Exercise 5: Benefit-Cost Estimation



Sharon Mielbrecht

Pacific Disaster Center

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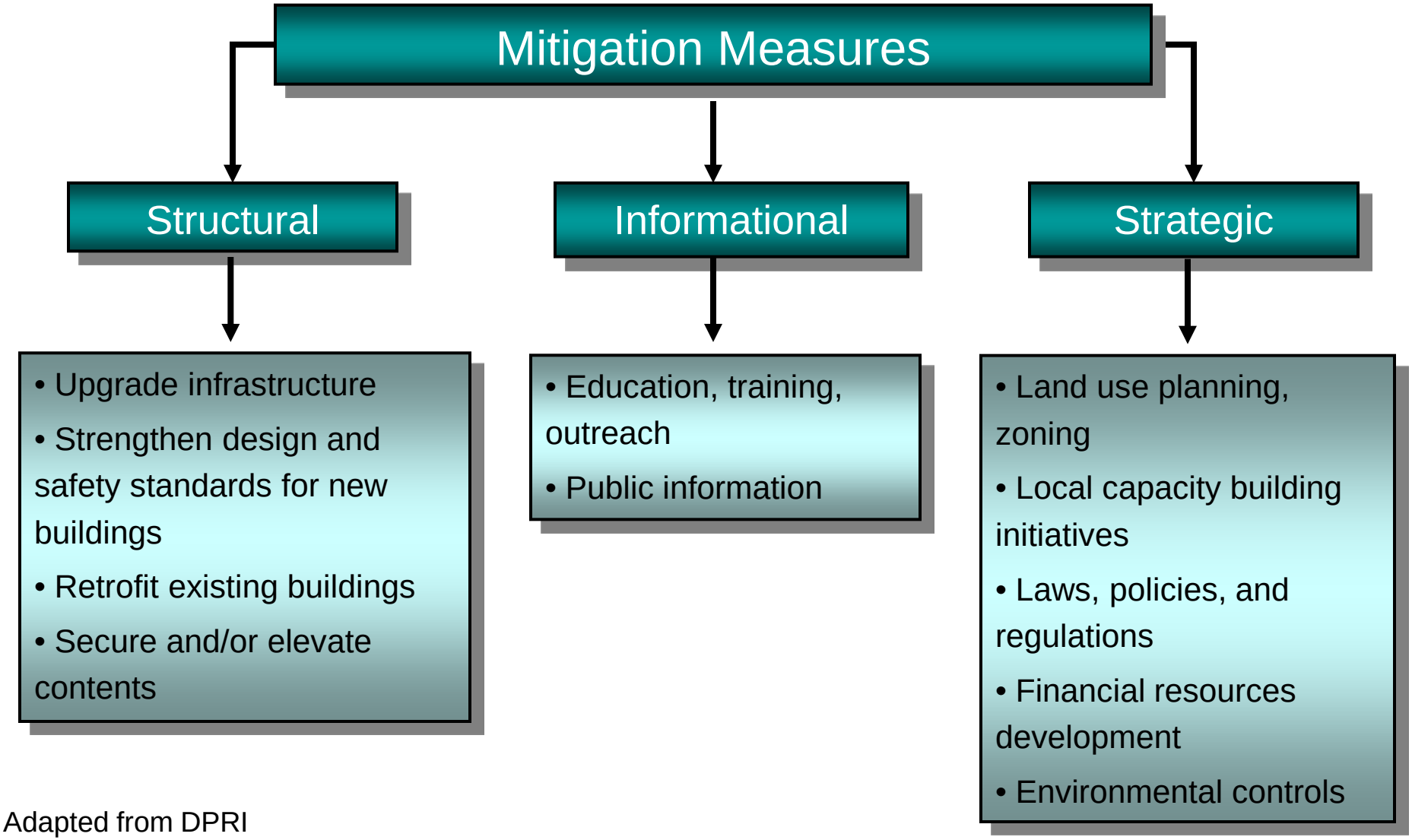
Mitigation Measures



Adapted from DPRI

Selecting Mitigation Projects

- Does the project:
  - Address a repetitive problem or a significant risk?
  - Contribute to a long-term solution?
  - Consider future changes to the area?
  - Not cost more than the anticipated value of the benefits?
  - Has it been determined to be the most practical, effective, and environmentally sound alternative after consideration of a range of options?

What is a Benefit?

- **Benefit = Avoidance of loss expressed in monetary unit ($):**
  - Avoided physical damages
    - Buildings, contents, infrastructure, site contamination, equipment

What is a Benefit? (Continued)

- Avoided loss of function impacts
  - Displacement costs for temporary quarters, loss of rental income, loss of business income, lost wages, disruption time for residents, loss of public services, economic impact of loss of utility services, economic impact of road/bridge closures.

What is a Benefit? (Continued)

- Avoided casualties
  - Deaths, injuries
- Avoided emergency management costs
  - Operation of EOC, evacuation or rescue, security, temporary protective measures, debris removal and cleanup, other management costs

What is a Cost?

- **Cost = the price paid to produce and maintain a mitigation project.**
  - Pre-construction or Non-construction costs
    - Property survey, appraisal
    - Planning, design
    - Site acquisition

What is a Cost? (Continued)

- Construction costs
  - Building materials
  - Demolition
  - Site restoration
  - Site management
  - Equipment

What is a Cost? (Continued)

- Ancillary costs
  - Contractor costs and mark-ups
  - Permitting fees
  - Project management
- Annual maintenance costs

Day 3: Thursday, October 21th

HANDS-ON EXERCISE: BENEFIT-COST ESTIMATION

Exercise Overview

- Given a hypothetical scenario:
  - Determine the probability of two hazards to a given location by using GIS.
  - Identify estimated costs and anticipated benefits for two mitigation projects.

