9th National Conference on Transportation Asset Management
Making Asset Management Work in Your Organization

Condition of Roadways and the Dynamics of Highway System Performance: An Assessment Framework

Mohammadsaied Dehghani
Ph.D. Candidate, Center for Sustainable Transportation Infrastructure (CSTI)

Gerardo W. Flintsch
Professor, The Via Department of Civil and Environmental Engineering
Director, CSTI

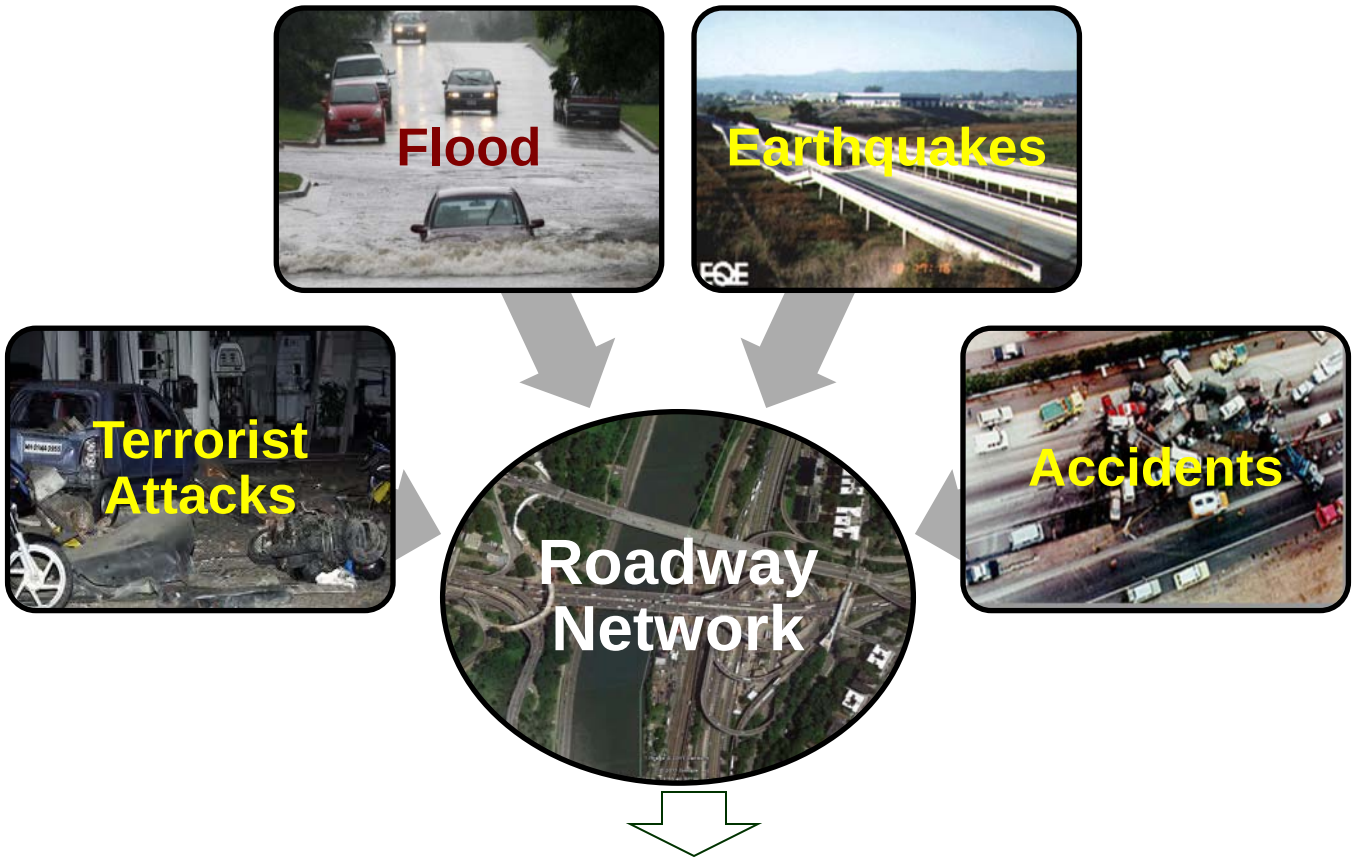
Sue McNeil
Professor, Civil and Environmental Engineering
Director, University Transportation Center
University of Delaware

