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Panel: The Role of Transportation Systems in Regional Evacuation Models

Planning Against Hazards for a Resilient and Sustainable Community Through Adaptive Transportation Systems

Catastrophes and Complex Systems: Transportation

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Sources: Listed at the end of the presentation in detail

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Planning Against Hazards for a Resilient and Sustainable Community Through Adaptive Transportation Systems

Clarifying Basic Concepts from an Urban Planning Perspective

Sustainability

- Economic efficiency, environmental stewardship, and social equity
- Striving for a balanced system

Resilience

- Ability to bounce back quickly
- Anticipatory planning: preparation for hazards, reduction of vulnerability

Adaptation

- Adjustment in built, natural or human systems
- Adaptation and Mitigation as joint concepts

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Transforming the Planning Concepts into Transport Systems

The ability to respond quickly to disasters and catastrophic events is founded in the capability of transport systems to

- (1) Withstand the impact of the event
(ADAPTATION)
- (2) Recover quickly from the event
(RESILIENCE)
- (3) Provide life-saving and basic functions despite the event
(SUSTAINABILITY)
- (4) Avoid or reduce contribution to impact of future events
(MITIGATION)

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The Challenge in Transport Systems

Transportation infrastructure can be classified as “**critical**”, because its loss creates a significant threat for needed supplies and services, while adversely affecting a multitude of other infrastructures

Transportation systems are complex, large, integrated and open systems (**CLIOS**)

Complex links and nodes of transportation networks make it hard to **predict** the ripple effects that the system will experience once a hazard strikes

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Adaptation and Mitigation

Infrastructural development as protective barriers

Protection from the “inside”:

Materials, e.g. durability enhancement, design structures

Protection from the “outside”:

