Incorporating Pavement Preservation (P^2) into Decision-Making Process

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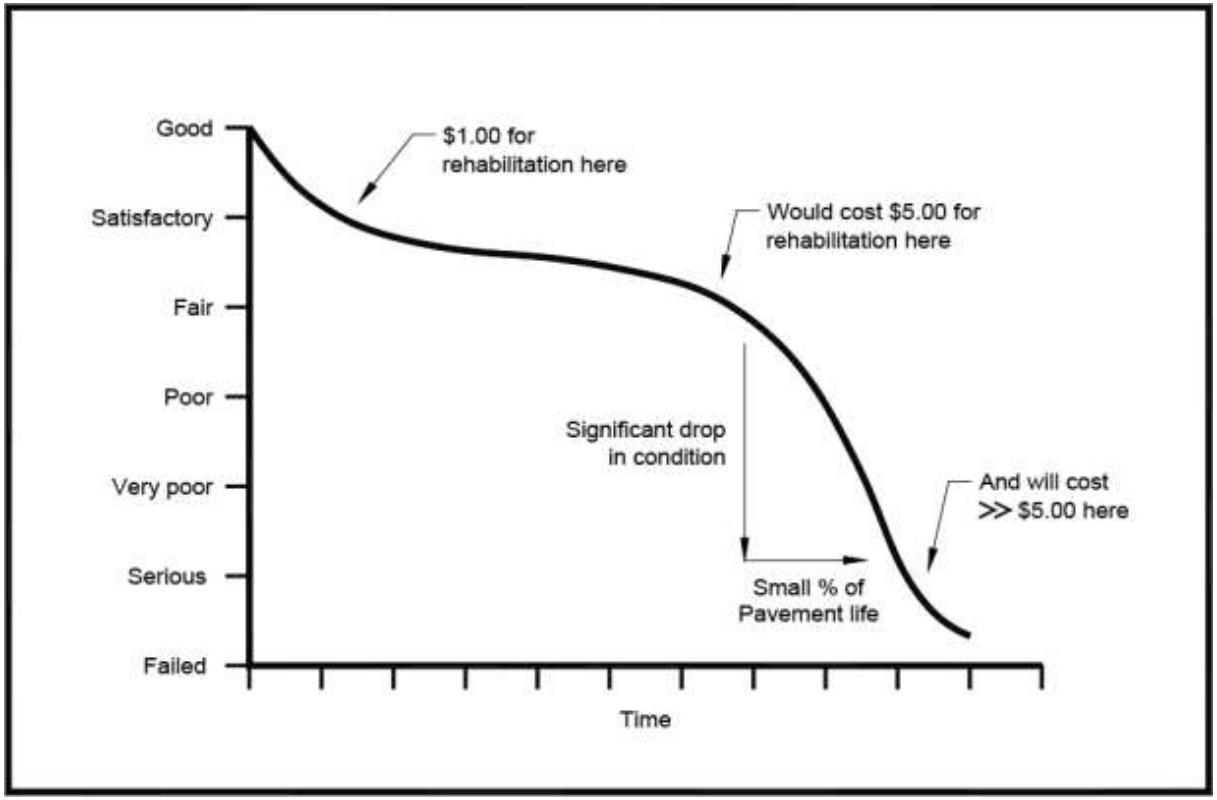
Presentation Outline

1. **Background**
2. Performance Modeling
3. Performance Measures
4. Treatment Timing & Remaining Service Interval