Center for Sustainable Transportation Infrastructure

Outline

- Introduction
  - ✓ Background
  - ✓ Significance
- Conceptual Framework
  - ✓ Hypothesis
  - ✓ Conceptual methodology
- Example Applications
  - ✓ Evaluating different roadway status
  - ✓ Resource allocation
- Applications/Conclusions

Introduction - Framework



Introduction - Background

- **Natural disasters and terrorist attacks**
  - ✓ **Low probability**
  - ✓ **High consequence**
  - ✓ **Japan tsunami**
    - ➢ **$309 billion**
    - ➢ **Return period 1000 years**

http://www.bbc.co.uk/news/business-12828181

- **Another significant cause of performance reduction**

→ The condition of roadways

Significance

- **The annual cost of vehicle crashes, in the U.S. is about $230 billion** (ASCE report, 2009)
- **Annual cost of time and fuel wasted in traffic $78.2 billion** (ASCE report, 2009)

Roadway condition amongst factors responsible for these costs (ASCE report, 2009)

Characterizing performance of roadway systems based on the condition of components

Objective

- **To propose an approach to asses the system-level performance of roadway networks as:**
  - ✓ **A complex network of dynamically interconnected assets**
  - ✓ **In which the condition of the assets affect the system performance** (efficiency, vulnerability, resiliency, etc.)
- **To illustrate how this approach can help managing the network more effectively**

System-level Performance

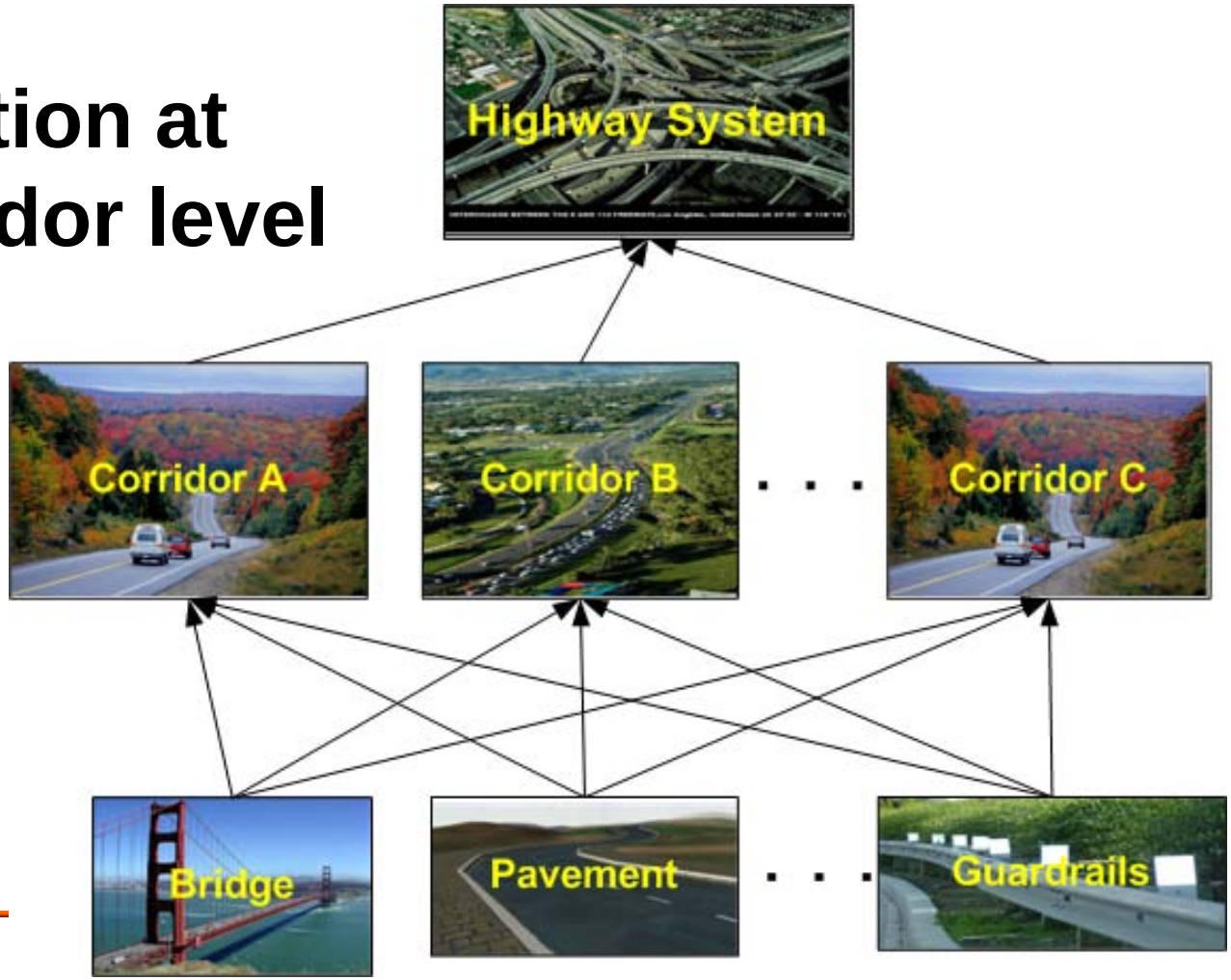
- **How can we measure the performance of highway infrastructure at system-level?**