Dams, land-use changes, woodlands

Alternative transport options

Rerouting

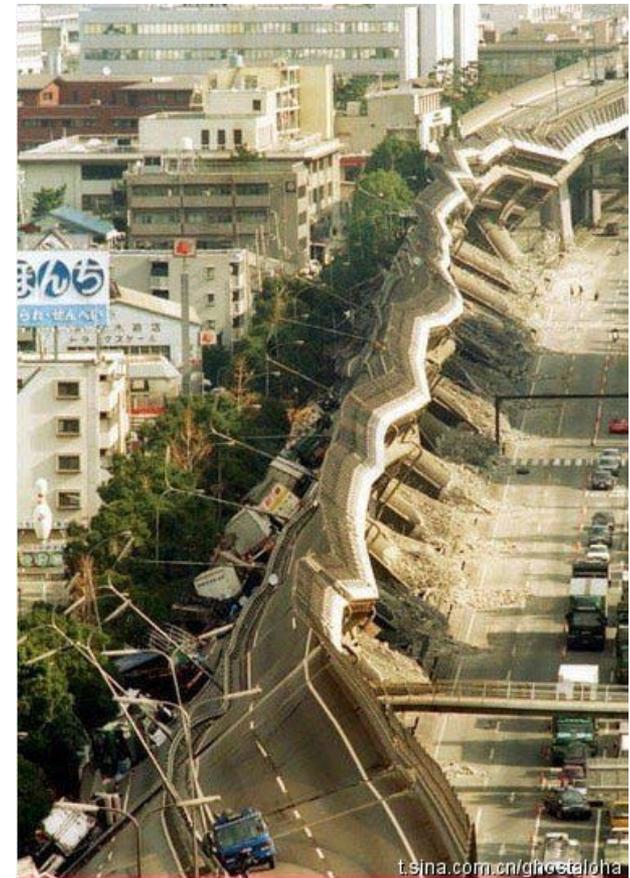
Secondary routes

Multimodality

BRT, Rail - TRANSIT

Alternative energy/fuel

Bio, hydrogen



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Transport needs to

Provide life-saving and basic functions despite the event

Water, Food and Medical supplies

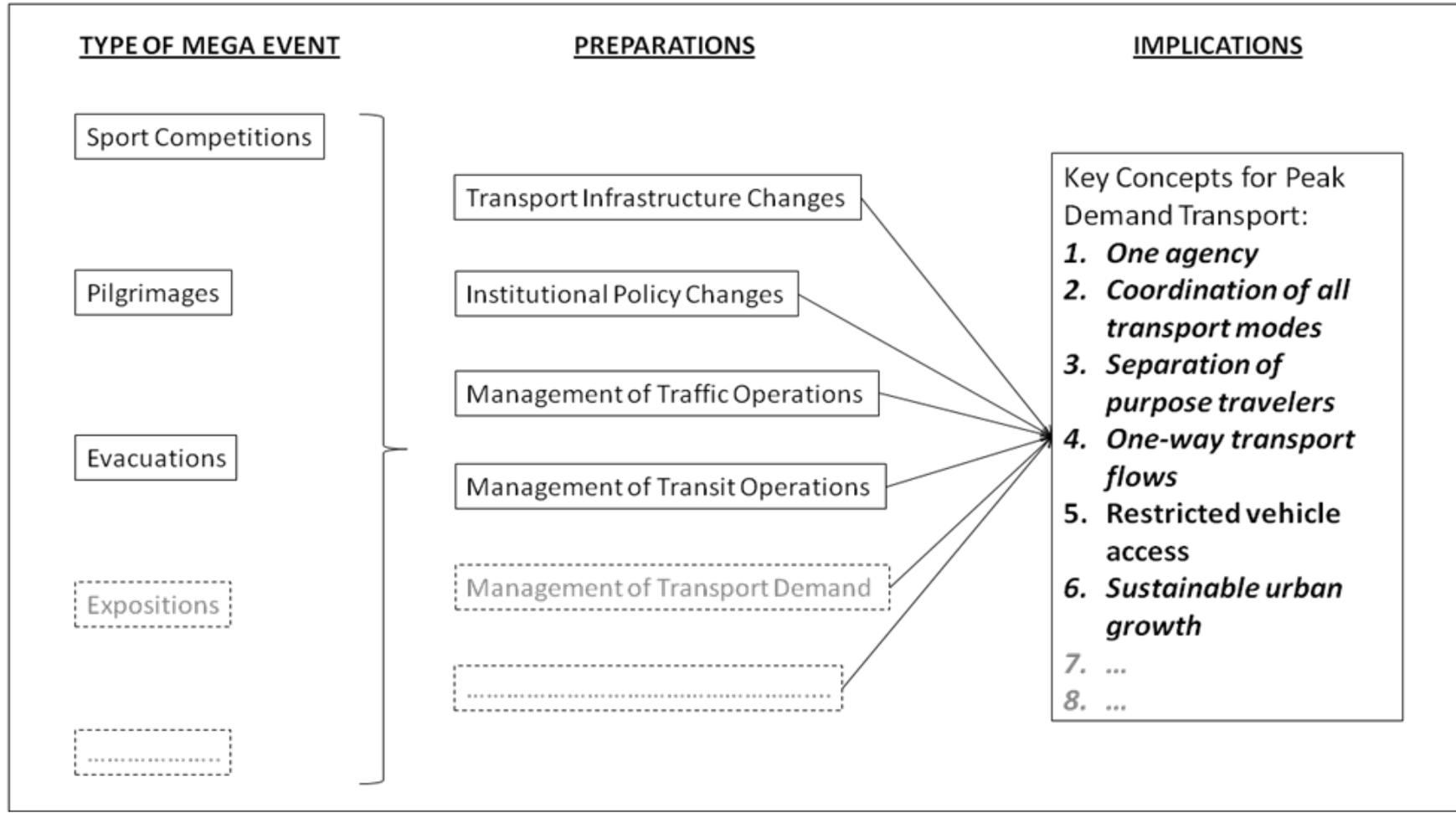
Evacuations

	Sport Mega-Events: Olympic Games	Pilgrimages: Hajj	Evacuations in: Miami/New Orleans
Frequency (same city)	Unique	Repeated	Repeated
Predictability (years)	Expected	Expected	Unexpected
Cultural background	Celebration	Religious Diligence	Forced movements
Mobility Scale	Urban	Regional	Regional
Primary type of transport mode	Rail	Bus	Cars

