Promoting the Use of Pavement Management Through Cost Analyses

Katie Zimmerman, P.E.
Applied Pavement Technology, Inc.
KZimmerman@pavementsolutions.com

Factors Influencing the Use of Pavement Management - Past

- Technology Changes
- Policies/Guidelines/Legislation
  - AASHTO Guidelines
  - FHWA Policy
  - ISTEA

Factors Influencing the Use of Pavement Management - Present

- Retirement of Trained Personnel
- Lack of “Push”
- Focus on Asset Management

It's time to get back into the business of promoting Pavement Management …

… as a way of doing business that makes "cents"…

...and cost analysis tools can help us accomplish this.

Cost Analysis Tools Used and Supported by Pavement Management

- Equivalent Annual Cost
- Benefit Cost Analysis
- Reduction in Life Cycle Costs
- Maintenance Cost Effectiveness Evaluation
- Cost Evaluations to Achieve Agency Goals
- Impact Analysis Results

Analysis Type 1: Equivalent Annual Cost

- Evaluate the cost associated with a given pavement strategy on an annual basis
- Needs
  - Total costs
  - Years of service

Equivalent Annual Cost Example

- Strategy 1: Overlay
  - Expected Cost: $200,000
  - Expected Life: 10 years

$$EAC = \frac{\$200,000}{10 \text{ years}} = \$20,000/\text{year}$$

Equivalent Annual Cost Example (cont.)

- Strategy 2: Overlay followed by Seal Coat in year 9
  - Expected Cost: $200,000 + $77,500
  - Expected Life: 15 years

$$EAC = \frac{\$277,500}{15 \text{ years}} = \$18,500/\text{year}$$

Equivalent Annual Cost Example Summary

Strategy	EAC ($/year)
Strategy 1: Overlay	$20,000
Strategy 2: Overlay with Slurry Seal	$18,500

Note: This analysis ignores the time value of money

Extrapolated over the entire network, an agency can realize large savings by reducing the annual cost of preservation