Bridge = C
Pavement = B
} → Corridor performance? → System performance?

Road 1= C
Road 2 = D
} → System performance?

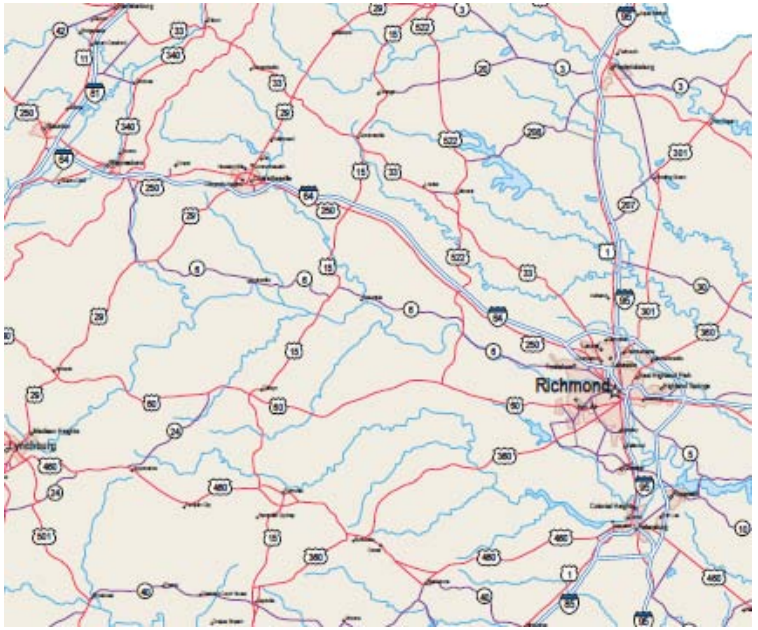
System-level Performance

- Individual component performance
- Aggregation at the Corridor level



System-level Performance

- Capture the interdependencies
- Translate the outcomes into transportation-related measures
  - ✓ Travel time
  - ✓ Miles traveled
  - ✓ Fuel consumption

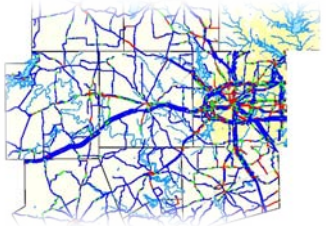


Hypothesis (linking condition to performance)

