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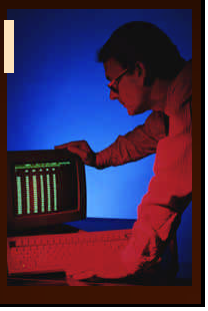
Making Network-Level Preservation Policies



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What We'll Cover

Role of network -level
Problem structure
Life -cycle costing
Example
Preservation in Pontis
State of the practice

Improving Results

Day 3

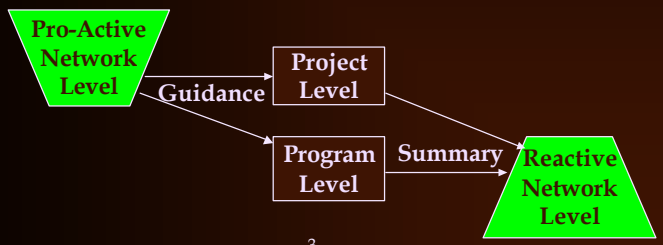
Background 1
Basics 2
Policies 6
Programming 7
Projects 8
Results 9
Quality 10
Improving 11
Summary 12

2

3

2-Sided Role of Network Level

- **Pro-Active**
  - Develop Policies, Standards, Strategies
  - Allocate Resources
- **Re-Active**
  - Summarize Projects
  - Simulate Condition
  - Predict Needs



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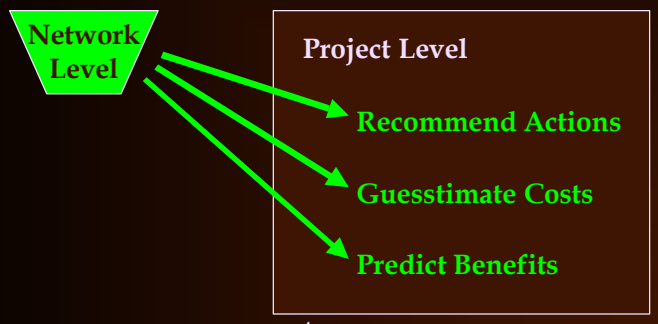
Role of Network Level

- In Project-Level Bridge Management



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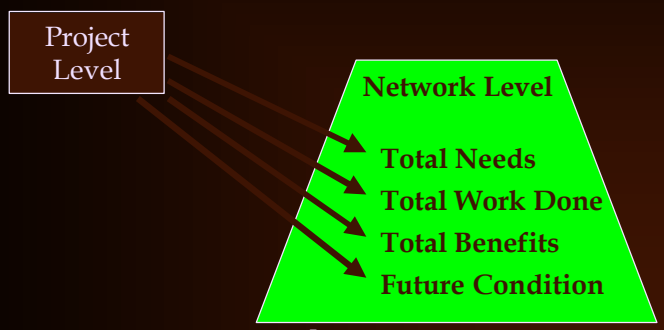
Role of Project Level

In Network-Level Bridge Management



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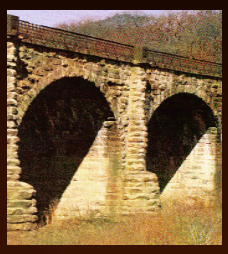
Problem Structure



Objectives
Constraints
Policy variables

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Objectives

- Minimize Agency Costs
- Minimize User Costs
- Maximize Service Life
- Maximize Progress Toward Optimal Condition

Presentation

7 7

Constraints

- Budgets
  - Total Bridge Budget
  - Federal vs. Non-Federal Funding
  - Budget by District or
  - Highway System

8 8

Constraints

- Level of Service and Design Standards
  - Lane Width
  - Shoulder Width
  - Alignment
  - Vertical Clearance
  - Horizontal Clearance
  - Waterway Adequacy
  - Load Capacity

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Policy Variables

- Choice of Action based on:
  - age
  - condition
  - classification
  - traffic
  - environment
- Target Condition

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Policy Requirements

- Consistency with agency's deterioration and cost experience
- Feasibility of actions
- Sustainability (steady state)

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Steady State Demo

1. Start with 100 chips in state #1
2. Each turn, move the chips among the states according to the transition matrix.
3. Repeat.

Reset

From Bag \ To Bag	1	2	3	4	5	
1	90	10				Do Nothing
2		80	10	10		Do Nothing
3	10	10	70	10		Preventive
4				50	50	Do Nothing
5	90	10				Rehab

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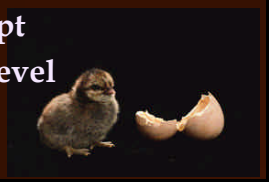
Relationship to Life-Cycle Costing

What is Life Cycle Costing?
Objections to the Concept
Application to Network Level



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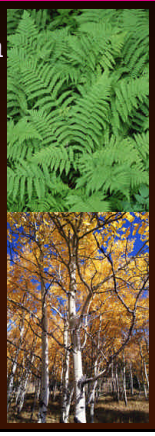
What Is Life Cycle Costing?