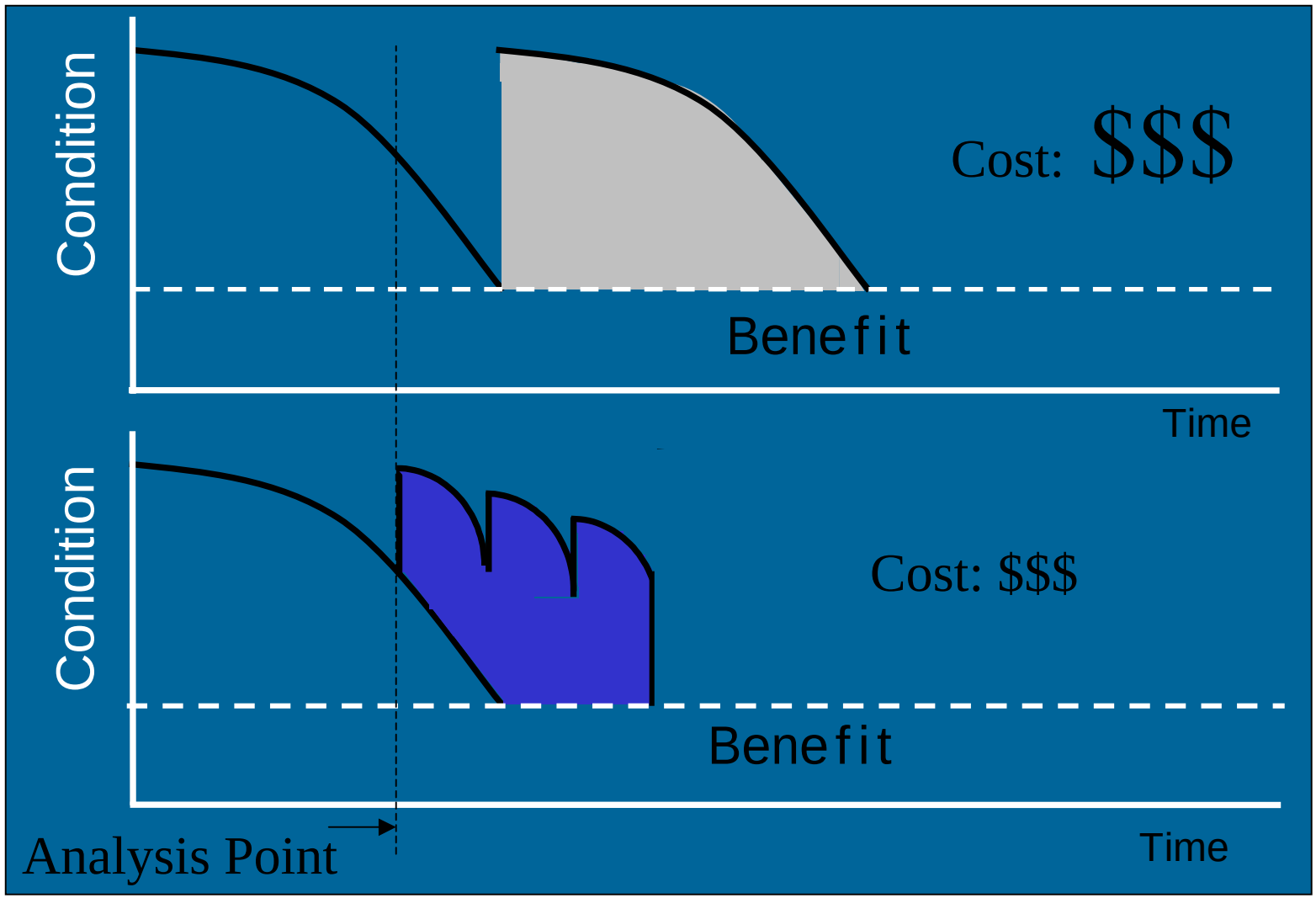
Analysis Type 2: Benefit Cost

- Similar to the type of analysis conducted in most pavement management systems
- The application of a treatment results in a “benefit”
- Each treatment also has a cost
- The treatment with the highest benefit cost ratio provides the best bang for the buck

Which Is Better For the Agency?

- Scenario 1: Let a pavement continue to deteriorate for several years before applying an overlay.
- Scenario 2: Apply a series of 3 preventive maintenance treatments beginning immediately.

Comparison of Alternatives



Benefit Cost Comparison

Strategy	Benefit (condition*age)	Cost, $M
Rehabilitation	1000	$3.5
Preventive Maint.	250	$0.5

Rehab Strategy: $B/C = \frac{1000}{3.5} = 286$

PM Strategy: $B/C = \frac{250}{0.5} = 500$

Analysis Type 3: Reduction in Life Cycle Costs

- By reducing the life cycle cost associated with each road, we can reduce the costs associated with the preservation of the system
- Life cycle costing allows you to consider all costs in an analysis period on an equivalent basis
- Pavement management can help establish the treatment strategies and treatment timing

