

# Why There Are No Infrastructure Asset Management Needs

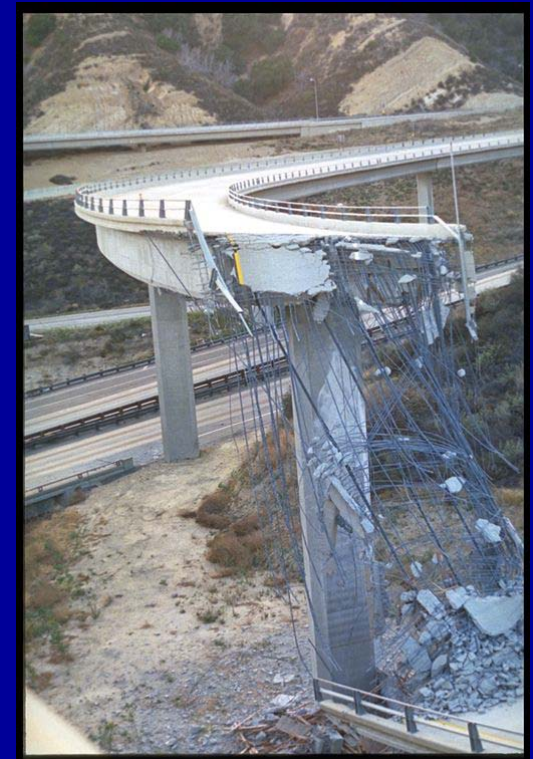
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# The Need

- Shortfall in infrastructure investment
- Collapsing bridges
- Bursting water pipes
- Polluted rivers
- Need to incorporate sustainability into our thinking
- But is this a research need?



# Motivation for Presentation

- Can we defend this as an area of intellectual inquiry? (intellectual motive)
- How will competing disciplines view our stance? (strategic motive)
- Some evidence that a devil's advocate can improve group decision making

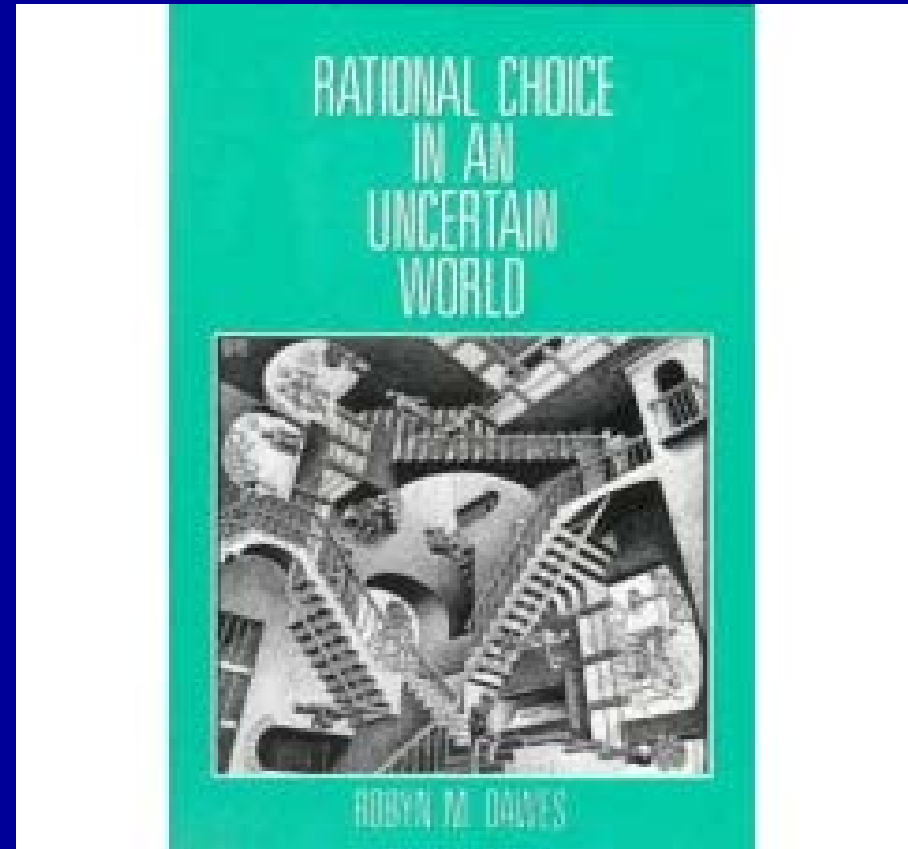
# Why there are no asset management research needs

