Freight Transportation Resilience Needs

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ICF International
What is freight resilience?

NAS definition

Individual, community, & national resilience is the ability to:

- prepare and plan for,
- absorb,
- respond to,
- recover from, and
- adapt to adverse events

Schematic of Preparedness as a Function of Long Term Recovery Planning

Similar Definitions employed by FHWA and FTA
WHY SHOULD THE FREIGHT COMMUNITY CARE ABOUT RESILIENCE?

Maybe You’ve Noticed…

• Flooding in Houston, TX, May 2015
• Flooding in Michigan, August 2014
• Flooding in Colorado, September 2013
• Superstorm Sandy, October 2012
• Tropical Storm Lee, September 2011
• Hurricane Irene, August 2011
• Heat Wave in Midwest, summer 2011
WHY SHOULD THE FREIGHT COMMUNITY CARE ABOUT RESILIENCE?

Maybe you’ve noticed…

Texas and Oklahoma, May 2015

Michigan, August 2014

Colorado, September 2013

Vermont, August 2011

Photo sources (clockwise): AP Photo/Brandon Wade, AP Photo/Carlos Osorio, Colorado DOT, VTrans
WHY SHOULD THE FREIGHT COMMUNITY CARE ABOUT RESILIENCE?

Not to mention...

Washington landslide, March 2014

Texas drought, 2011

California wildfires, 2014

Buffalo snow storm, December 2014

Photo sources (clockwise): USGS, City of Austin, Fox News, necn
Why should the freight community care about resilience?

• 12/15 extreme precipitation leads to widespread flooding across Midwest
  • Freight disruption in IL and MO
  • Port, pipeline, and refinery closures in TN
  • UP canceled 70 trains in St. Louis area

• 12/12 Sandy halted operations in NY-NJ
  • Caused hazmat incidents
  • Swept debris in channels
  • Saltwater corroded equipment
  • Power loss delayed recovery operations
U.S. Selected Significant Climate Anomalies and Events May and Spring 2015

AK was record warm for May with a temperature 7.1°F above average. The warmth was widespread with Barrow and Juneau being record warm.

Seven states across the West had a top 10 warm spring. CA had its warmest Jan-May on record, at 5.1°F above average.

The contiguous U.S. drought footprint shrunk to 24.6%, the smallest since Feb 2011. Drought conditions improved across the Great Plains, but remain entrenched in the West.

CO, OK, and TX were record wet for May with widespread flooding. It was also the all-time wettest month for OK and TX. TX was record wet for spring.

HI had a mixed precipitation pattern during May with little change in drought conditions. Over 20% of the state is in drought.

The Northeast was warm and dry with drought developing. CT, MA, NH, and RI were record warm for May.

There were over 400 preliminary tornado reports during May, the most since Apr 2011. There were 7 tornado-related fatalities.

On May 10, Tropical Storm Ana made landfall in SC with sustained winds of 45mph. Ana is the 2nd earliest landfalling tropical cyclone on record for the U.S.

FL had its warmest spring on record with a temperature 4.6°F above average. GA had its 3rd warmest spring.

The average U.S. temperature during May was 60.8°F, 0.6°F above average. The spring U.S. temperature was 53.2°F, 2.2°F above average. May U.S. precipitation was 4.36 inches, 1.45 inches above average and the wettest month of any month on record. The spring precipitation total was 9.33 inches, 1.39 inches above average.
U.S. Selected Significant Climate Anomalies and Events
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Please Note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: http://www.ncdc.noaa.gov/sotc
Weather-related loss events in the U.S. 1980 – 2014

Number of events

Number


Meteorological events
(Tropical storm, extratropical storm, convective storm, local storm)

Hydrological events
(Flood, mass movement)

Climatological events
(Extreme temperature, drought, forest fire)

© 2015 Münchener Rückversicherungs-Gesellschaft, Geo Risks Research, NatCatSERVICE – As at January 2015
## Selected Implications for Freight Systems

<table>
<thead>
<tr>
<th>Extreme Weather</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flooding / Heavy Downpours</td>
<td>• Washouts&lt;br&gt;• Disruption of freight services&lt;br&gt;• Risk of hazardous cargo accidents</td>
</tr>
<tr>
<td>Tropical Cyclones</td>
<td>• Hazardous conditions&lt;br&gt;• Infrastructure Damage&lt;br&gt;• Debris fields&lt;br&gt;• Saltwater intrusion/Equipment failure</td>
</tr>
<tr>
<td>Wildfires</td>
<td>• Service interruptions&lt;br&gt;• Damaged infrastructure</td>
</tr>
<tr>
<td>Winter Storms</td>
<td>• Hazardous conditions&lt;br&gt;• Disruption of freight services</td>
</tr>
<tr>
<td>Extreme Heat</td>
<td>• Asphalt deterioration, equipment failure</td>
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</tbody>
</table>
Why should the freight community care about resilience? Cascading impacts