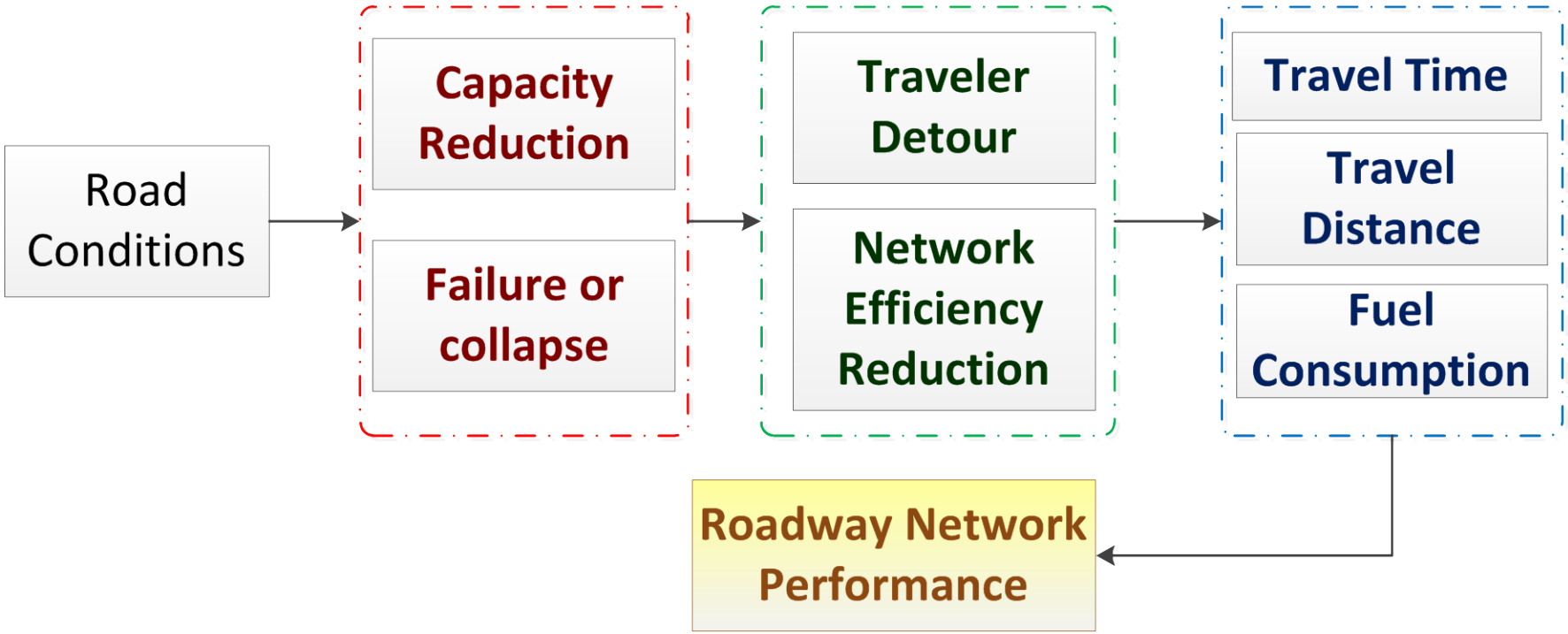
Poor Condition

Consequences

System Performance

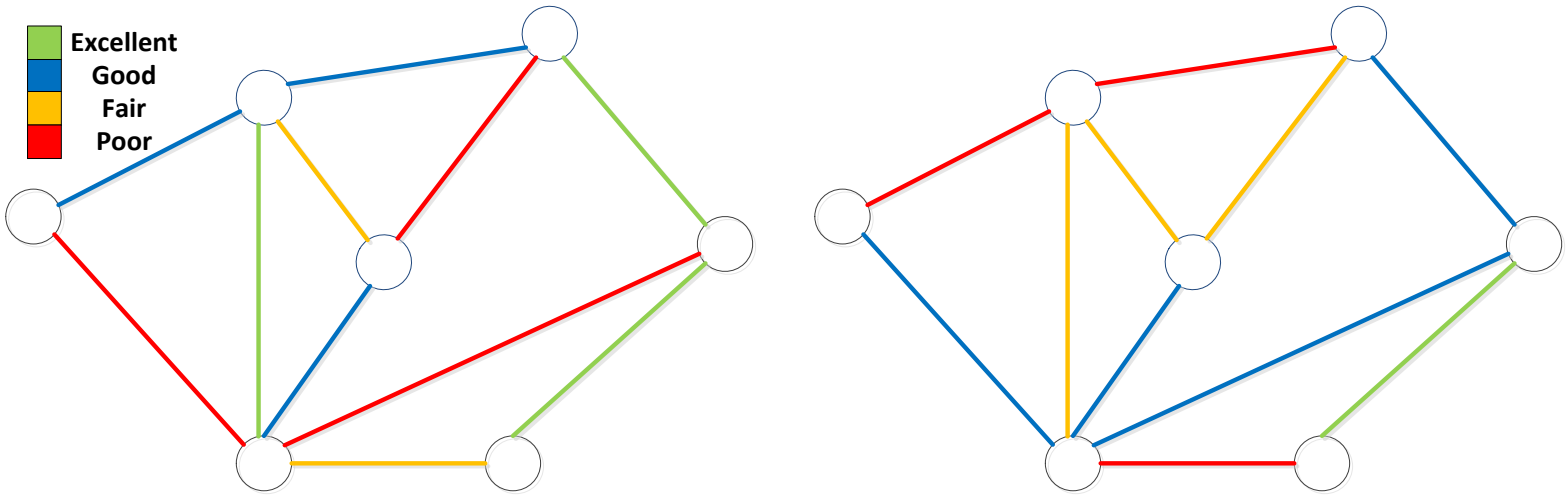


Conceptual Framework



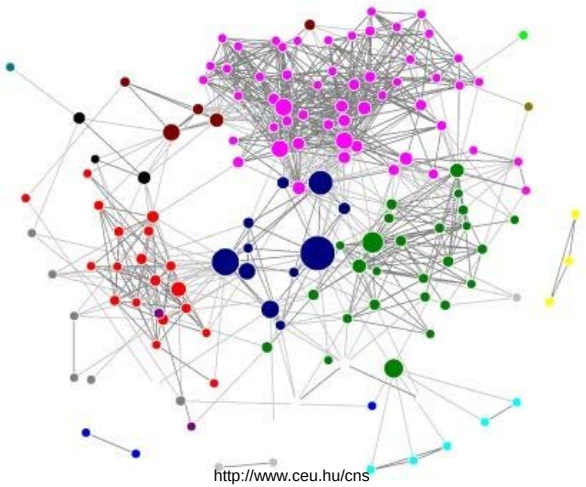
Applications

- Which roadway network …