Define Cost Streams
Strategy A

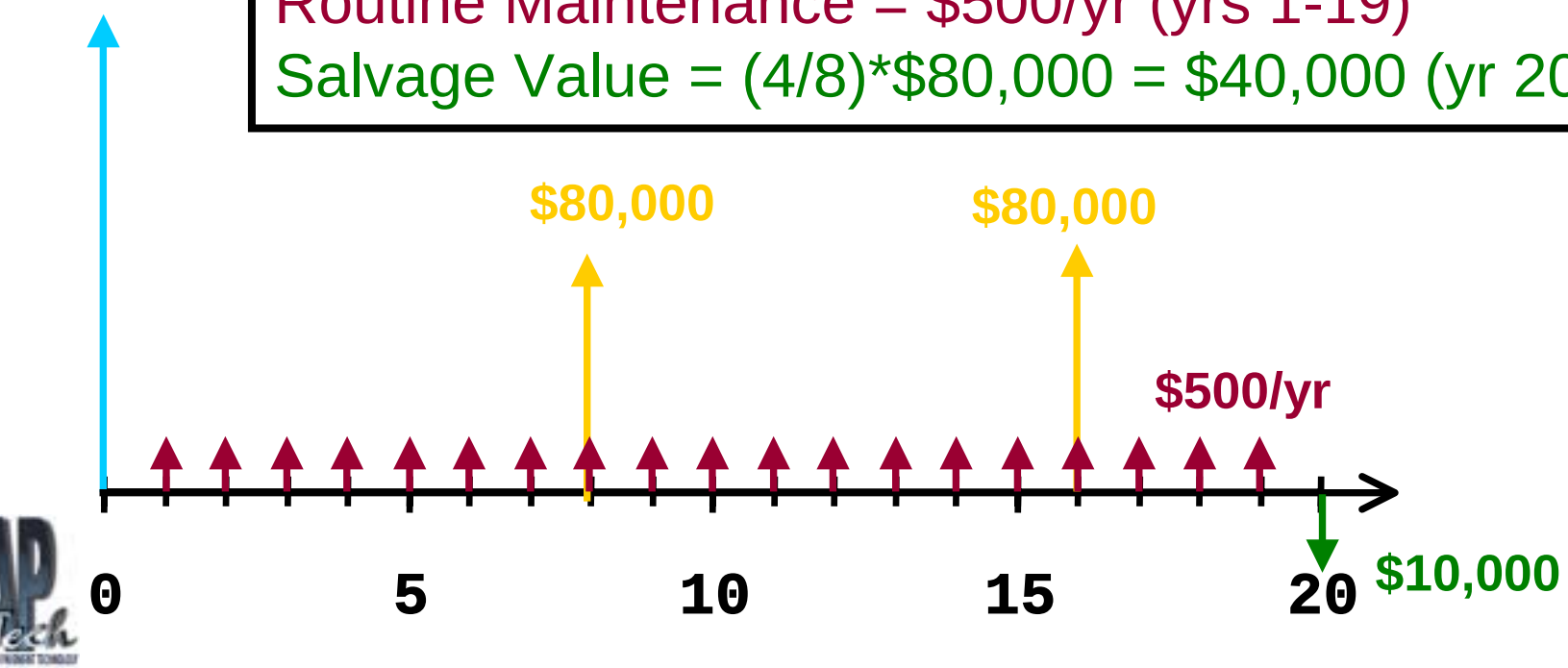
Cost Stream Summary

Initial Construction = $400,000 (yr 0)

Treatment 1 = $80,000 (yrs 8 & 16)

Routine Maintenance = $500/yr (yrs 1-19)

Salvage Value = (4/8)*$80,000 = $40,000 (yr 20)