- 1. It's already been done
- 2. It can't be done
- 3. It shouldn't be done

#1 It's already been done

# The book has been written

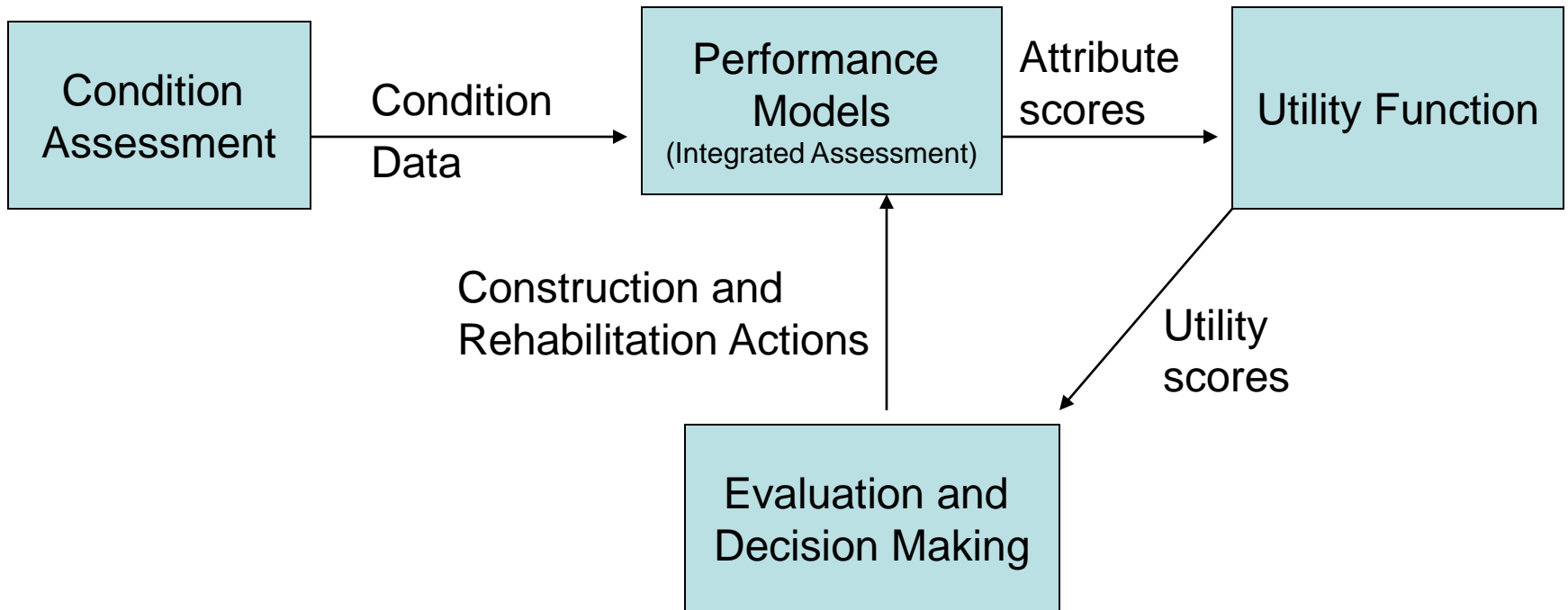
- Managing assets is about making decisions
- We have Subjective Expected Utility Theory (SEUT)
  - a normatively correct system of decision making under uncertainty
- We have benefit-cost primers as well



# Subjective Expected Utility Theory

- Enumerate options, uncertainties
- Assign probabilities to outcomes (preferable based on data but subjectively if needed)
- Utility function quantifies risk preferences and trade offs among different attributes
- Systematically evaluate options and identify one with the highest expected utility-the preferred outcome

# SEUT Framework





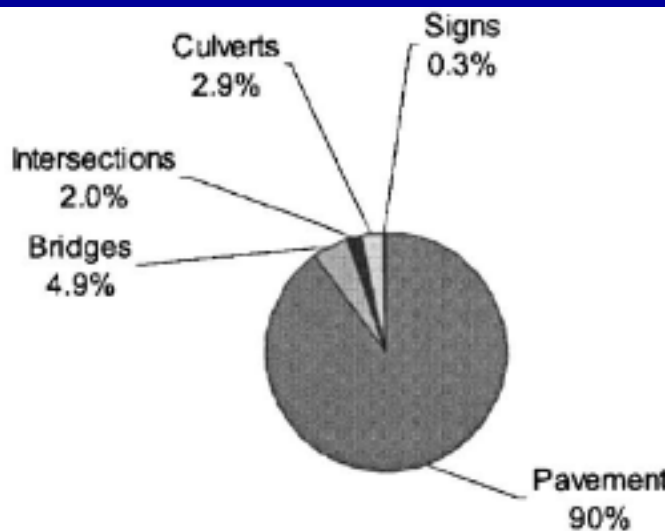
# Example (Gharaibeh et al. 2006)

Conditions of different asset classes are valued by a utility function:

$$\max_{x_i^t} U = \sum_{t=1}^{t=T} \prod_{i=1}^{i=I} (Kk_i u_i^t + 1)$$

subject to  $0 \leq x_i^t \leq h_i^t \quad \forall i \in I, t \in T$

Find allocation corresponding to maximized utility:



# What SEUT offers us

- A means to deal with uncertainty (probability)
- Elicitation procedures to assess preferences regarding risk and tradeoffs among different attributes
- Procedures for identifying what we need to know
  - What matters and what doesn't
  - What information is worth acquiring

# A common reaction

- Does anybody actually use this stuff?
- We have a normatively correct system but it is under used
  - It should be taught in high school
- This is more an educational issue than a research issue

# Education and Training

- We need forward thinking managers and consultants
  - How effective are asset management workshops at TRB, WEF, ASCE?