  - ✓ Is more efficient?
  - ✓ Less costly to users?
  - ✓ Less costly to agency?



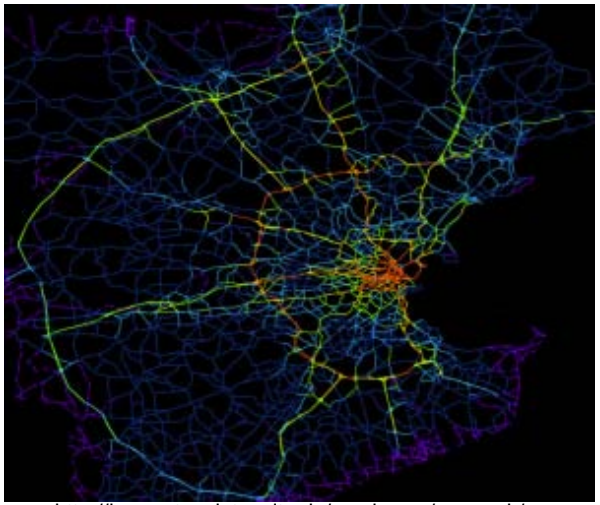
Applications - Considerations

- **Road Topology**
  - ✓ **Where is it in the road?**
  - ✓ **Connectivity level**