Hands-On Exercise: Benefit-Cost Estimation

APEC Workshop on Hazard Mapping and Risk and Vulnerability Assessment

October 19-21, 2010
Grand Formosa Regent Taipei
Chinese Taipei

Goals of Exercise 5: Estimating Costs and Benefits

In this exercise we will start with a hypothetical scenario, and determine the probability of two hazards to a given location by using GIS. We will then identify estimated costs and anticipated benefits for two mitigation projects. INFORMATION FOR EXERCISE USE ONLY.

Scenario / Mitigation Projects

Highway X runs along a section of the eastern coastline of Chinese Taipei and links two rapidly growing cities: City A and City B. Along with the rapid expansion of these two cities, the large volume of commuter traffic, and an increasing demand for exchange of goods between the cities, make dependence upon Highway X critical. Large trucks traverse the 2 lane road on a regular basis. Residents living in and commuting to work between the two cities are becoming increasingly dissatisfied with the congestion and poor condition of the highway which are responsible for numerous traffic accidents and fatalities each year. On average, 93 fatalities result each year (based on data from the past 5 years).

Due to its proximity to the coast, the highway is subjected to flooding due to storm surge from tropical cyclones which impact the region at least once each year. It is also routinely flooded by heavy rainfall. Delays during inclement weather are frequent, and the only available detour between the cities is roughly 200 km long. Emergency management costs and constant temporary repairs are a continuous drain of resources for both cities sharing the cost, amounting to $5 million each year.

The two cities have formed a Mitigation Council and have initiated discussions about a number of possible mitigation actions. The Council wishes to consider not only the risk of flooding, but also the risk to earthquakes.

After much deliberation, the Council has prioritized two (2) mitigation options:

1. Widen and resurface the existing road (4 lanes).
2. Build an elevated roadway (10 km in length) over the flood prone area.

Further discussions and a detailed cost to benefit analysis are necessary before a decision is made. The Council is considering the following additional information:

The Ministry of Transportation has provided an initial estimate for widening and resurfacing the existing road (to 4 lanes) at a cost of $8 million per km. The cost to build the elevated roadway over the flood

prone area will be $50 million per km. Mitigating the elevated roadway for earthquake risk will double the cost per km.

If mitigation option 1 is implemented, it is estimated that traffic-related casualties will be reduced by 70%. In addition, delays due to traffic congestion or accidents will be reduced significantly.

If mitigation option 2 is implemented, temporary repairs to the road due to flooding and storm surge impacts will be largely eliminated.

What important costs have not been considered in the above estimates?

Part I – Instructions

To complete the first part of this exercise, you will need to open the .mxd project file entitled: *APEC_HMRVA_EX5* located in the *Exercise5* folder. Zoom in to the area of interest that includes City A, City B, Highway X, and the Detour road.

Use GIS to answer the following questions:

1. For the area under consideration, what is the maximum likely intensity of an earthquake within a 50-year period?
2. For this same area, what storm intensity has a 10% chance of occurring within a 10-year period?
3. What is the approximate distance between the two cities (in kilometers)? (Hint: Use the **Measure** tool). 

Part II – Instructions

Discuss the two mitigation projects that are being considered to address the situation described in the scenario. As a group, answer the following questions to the extent possible with the information provided. Record your answers on the flip charts provided, and be prepared to share your discussions with the larger group.

1. What costs are expected for each project in each of the following categories?
    a. *Pre-construction or non-construction costs*
    b. *Construction costs*
    c. *Ancillary costs*
    d. *Annual maintenance costs*
2. What anticipated benefits are foreseen for each mitigation project in each of the following categories?
    a. *Avoided physical damages*
    b. *Avoided loss-of-function impacts*
    c. *Avoided casualties*
    d. *Avoided emergency management costs*
3. How do benefits and costs differ most significantly from one project to another?
4. Which of the mitigation options are you most likely to implement based on your discussions?
5. What issues will NOT be addressed by each project?

Note: The information contained in this document is fictitious and is provided for use solely by workshop participants to consider a hypothetical scenario.

Acknowledgements

Day 3 Hands-on Exercise

Exercise 5: Basic Cost-benefit Analysis

- **Contributing Authors**
  - Sharon Mielbrecht, Pacific Disaster Center
  - Todd Bosse, Pacific Disaster Center
  - Heather Bell, PhD, Pacific Disaster Center

- **Published Source Materials**
  - Pacific Disaster Center. 2010. Course materials developed for the Ministry of Agriculture and Rural Development (MARD) Natural Disaster Risk Management Project: Education and Training Program. Hanoi, Vietnam, March-May 2010.
  - Pacific Disaster Center. 2004. Multi-hazard Urban Risk Assessment for Marikina City, Philippines, and Guidelines for Implementing Multi-hazard Risk Reduction Strategies for an Urban Environment. Marikina City, Philippines, January-December 2004.
  - United States Federal Emergency Management Agency (FEMA) (2010). Benefit-Cost Analysis Course (FEMA BCA).
  - United States Federal Emergency Management Agency (FEMA) (2007). Using Benefit-Cost Review in Mitigation Planning (FEMA 386-5).