Define Cost Streams
Strategy B

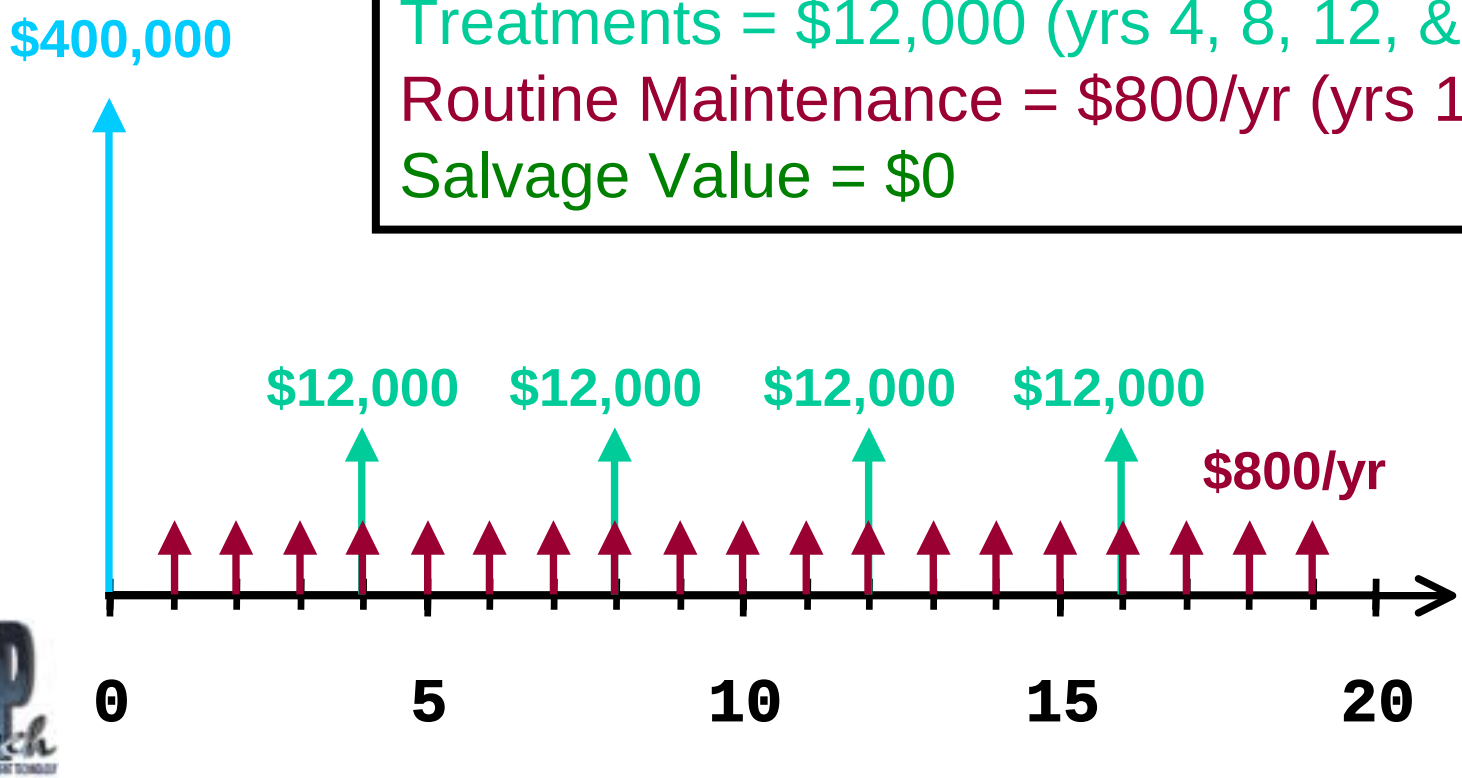
Cost Stream Summary

Initial Construction = $400,000 (yr 0)

Treatments = $12,000 (yrs 4, 8, 12, & 16)

Routine Maintenance = $800/yr (yrs 1-19)

Salvage Value = $0



Compute Costs
Strategy A

PW (initial)	=	$ 400,000
PW (routine maint.)	=	$ 6,567
PW (treatment 1)	=	$ 58,455
PW (treatment 2)	=	$ 42,713
PW (salvage value)	=	$ – 18,255
Total PW	=	$ 489,480

Discount Rate = 4%, Analysis Period = 20 yrs

Compute Costs
Strategy B

PW (initial)	= $	400,000
PW (routine maint.)	= $	10,507
PW (all 4 applications)	= $	32,928
PW (salvage value)	= $	0
Total PW	= $	443,435

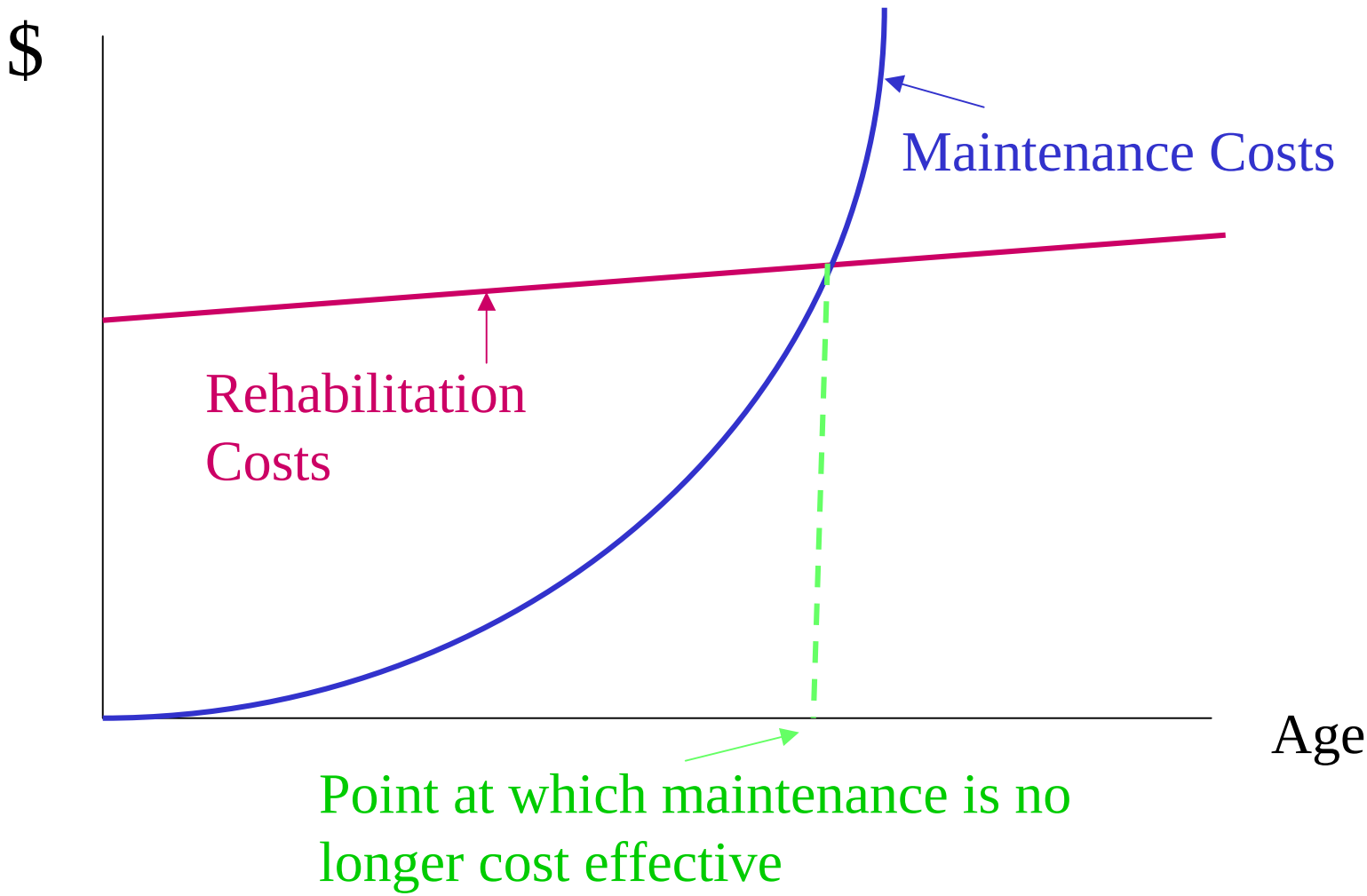
Discount Rate = 4%, Analysis Period = 20 yrs