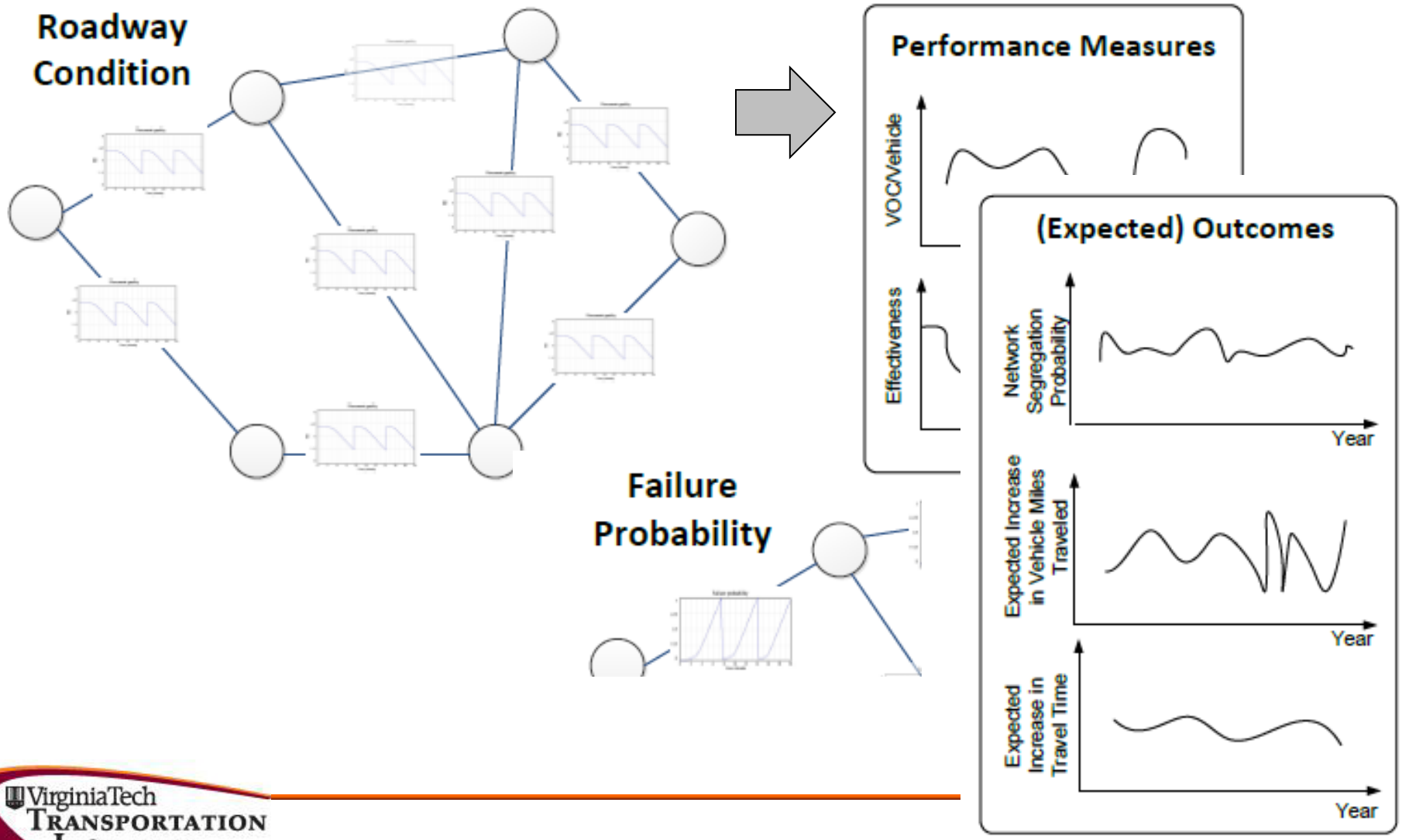
http://www.ceu.hu/cns

- **Travel pattern**
  - ✓ **O-D travel demand**
  - ✓ **Which roads are more used?**