- Considers all costs expected in a bridge's life
  - Initial Construction
  - Improvements
  - Repairs and Rehabilitation
  - Maintenance
  - (Sometimes) User Costs
  - (Sometimes) Environmental Costs
  - (Sometimes) Salvage Value



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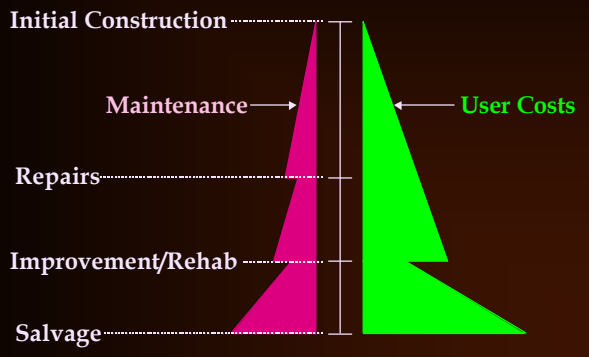
Life Cycle Cash Flows



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Objections to Life Cycle Costs

- Does not account for all potential benefits of replacement
- Requires large amount of data or assumptions about the far future
- Often ignores user costs

☆ Values the physical bridge rather than its role in the transportation system

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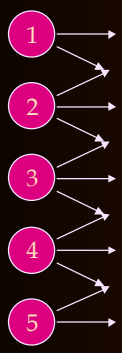
Application to Network Level

- Alternative Approaches
  - ① Sampling - Apply Life-Cycle Costing to Abstract or Sampled Bridges.
  - ② Reactive - Apply to All Bridges and Then Sum Up the Results.
  - ③ Going Concern - Maintain Constant Mobility Beyond Currently-Existing Bridges.

Explanations

17 17

The Going Concern



- Small number of states
- Small number of alternatives per state
- Same states and choices each year

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Network Optimization Example

Concrete Deck - Bare (Moderate Environment)

Reset

Zoom

Step-by-Step 1 2 3

Sensitivity Analysis

Discount Rate	0.95	0.92	0.91
Repair Cost	334	400	410
Repair Effect	69.7	20.0	0.0
Deterioration	9.5	7.0	6.3

Solve

Finish

		Action	Unit Cost	Transition Probabilities 1	2	3	4	5	Fail	LT Cost
1		State 1 - No damage								0
>>	0	Do nothing	0	87	13	0	0	0	0	105
	1	Protect	538	87	13	0	0	0	0	643
2		State 2 - Distress <= 2%								0
>>	0	Do nothing	0	0	87	13	0	0	0	148
	1	Repair	592	44	50	6	0	0	0	719
	2	Protect	237	83	17	1	0	0	0	344
3		State 3 - Distress 2-10%								0
>>	0	Do nothing	0	0	0	95	5	0	0	209
	1	Low repair	700	0	87	13	0	0	0	848
	2	High repair	334	70	28	3	0	0	0	447
4		State 4 - Distress 10-25%								11
	0	Do nothing	0	0	0	0	91	9	0	458
	1	Low repair	700	0	44	54	2	0	0	878
>>	2	High repair	334	70	28	3	0	0	0	447
5		State 5 - Distress > 25%								369
	0	Do nothing	0	0	0	0	0	91	9	1186
>>	1	High repair	700	61	35	4	0	0	0	818
	2	Replace	1076	81	16	1	0	2	0	1197
		Failure	5382							

How it works

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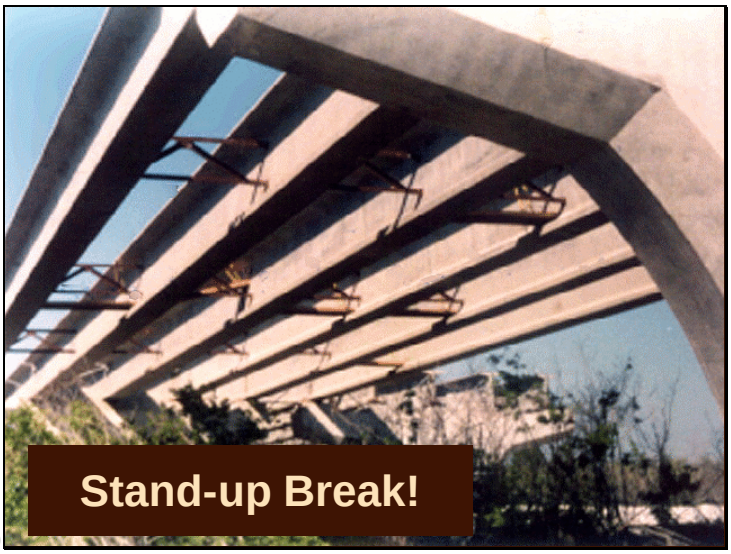

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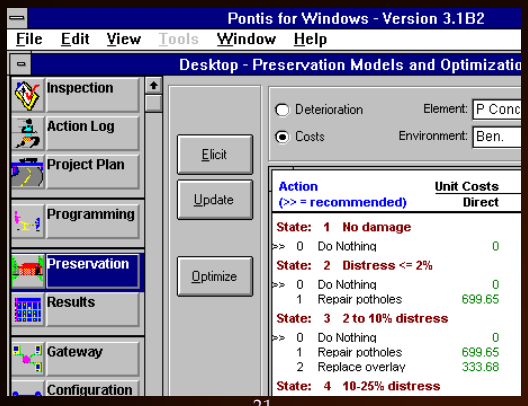
Pontis Preservation Policies



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Network-Level State of the Practice

Responsiveness vs. Realism
Limitations

22 22

Responsiveness vs. Realism

- A Delicate Balancing Act

Responsiveness	Realism
High Speed	Low Speed
Low Detail	High Detail
Low Data Costs	High Data Costs

Top-Down	Bottom-Up
Pro-Active	Reactive

23 23

Limitations

- Aspects Not Currently Handled Well
  - Routine maintenance (deck patching, sealing, washing, brush clearing)
  - Fatigue
  - Scour
  - Seismic
- Major limitation is still the quality and cost of data

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