Sector Focus: Transport

Keith Bettinger
26 September 2019
Overview

- A story about Hawaii
- Global infrastructure vulnerability to hazards
- Climate change and investment decisions
- What’s happening around the world in terms of managing risks to transport
- Some ways forward
E Komo Mai!!!

Visitor Arrivals to Hawaii

Source: DBED&T, State of Hawaii

9/26/19
Global multi-hazard road and railway infrastructure exposure

Global Expected Annual Damages (EAD) range from 3.1 to 22 billion US dollars, of which approximately 73% is caused by surface and river flooding.

Many coastal areas show high exposure to risk

ARTICLE
https://doi.org/10.1038/s41467-019-10442-3

A global multi-hazard risk analysis of road and railway infrastructure assets

E.E. Koks¹,², J. Rozenberg³, C. Zorn⁴, M. Tariverdi³, M. Vousdoukas⁴,⁵, S.A. Fraser³, J.W. Hall¹ & S. Hallegatte³
Dominant hazards

Fig. 2 Dominant hazard per region. This figure presents the hazard causing the highest transport infrastructure exposure in each region. The pie chart shows the relative percentage of land area (excluding areas with insufficient data) where that specific hazard causes the highest exposure.
Expected Annual Damages (EAD)
Benefits of design standards upgrades
Impacts and infrastructure
Number of natural loss events worldwide 1980 – 2017
Economic damage
Asia and the future

Regional Contribution to International Passenger Traffic Growth 2016–2040

- Europe: 26.0%
- Asia-Pacific: 38.8%
- Middle East: 17.9%
- Africa: 2.2%
- Latin America Caribbean: 6.9%
- North America: 8.4%
Climate change impacts on roads

<table>
<thead>
<tr>
<th>Event</th>
<th>Impact on Road Infrastructure</th>
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<tbody>
<tr>
<td>Increased temperature</td>
<td>Damage to concrete and bridge expansion joints;</td>
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<td>Heat waves</td>
<td>Buckling, fissuring of asphalt pavement</td>
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<td>Rutting</td>
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<td>Fewer colder days and shorter winters</td>
<td>Reduced snow removal but increased freeze-thaw degradation of asphalt</td>
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<td>Sea levels rise and tidal surges</td>
<td>Intermittent or permanent flooding</td>
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<td>Surface damaged</td>
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<td>Weakening of key infrastructure support (bridge pilings)</td>
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<td>Damage to critical drainage infrastructure</td>
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<td>Increased costal erosion – road collapse</td>
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<td>Exacerbate salinity (corrosive effect)</td>
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<td>Extreme precipitations</td>
<td>May overwhelm drainage infrastructure</td>
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<td>Erosion, scouring, slop failure, flooding</td>
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<tr>
<td>Extreme winds and storms</td>
<td>Wind damages bridges, gantries, signs, electricity networks, lightning</td>
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<td>Storm surge means damage from increased wave height and strength</td>
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</table>
Impacts on other modalities

- Consider sudden and slow, direct and indirect
- Cascading failures disrupt operations
- Higher temperatures require longer runways
- Heat/frost-thaw impacts on roads, bridges, railway beds
- Greater corrosion from periodic salt-water inundation, wetter ground and reverse infiltration
Impacts on air operations

**Precipitation change**
- Disruptions to operations (e.g., airfield flooding, ground subsidence)
- Reduction in airport throughput
- Inundation of transport access (passengers and staff)
- Loss of local utilities provision (e.g., power)
- Inadequate drainage system capacity
- Inundation of underground infrastructure (e.g., electrical)

**Sea-level rise**
- Loss of airport capacity
- Loss of airport infrastructure

**Temperature change**
- Changes in noise impact due to changes in aircraft performance
- Heat damage to airport surface (e.g., runway, taxiway)
- Increased heating and cooling requirements

**Wind changes**
- Convective weather: disruption to operations
- Local wind patterns: potential disruption to operations and changes to distribution of noise impact
- Crosswinds: reduction in capacity

**Extreme events**
- Disruptions to operations
- Disruption to ground transport access
- Disruption to supply of utilities

**Precipitation change**
- Disruptions to operations (e.g., airfield flooding, ground subsidence)
- Reduction in airport throughput
- Inundation of transport access (passengers and staff)
- Loss of local utilities provision (e.g., power)

**Sea-level rise**
- Loss of airport capacity
- Impacts on en-route capacity due to lack of ground capacity
- Loss of ground transport access

**Temperature change**
- Changes in aircraft performance
- Changes in noise impact due to changes in aircraft performance

**Wind changes**
- Convective weather: disruptions to operations
- Convective weather: route extensions

**Extreme events**
- Disruptions to operations
- Disruption to ground transport access
- Disruption to supply of utilities
Investment considerations

- Private sector investment depends on infrastructure availability
  - Availability/condition of infrastructure affects competitiveness

- Infrastructure investment decisions based on cost-benefit analysis
  - Long-term benefit streams guide decisions

- Bond rating, interest rates, insurance all affect costs of infrastructure investment

- Changing environmental conditions (CLIMATE CHANGE) potentially affect benefit streams
Investment considerations 2

- ADB, WB, other MFIs requirement climate screening and climate proofing

- Bond raters, insurance companies now care about climate change

- RoI for projects depends on total network performance

- Lack of adaptation = competitive disadvantage

Climate change poses credit risk as U.S. Midwest, Southeast heat up - Moody's
What is happening globally?

- Marrakech Partnership on Global Climate Action: “Navigating a Changing Climate”

- Assessing vulnerabilities/risks to international transportation systems and producing guidance…
  - ICAO, PIANC, IAPH, IRF, others…

- Altering standards at the national level (e.g. FRANCE, NORWAY)

- Developing international standards for assessment and adaptation planning…
  - ISO, CEN/CENELEC

- MLIs prioritizing infrastructure adaptation and network resilience
Risk Assessment: Strengthening Critical Infrastructure against Natural Hazards in Tajikistan

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<tr>
<th>Bridge</th>
<th>Glacial Lake Outburst</th>
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RailAdapt: UIC

- Framework for adapting rail systems management, operations, procurement (mainstreaming)
- Consider range of current and future weather conditions
- Develop adaptation plans
- Compiles best practices

“...a transport system in which the world’s railways have acquired the flexibility to intelligently adjust to climate change, thereby providing their economies and societies with reliable and cost-efficient transportation services”.
“…to provide organizations with a consistent, structured and pragmatic approach to prevent or minimize the harm that climate change could cause and also take advantage of opportunities.”

Includes

- Assessing CC impacts
- Adaptation planning
- Implementation

Additional guidance to be developed includes ISO 14091 (adaptation pathways)

ISO 14090:2019
Adaptation to climate change — Principles, requirements and guidelines
General Steps Forward

- Conduct vulnerability assessments of transportation networks
- Governments, private sector, international organizations should establish inventories of critical and sensitive nodes
  - Share regionally and internationally
- Mainstream CC into procurement, management, m&o, design of routes and facilities
  - Including EIA
- Improve and strengthen regulations and enforcement
- Develop better CBA tools for estimating benefits and incremental costs
Mahalo...Mahalo Nui Loa

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