental changes or strategic adjustments as needed
  - Reassess vulnerabilities over time

Continual process toward resilience

Informing Vulnerability Assessments and Risk Management

- **How can asset management systems be modified to address the risks from extreme weather events and climate change?**
  - Collecting relevant data to inform screening and risk management
  - Monitoring impacts
  - Evaluating climate/weather conditions when impacts occur

Collecting Relevant Data for Screening and Risk Management

- **Location**
- **Elevation**
- **Proximity to FEMA floodplain (100yr, 500yr)**
- **Design standards applied, where relevant**
  - Temperature
  - H&H
- **Condition**
- **Design life *as well as* anticipated useful life**

Monitoring Impacts

- **Flooding**
  - Date of flooding
  - Frequency of flooding
  - Depth of flooding
  - Cause of flooding
  - Closure duration
  - Cost of repair (materials)
  - Cost of repair (labor)
- **Temperature Changes**
  - Potholes
  - Rutting
  - Frequency of slow-orders (rail)
  - Rail kinks (rail)

I-80 overtopping at the Cedar River east of Iowa City, June 2008. Photo credit: Iowa DOT.

When Impacts Occur, Pair with Weather Conditions

- **What conditions were associated with the impacts?**
  - E.g., rainfall intensity, 5-day precipitation totals, high temperature, 7-day average high temperature, high tide
  - Did similar assets with similar exposure perform differently? Why?
- **Build institutional relationships with data providers (e.g., NWS, USGS, US ACE)**
- **Over time, inform decision-making**
  - Forecast calls for a heavy downpour, with intensities of > 2” per hour
    - Target locations that may be affected
  - Revisit asset design upon replacement
  - Evaluate ROI

Severe roadway damage during a storm.
Photo credit: Foothills Media Group, 2011.

Conclusion

- **Climate change will present new challenges and risks to transportation systems**
- **Past events, while instructive, are not sufficient to inform future designs or risk management approaches**
- **Data collection processes must be expanded to include new kinds of information throughout the lifetime of the asset**
- **More comprehensive, more robust asset management data must be applied to inform climate-resilient decision making as part of a continual process towards resilience**

Thank you!

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