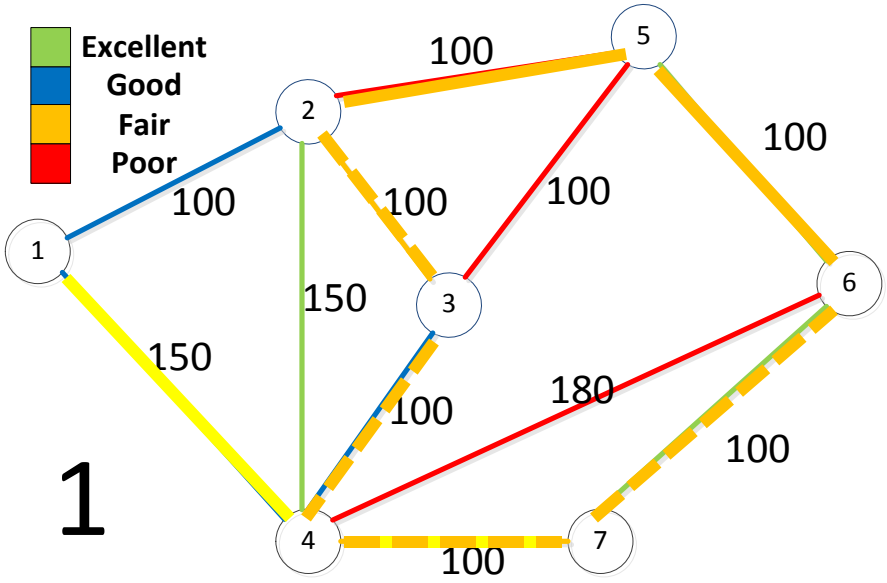


http://humnet.scripts.mit.edu/wordpress/research/

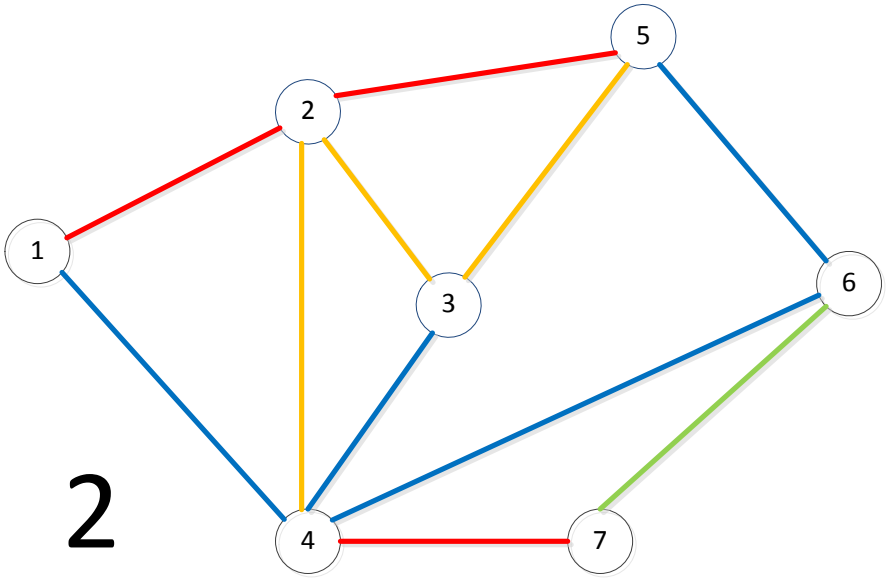
Applications - Monitoring



Example



1



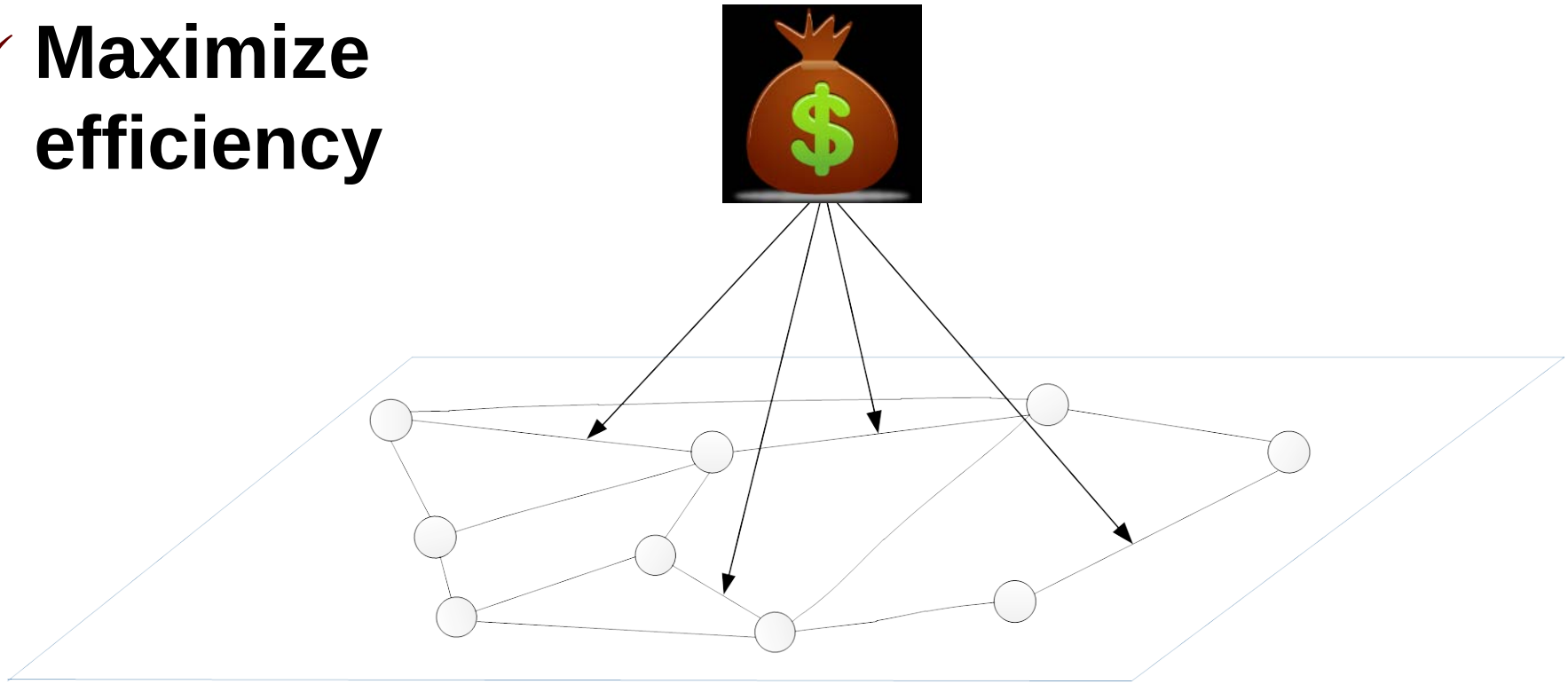
2

O/D	Travel (Vehicles/day)
1-7	100
2-6	150

O/D	Original VMT	VMT in Case	
		1	2
1-7	25000	25000	43000
2-6	30000	60000	45000

Application Resource Allocation

- ✓ **Minimize user and agency cost**
- ✓ **Maximize efficiency**



Expected Contributions

The proposed approach will support:

- ✓ **Risk analysis (vulnerability) of different treatment scenarios**
- ✓ **Effective resource allocation for preservation**
- ✓ **More dynamic monitoring of the system**

Conclusions

- **New Approach for Assessing Performance**
  - ✓ **Network performance is often assessed against disastrous events, but …**
  - ✓ **The effect of road condition is not explicitly addressed in roadway system-level performance**
- **Condition-based performance can help**
