Stakeholder vulnerability assessment of maritime infrastructure: Method development and pilot project for Rhode Island

Austin Becker, PhD
Assistant Professor of Coastal Planning, Policy, and Design
Departments of Marine Affairs and Landscape Architecture
University of Rhode Island

Innovative Technologies for a Resilient Marine Transportation System
Transportation Research Board
4-25-14
RESILIENCE

Prepares, resists, recovers, and adapts to successfully function under the stress of disturbances (USACE).

WHAT CAN WE DO?
Identify, assess & select strategies

WHAT CAN WE EXPECT?
Identify vulnerabilities

WHAT CAN WE LEARN?
Revise & share lessons learned

Monitor & evaluate

Implement strategies
Complex seaport stakeholder cluster

- Generate profits
- Facilitate commerce
- Steward for public health/well being
- Environmental protection
- Generate profit
- Make port an economic engine
- Create jobs
- Protect adjacent communities
- Environmental advocacy
- Provide research assistance
- Generate new knowledge

 Internal Port
(port authority or port operator)

(Based on Winkelmans and Notteboom, 2007)
Cascading consequences for port stakeholders

1) **Direct damages**
   (e.g., structures, equipment, freight, land, etc.)

2) **Indirect costs**
   (e.g., lost wages, business interruptions, cleanup costs)

3) **Intangible consequences**
   (e.g., quality of life, environmental damages, loss of essential services)

*IPCC 2012*
External stakeholders bear high % of costs

Gulfport

Intangible consequences
- Port
- Shared
- External stakeholders

Indirect costs

Direct damages

% of cost borne by stakeholders

Providence

Intangible consequences

Indirect costs

Direct damages

% of cost borne by stakeholders

0% 20% 40% 60% 80% 100%
Ports concerned, but little action thus far

- Impacts should be addressed by ports: 81%
- Feels informed about climate impacts: 31%
- Has adaptation plan: 4%

(N=93)

(Becker et al 2010)
WHAT CAN WE DO?
Identify vulnerabilities

WHAT CAN WE EXPECT?
Identify, assess & select strategies

WHAT CAN WE LEARN?
Revise & share lessons learned

RESILIENCE
Monitor & evaluate
Implement strategies
Setting a research agenda

What can we expect? What can we do?

Stakeholder-based vulnerability assessments

Public – Private - NGO
 Problem Identification
 Vulnerability Assessments –

• Energy port
• High exposure
• NO recent hurricane

Case Study of Providence, RI

Becker, A. et al. (In press).
Method and process

1) Identify stakeholders
2) Create storm scenario & thought prompts
   Maps, visualizations, HAZUS data, etc
3) Conduct workshop with stakeholder group
4) Elicit perceptions, rankings, priorities
5) Synthesize and input to decision making process (e.g., investments, priorities, policies)
Port of Providence in Cat 3 simulated hurricane
(Surge layer provided by Applied Science Associates)
Visualizations

https://www.dropbox.com/s/qi6wzw3h9pxxgug/Floodwater%20Simulation%201.wmv
Decision support tools
Impacts of concern

Stakeholders

Goals/missions

Strategy alternatives

(Haymaker, 2006)
Advantages of stakeholder approach

- Allows for a variety of inputs (e.g., visualizations, surge maps, HAZUS outputs)
- Engages full stakeholder network in resilience planning (i.e., towards COPRODUCTION)
  - Informs decision makers of user concerns/priorities
  - Can lead to information sharing and behavior change
- Helps create enabling environment for investment in adaptation
Emerging issues...

1. How do stakeholders perceive:
   1. Responsibility for adaptation?
   2. The impacts that concern them most
   3. The costs associated with adaptation
   4. The threshold for investment

2. How do user perceptions of impacts compare to “decision maker” perceptions?

1. How do various “strategies” meet the objectives of stakeholders?
   1. Engineering strategies (e.g., build a dike, elevate)
   2. Policy strategies (e.g., better building codes, zoning regulations)
   3. Incentives (e.g., insurance reductions)
Funding support for this work from RI Dept. of Transportation and the URI Transportation Center
Many thanks to the Transportation Research Board

Contact
Austin Becker
abecker@uri.edu
web.uri.edu/abecker
EXTRA SLIDES BELOW
Ports: Critical, complex, constrained

Critical - Economic engines at every scale

Complex – Multiple stakeholders across space and time

Constrained - Dependent on specific and environmentally-sensitive locations

(Asariotis and Benamara 2012; Notteboon and Winkelmans 2003; EPA 2011; AAPA 2013)
How do engineers think about time?

- Actual working life: >75 years
- Project Design Life: 50 years
- My career (~35 years)
- My child's life (~100 years)
- My grandchild's life (~105 years)
- The rest of my life (~55 years)

Fundamental shift...
Port decisions do not always account for stakeholder concerns

Oct. 29, 2012
“Super storm” Sandy
You've seen one port, you've seen one port.

Mike Giari, Port Director of Redwood City
Unsuitable design standards for climate change

**Design Standard**
- Better than 1-in-100 year event
- 1-in-100 year event
- Less than 1-in-100 year event
- Not sure/no answer
- Does not consider

**Percent of respondents (n=93)**

- Quays/berths
- Terminals

**Planning to construct**
Ports have few formal plans that address adaptation

- **Has specific adaptation policy document**: 4%
- **Funded as line item in budget**: 8%
- **Addressed in strategic plan**: 12%
- **Carries specific climate change insurance**: 16%
- **Holds staff meetings to discuss adaptation**: 18%
- **Part of design guidelines or standards**: 28%

N = 89
Majority of 115 impacts: Intangible consequences

- Direct damages (n=40)
- Indirect costs (n=25)
- Intangible consequences (n=50)
128 port resilience strategies

Long range planning efforts: 6
Private sector and insurance policies: 10
Building codes and land use regulations: 10
Research (inc. risk assessment, forecasting improvements, and...): 13
Constructions and design: 24
Capacity building: 32
Emergency preparation, response, and recovery: 33

# of unique strategies mentioned in case studies
Overview

1. Ports cities and the climate change challenge

2. Setting the table for adaptation research

3. a) Vulnerability assessments
   b) Risk indices
   c) The leadership vacuum
Overview

1. Ports cities and the climate change challenge

2. Setting the table for adaptation research

3. a) Vulnerability assessments
   b) Risk indices
   c) The leadership vacuum
Overview

1. Ports cities and the climate change challenge

2. Setting the table for adaptation research

3. a) Vulnerability assessments
   b) Risk indices
   c) The leadership vacuum
2100
Ports and port stakeholders in harm’s way

Resilience challenges for ports in the face of climate change

Doubling of Cat 4 and 5 tropical storms

1-in-100 year storm event of today

Sea levels to rise 0.75 – 1.9 meters by 2100

1-in-3 year storm event of 2100

Inland flooding

(Bender et al. 2010; Grinsted et al. 2013; Rahmstorf 2010; Emanuel 2013; IPCC 2012; Tebaldi et al. 2012)
References

- Bryson JM (2004) What to do when...and how... An introduction to intelligent computing in engineering and architecture:320-327