Source: Kassens-Noor 2010

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Comparison to the Olympic Games



Source: Kassens-Noor, 2010

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Transport options		Adaptation	Resilience	Sustainability	Explanation
Land	Walk	Building of alleys, transformation into protective barriers against hazards	Expansions, exploration of alternative roadways as evacuation or emergency routes	Encouragement in every-day usage, most equitable and environmentally protective form of transport, highly efficient from governmental point of view	Viable alternative for infrastructural modifications and long-term development
	Bike	Expansion of bike paths, Separation from roadways, so as to increase capacity			
	Car	Highways, feeder systems vulnerable to flooding, tunnels are highly vulnerable	Avoid/prevent gridlock (capacity increase vs. operational stability = consideration of more capacity, more development)	Less reliance on vehicular traffic, exploration of alternative modes of transport, car-pooling options, HOV lines	Reduce reliance
	Bus				
	Metro	Protection against sea-level rise, flooding, mud slides, potential trap	Explore options for evacuation strategies – high-capacity movements	Make it competitive mode of transport systems	Consider Mass Evacuation potential
Rail					
Marine	Ports	Potential need for dams		Central points of entry and exits	Consideration of supplies and rescue operations, efficient operations as rescuer
	Boat, ship	Flexible capacity, storage potential	Potential role as freight and rescue deliverer	Load factors efficient, smart scheduling	
	River banks	Erosion protection	Scenario analysis for centennial flood events	Rimmed by trees and parks for sedation protection	
Air	Airports	Secure vicinity, flood protection, secure surrounding transport networks	Alternative arrangements for staffing/overnight stays, terminals as potential shelters	Reconsider efficient use of space, storage facilities for emergencies	Key role in response and recovery operations
	ATC	Keep operational at all times, exploring of alternative technologies: non-weather-related guidance and communication systems	Explore alternative operations, test events for air bridges, evacuation routes		
		Protective barriers as function of geographical location and surrounding settlements	Flexible response systems Scenario planning	Basic functionality Resources available	

Source: compilation from sources by the author

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The Solution

Planning against hazards should be integrated within the routine development processes of communities, cities, states, regions, and countries.

- Adaptive transport infrastructure,
- Resilient transport responses
- Sustainable transport operations

PLANNING GOAL



	Transport ingress and egress routes (Evacuation)	Protective spaces (shelter)
Economic	Transport Infrastructure Development	Hospitals
Environmental	Parks	Woodlands
Social	Public Transit	Community Centers

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Flexible Capacity Concept

- **Integrates core concepts - *proactively***
- Reduces physical and social vulnerability of communities
 - Exposure is the extent to which the community is located within hazard prone regions
 - Sensitivity is the extent to which communities possess “adaptive capacity” to deal with hazards and disasters
- Ensures that essential protective needs for resilient and sustainable communities are continuously met while cohesively integrated into the sustainability framework.
 - through new infrastructure
 - operational practices
 - viable institutions
 - social functionality of the transport system

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Exemplary Table of Supply Options

Transport options		Adaptation	Resilience	Sustainability
Land	Walk	Mixed land-use development	Exploration of options	Health-centered
	Bike			
	Car	HOV lanes	Borrowing alternatives, car-pooling emergencies	Emission Control: hybrids, natural gas, incentives
	Bus			
	Metro	Protective barriers within transport network, stability areas, water pumps	Controlled viable evacuation alternative	Transit-Oriented Development
	Rail			
Marine	Ports	Protective sea walls	Security Vehicle as viable alternative	Flexible management systems
	Boat, ship			
	River banks	Investments essential, reduction of flooding zones	Rimmed by trees and parks for sedation protection	Tree planting, protective walls
Air	Airports	Drainage systems	Equipment as shelters and storage	Secondary airports, military based airports
	ATC	Exploration of GPS options		
Status quo		Infrastructure Centered	Resource Centered	Economy Centered
Normative		Social network	Community	Environment, Equity