- Disruptions have had significant economic impacts on the freight services and producer industries
- Diversions can potentially overwhelm highway and rail systems and can cause community impacts
- Disruptions in freight also results in consumer impacts and economic losses throughout the country.
Why should the freight community care about resilience?
Many sources of possible disruptions

<table>
<thead>
<tr>
<th>Extreme weather, current and future</th>
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<tbody>
<tr>
<td>storms</td>
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<tr>
<td>intense precipitation</td>
</tr>
<tr>
<td>extreme heat</td>
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<tr>
<td>wildfires</td>
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<tr>
<td>high winds</td>
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<table>
<thead>
<tr>
<th>Geophysical</th>
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<tbody>
<tr>
<td>earthquakes</td>
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<tr>
<td>tsunamis</td>
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<tr>
<td>volcanoes</td>
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<td>landslides</td>
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<table>
<thead>
<tr>
<th>Human activity</th>
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<tbody>
<tr>
<td>accidents</td>
</tr>
<tr>
<td>terrorism</td>
</tr>
<tr>
<td>communications failures</td>
</tr>
<tr>
<td>economic failure</td>
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<tr>
<td>cyber attacks</td>
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Why should the freight community care about resilience? Requirements are growing in multiple areas

- Executive Order 13677 --- Climate-Resilient International Development (Sept. 2014)
- Amends E.O. 11988 (1977)
- FEMA Implementing Guidance (Oct. 2015)

Good practice as part of project development and planning to insure robust service over project life
What are the special challenges to freight resilience?

- Growing network complexity
- Multiple stakeholders and institutional challenges
- Competition and proprietary interests
What are the special challenges to freight resilience?

- Uneven communication
- Inadequate understanding of supply chain risks
- Inadequate analytic approaches
- Limited institutional capacity

Figure 4: Originating Tennessee River Traffic Passing through Kentucky Lock
What are the challenges to freight resilience?

Key analytical challenges

• Development and application of a risk analysis framework
  – Risk = Probability x Consequence
  – Probabilities of damage
  – Consequences

• How to assess vulnerability and risk
  – Current and Future

• How to prioritize risks?

<table>
<thead>
<tr>
<th>Probability</th>
<th>Insignificant</th>
<th>Minor</th>
<th>Moderate</th>
<th>Major</th>
<th>Catastrophic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost Certain</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>Extreme</td>
<td>Extreme</td>
</tr>
<tr>
<td>Likely</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>Extreme</td>
</tr>
<tr>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>Extreme</td>
</tr>
<tr>
<td>Unlikely</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Rare</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
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Prioritised risks
What are the challenges to freight resilience?
Key analytical challenges

• How can we plan for resilience in a comprehensive way?
  – Capital investment
  – O & M changes (and budgets)
  – Planning
  – Gray and green infrastructure

• What are the best resilience improvements to make?
  – How operationally effective?
  – How cost-effective?
  – Is it feasible (politically and operationally)?
  – Secondary costs and benefits
What can be done to improve freight resilience?

- Improve institutional coordination and build social capital
  - Raise awareness
  - Need for leadership
- Develop and adapt analytical approaches to supply chains
  - Multi-hazard framework
  - Risk analysis
  - Resilience planning
  - Strategy evaluation and implementation
- Policy approaches and investment
What can be done to improve freight resilience?

Improve institutional coordination and leadership

- Better understand stakeholder roles and responsibilities
- Raise awareness of supply chain implications
- Enhance communications and coordination
- Build trust and social capital
- Identify leaders and build leadership
  - Freight Advisory Councils

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
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<tbody>
<tr>
<td>Freight Operators (e.g. shippers, carriers)</td>
</tr>
<tr>
<td>State Freight Councils / Coordinating Bodies</td>
</tr>
<tr>
<td>State / Local Governments (e.g. MPOs, DOTs, Municipalities...)</td>
</tr>
<tr>
<td>Airport and Port Authorities</td>
</tr>
<tr>
<td>Federal Agencies (e.g. USACE, USCG, US DOT)</td>
</tr>
</tbody>
</table>
What can be done to improve freight resilience?
Develop and adapt analytical approaches

**World Bank Climate and Disaster Risk Screening for Transport Sector**

**U.S. DOT Vulnerability Scoring Assessment Tool (VAST)**

Freight assets vulnerable to seismic risk (courtesy Vanderbilt University)

**Road Vulnerability from Extreme Rainfall (courtesy Vanderbilt University)**
What can be done to improve freight resilience?

Key Next Steps

- Build social capital among stakeholders
- Better understand national, regional, and local supply chains
  - Diversion potential
- Identify critical cargo differences
- Assess enterprise risks
  - Temporal differences and spatial differences
- Plan for resilience comprehensively
- Invest strategically
Thank you!