# How do we reply?

- To apply the framework need
  - Model inputs
  - Options and interrelationships
- System identification

# System Identification

- How do we divide up the system?
  - Which interrelationships to model in an integrated fashion and which to treat as boundary conditions?
  - How will our efforts yield general knowledge (i.e., be research)? Can we identify good practices and common trends?
- How do we forecast performance of existing technologies?
  - Existing data is scattered
- Working new technologies into the system
  - Get inputs from pilot studies, other sources as appropriate

# Who should do this research?

- Need for long term commitment
  - Not 3 year grant cycle
- How general will results be?
- Will consultants and owners be better placed to do this?
- How do we integrate skills of academia?

# Performance Benchmarking

- AWWA is undertaking this for water industry
- There are likely opportunities to deepen/broaden this effort
- International Infrastructure Observatory
  - Pool data across different managers
  - Find out what is generally applicable and what isn't
  - Improve performance estimates
  - Identify benchmarks and best practices
- We are doing this to some extent, but are we getting the information that is needed to those who need it?



# Getting the information to those who need it: I-35

- 1996 Grand River Bridge structural failure due to gusset plates
- In the absence of a national system to benchmark performance of cohorts of comparable assets...
- "MnDOT reports that none of its employees were aware of the failure of the Grand River Bridge," the legislature's report states. "The Federal Highways Administration [sic]...should take steps to ensure that information on bridge deficiencies is shared with MnDOT and other state departments of transportation in the future."
  - Cho and Van Hampton, ENR May 22, 2008

#2 It can't be done

# Recap

- SEUT theory provides a framework for infrastructure management
- Need applied research and consulting to provide objective data where possible

# Another Perspective

- First of all SEUT is NOT universally accepted
  - People's behavior violates SEUT all the time
- Second even if there is a system that doesn't mean it's being used

# Social sciences side of AM

- The failure to adopt SEUT opens up all kinds of social science research questions
- Descriptive/positive side of asset management

# What we know already

- Infrastructure projects do not necessarily perform as advertised (Flyvbjerg et al. 2005)
- Infrastructure projects are often not selected based on benefit-cost analysis (SEUT) (Docherty et al. 2007)
- You might think these suggest the need for further research...

# Why these are not tractable research questions

- Infrastructure systems are large, expensive systems
- We can not feasibly control conditions or conduct multiple experimental trials
- We observe only the one set of outcomes
- Without a control how can we validate our management model

# What would we have to do to make it research?

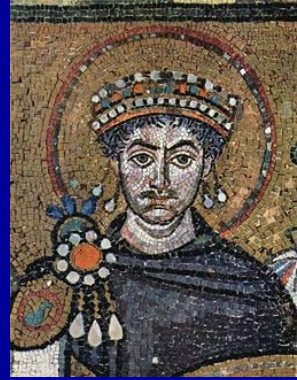
- Research – generally applicable knowledge
- Would need both depth and breadth
- Something like an international infrastructure observatory PLUS social studies of decision processes at a statistically representative number of asset managers



#3 It shouldn't be done



# Technocrats vs. Politicians



- As we integrate across asset systems we will inevitably come up against basic questions of what type of society we want to have
  - Sprawl vs. high density housing
  - Public transit vs. automobiles
  - Green roofs vs. lowest first cost
- These decisions are not made on a solely engineering basis



# How do we engage public values in our work?

- Old system: throw our analysis over the engineer-politician divide and let them deal with it
- This was tried in the domain of risk assessment
  - We gave up
  - What is a value-free assessment of carbon emission impacts of infrastructure design?
- Now speak of involve interested and affected parties and an analytic-deliberative process
  - Whatever this is it's not a controlled experiment

# Validation

- Descriptive: Possible to develop but would require large scope of effort to identify generally applicable information.
- Prescriptive: Does “validation” even have meaning? How do you show that as a result of your efforts decision maker has achieved a result more in line with decision maker’s preferences?

# Summary

- A basic framework for asset management has been developed
- Efforts to develop generally applicable information
  - would need to be very broad ranging,
  - would be difficult to validate,
  - would need to involve a broad range of interested and affected parties to develop recommendations that are reflective of societal values.

# Discussion Points

- Do we have the educational programs and workshops we need for asset management?
- How well are we doing at collecting, compiling information and learning from what we are already doing? How can we do better?
- To what extent do management plans of public, technocrats/engineers, and politicians diverge? Is this divergence harmful and can it be reconciled?
- Who should do this research and how?