Source: compilation from sources by the author

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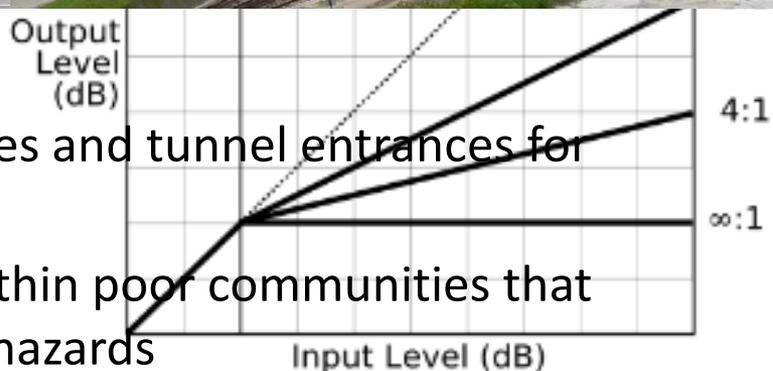
Source: <http://www.msnbc.msn.com/id/34533015>



source: <https://picasaweb.google.com/lh/photo/zFk1huGp2fuTYTXUvRTMeA>

- Likely transport system candidates:

- Transport infrastructure, low-lying bridges and tunnel entrances for roads, rail, and transit systems.
- Social structures are most vulnerable within poor communities that do not possess resources to respond to hazards



Source: http://www.pardonskilledesigns.com/network_management.php

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A Communities' Adaptive Transport Capacity

- Flexibility of communities to respond to hazards,
 - Access to different types of transport systems
- Immediate access to resources,
 - Exact time tables are fixed
 - Automatic response/plan of action from transport organizations
- Stability, regularity and preparedness within communities during non-hazard times
 - Self-sustaining
 - Used
 - Integrated in day to day operations
 - Routine

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Conclusions

- Flexible, adaptive capacity has to be integrated in our today's standard urban and transport planning approach.
- Adaptation has to be integrated into our built, natural and human environment.
- The concepts of social responsibility and accountability can play a powerful part in transforming communities into sustainable and resilient entities.
- In quantifying the impact, additional members may bring to resilient and sustainable communities three key questions that need to be addressed when integrating adaptive, resilient and sustainable transport systems:
 - Adaptive: “What is the most critical piece of the transport system?”
 - Resilient: “What is the most vulnerable piece of the transport system?”
 - Sustainable: “How can transport resilience and transport adaptation be integrated into the sustainability framework?”

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Thank you!

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Beneficiaries

- **Governments:**
 - Preparations for the new normal, an ounce of preparation is better than a pound of cure
 - Sustainability
 - Protection as trust-building
- **Public**
 - Protection of health and life
 - Employment opportunities – knowledge as exportable good and service
- **Corporations**
 - Liability protection
 - Education of talent

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What is a resilient community?

- Protected
 - Resource availability
- Prepared
 - Immediate response possible
- Networked inside and outside the community
 - Support
 - Information Technology (IT)
- Educated on emergency responses
 - Risk of community
 - Response mechanisms
 - Location of shelters
 - Flood zones
 - Transport accessibility and mobility

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What is a sustainable community?

- Stable
- Balanced
 - Economic efficiency (employment)
 - Environmental stewardship (green)
 - Socially equitable (no tensions)
- Caring
- Responsible
- Driven through self-motivation (bottom-up approach)
- Empowered

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What is an adaptive transport system?

- Flexible
 - Loss of critical infrastructure can be accommodated through secondary options
 - Integrative
 - Integrated
 - Secured
 - Safe
 - Reliable
 - Equilibrated
 - Supply meets demand
- } To all social classes while linked with land-use systems

The Role of Transportation Systems in Regional Evacuation Models

Moderator: Herb Engle (DHS S&T)

Eva Kassens – Noor
Michigan State University

- Integration of resilience, sustainability, adaptation and mitigation concepts for future Urban Development
- Adaptive Transport Systems as flexible, reliable, functional key ingredient to achieve sustainable and resilient communities