Interpreting Analysis Results

Strategy No.	Strategy Description	PW
1	Strategy A	$489,480
2	Strategy B	$443,435

Strategy B reduces the life cycle cost associated with the maintenance of the facility approximately $2,302/per year. Across an entire network, the cumulative effect can be dramatic.

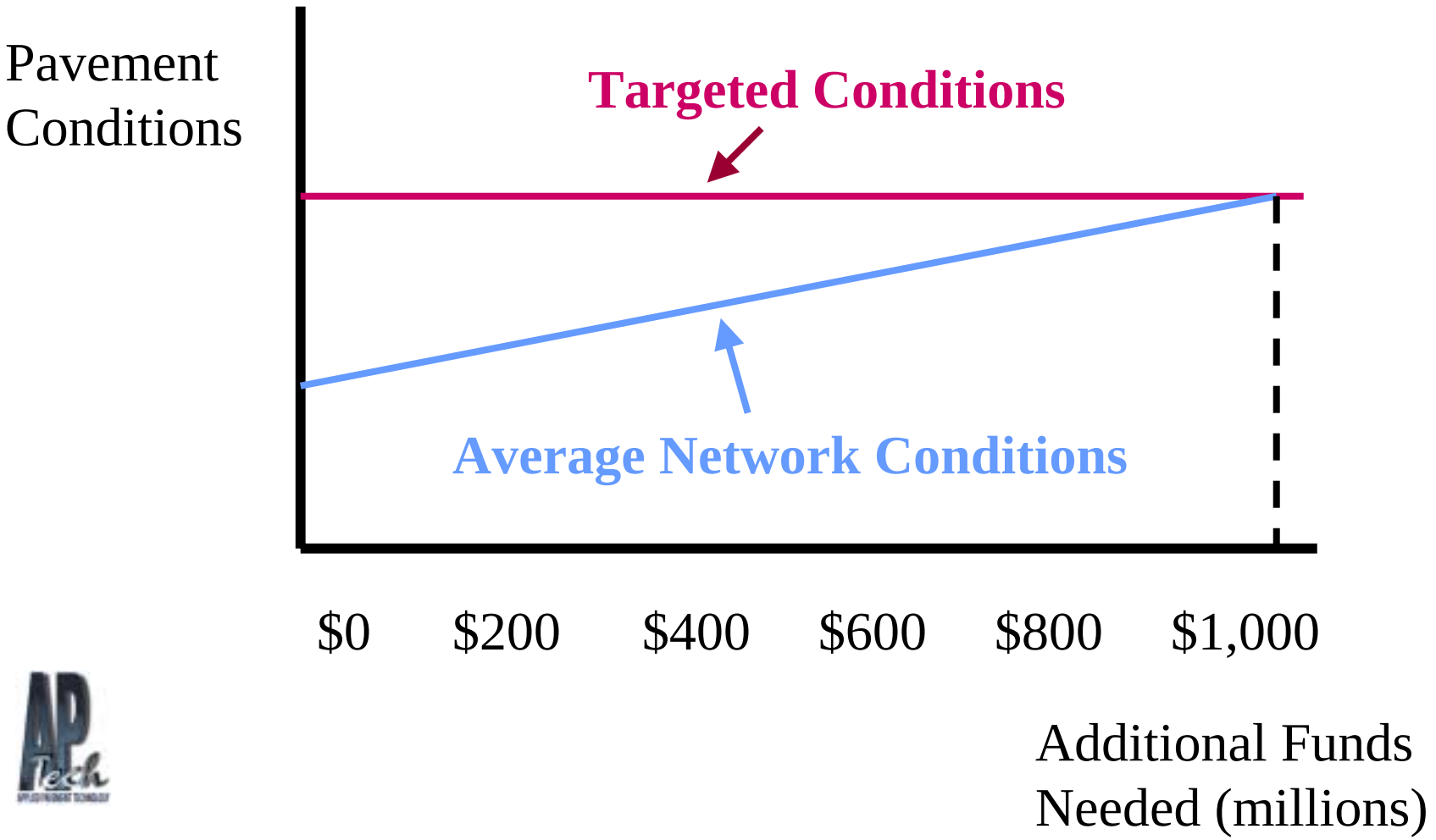
Analysis Type 4: Maintenance Cost Effectiveness Evaluations