  - ✓ **Dynamic system monitoring**
  - ✓ **More effective asset management**
  - ✓ **Optimal resource allocation**

WORLD ROAD ASSOCIATION
MONDIALE DE LA ROUTE
1909-2009

Norfolk, VA,

September, 19-21, 2012

7th Symposium on Pavement Surface Characteristics SURF 2012

Smooth, Safe, Quiet, and Sustainable Travel through Innovative Technologies

www.SURF2012.org

AASHTO
THE VOICE OF TRANSPORTATION

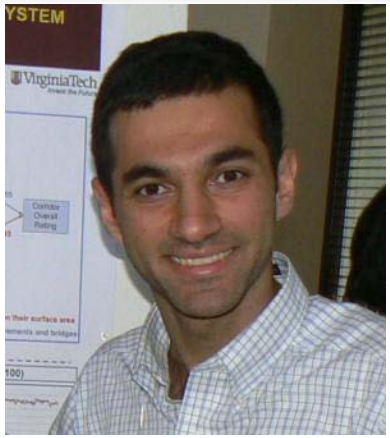
Virginia Tech
TRANSPORTATION INSTITUTE

U.S. Department of Transportation
Federal Highway Administration

Virginia Center for Transportation
INNOVATION & RESEARCH

9th National Conference on Transportation Asset Management
Making Asset Management Work in Your Organization

Condition of Roadways and the Dynamics of Highway System Performance: An Assessment Framework



VirginiaTech
Invent the Future

Mohammadsaied Dehghani

msaied.dehghani@gmail.com

VirginiaTech Transportation Institute
Center for Sustainable Transportation Infrastructure