Analysis Type 5: Cost Evaluations to Achieve Agency Goals

- Agencies are establishing performance standards
  - Michigan: 95% of the expressways and 85% of the trunk highways in good to fair condition within 10 years
  - Is this achievable without increasing funds? If not, how much more money is needed?

Achieving the Goal



Analysis Type 6: Impact Analysis Results

- Most common use of pavement management systems
- Allows an agency to compare various rehabilitation strategies to determine the most effective approach to pavement preservation

Example of Impact Analysis

- Small agency with a total of 80 miles of roads
- 20 miles are in each of the 4 condition categories (Excellent, Good, Fair, Poor)
- 20% of the network deteriorates to the next condition level each year
- It costs $100 to repair a road in poor condition
- It costs $25 to repair a road in fair condition

Worst First Scenario

	Now	Year 1	Ttl	Year 2	Ttl	Year 3	Ttl
Exc	20	-4 +4	20				
G	20	-4 +4	20				
F	20	-4 + 4	20				
P	20	+4 -4	20				

Worst First

	Now	Year 1	Ttl	Year 2	Ttl	Year 3	Ttl
Exc	20	-4 +4	20	-4 +4	20		
G	20	-4 +4	20	-4 +4	20		
F	20	-4 + 4	20	-4 + 4	20		
P	20	+4 -4	20	+4 -4	20		

Worst First

	Now	Year 1	Ttl	Year 2	Ttl	Year 3	Ttl
Exc	20	-4 +4	20	-4 +4	20	-4 +4	20
G	20	-4 +4	20	-4 +4	20	-4 +4	20
F	20	-4 + 4	20	-4 + 4	20	-4 + 4	20
P	20	+4 -4	20	+4 -4	20	+4 -4	20

Alternate Strategy (75/25 split)

	Now	Year 1	Ttl	Year 2	Ttl	Year 3	Ttl
Exc	20	-4 +7	23				
G	20	-4 +4	20				
F	20	-4 + 4 -4	16				
P	20	+4 -3	21				

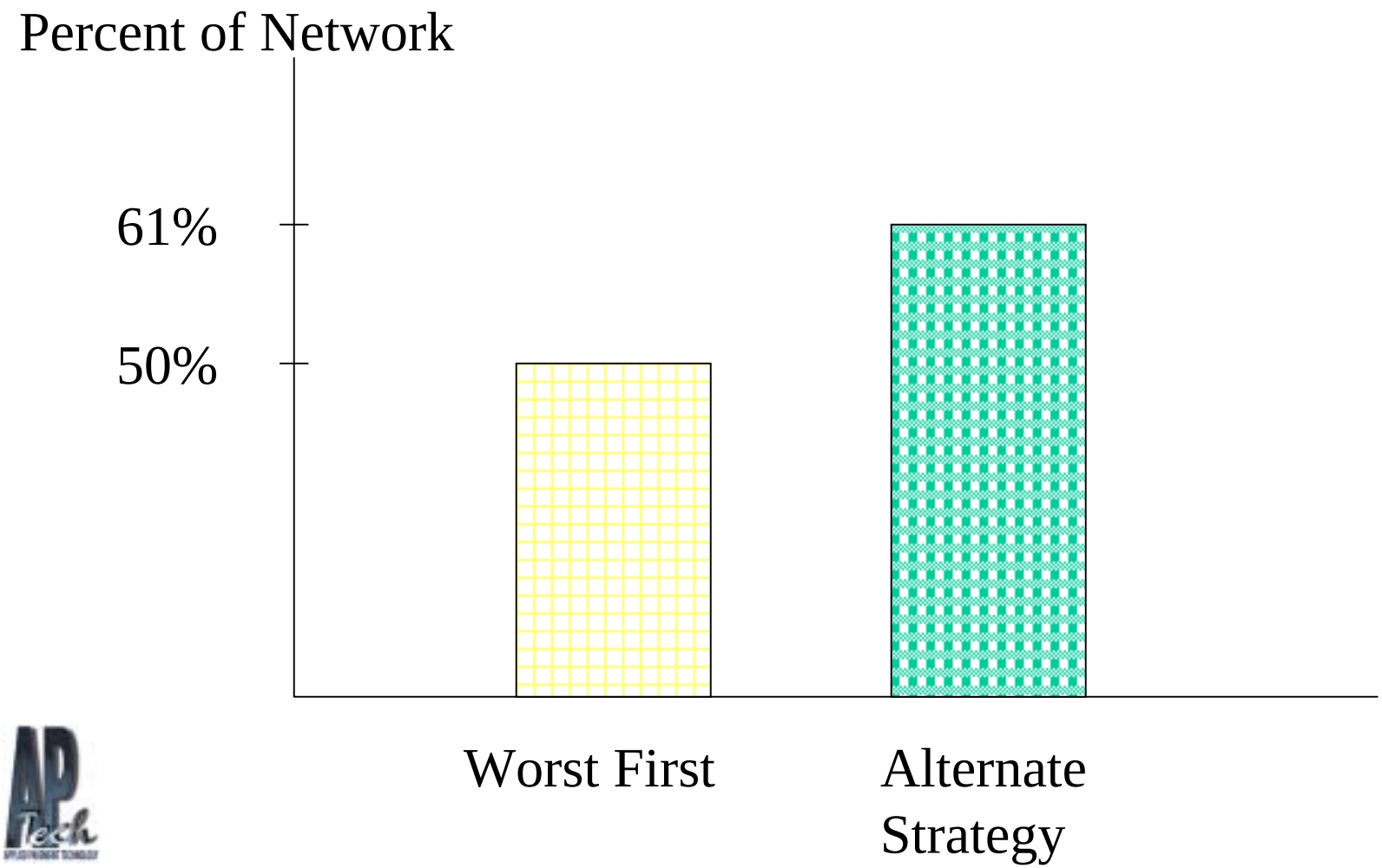
PM 2 Example (75/25 split)

	Now	Year 1	Ttl	Year 2	Ttl	Year 3	Ttl
Exc	20	-4 +7	23	-5 +7	25		
G	20	-4 +4	20	-4 +5	21		
F	20	-4 + 4 -4	16	-3 + 4 -4	13		
P	20	+4 -3	21	+3 -3	21		

Alternate Strategy (75/25 split)

	Now	Year 1	Ttl	Year 2	Ttl	Year 3	Ttl
Exc	20	-4 +7	23	-5 +7	25	-5 +7	27
G	20	-4 +4	20	-4 +5	21	-4 +5	22
F	20	-4 + 4 -4	16	-3 + 4 -4	13	-3 + 4 -4	10
P	20	+4 -3	21	+3 -3	21	+3 -3	21

Comparison of Results in Year 3

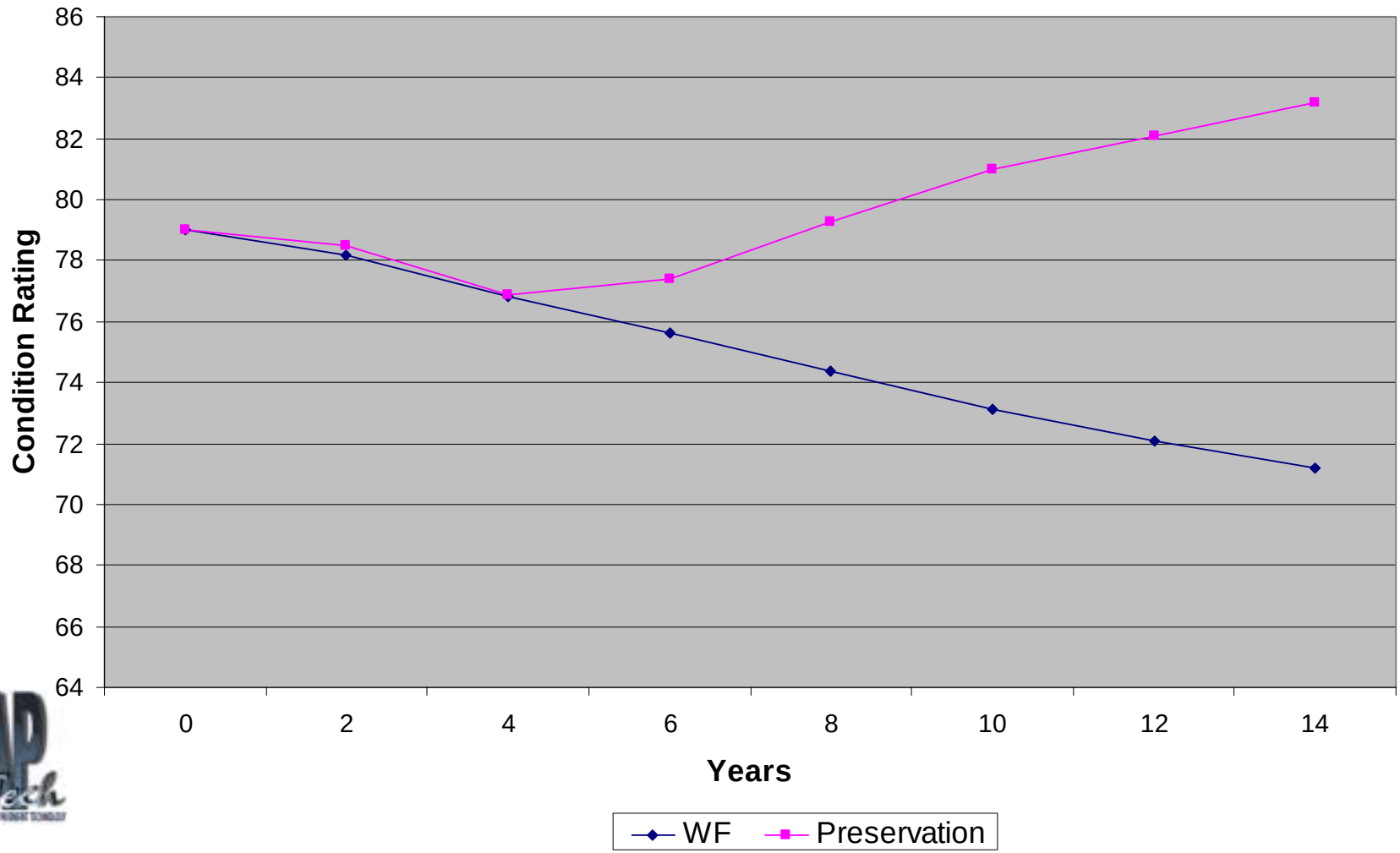


NC Simulation

- Impact Analysis
  - 1000 mile example
  - Conditions distributed based on actual data
  - Compared worst first to a strategy with pavement preservation
  - Resurfaced 50 miles per year in the worst first scenario (poor roads)
  - Fixed 100 miles of roads in fair condition in the preservation scenario

NC Simulation

Average Network Conditions



Wrap-Up

- Pavement management systems are a valuable tool to help manage facilities effectively
- The capabilities of a pavement management system need to be better used to demonstrate the effectiveness of our programs
- Cost analysis tools can be used to demonstrate cost-effectiveness.

Pavement Management Makes Cents!