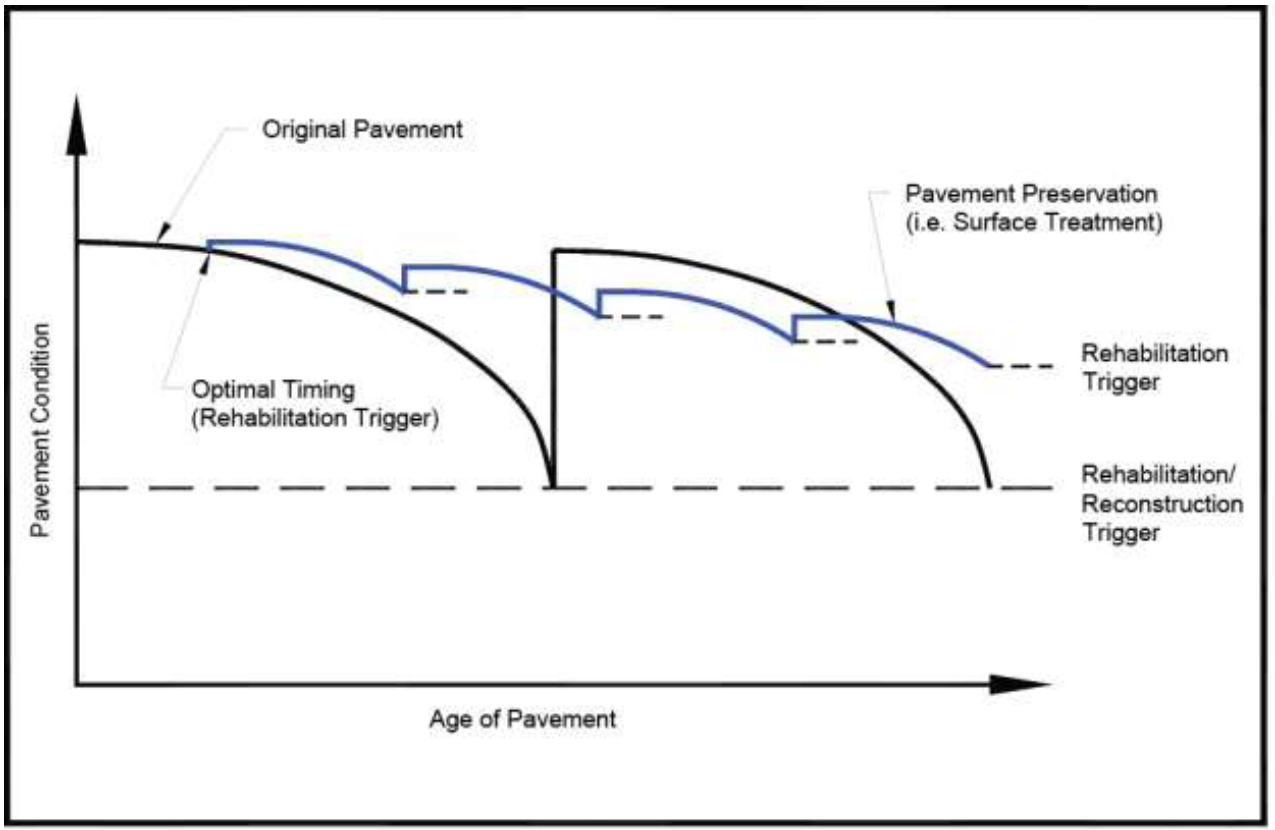
FAA AC 150/5380-7B (10/10/2014)

…discusses airport PMP concept, its basic essential components, and how it is used to make cost-effective M&R decisions



FAA AC 150/5380-7B (10/10/2014)

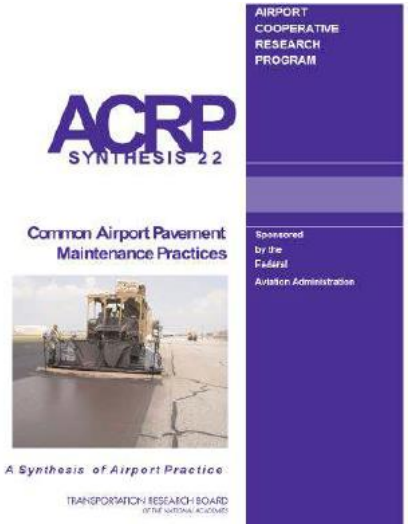
…illustrates pavement preservation concept, which begins with application of M&R techniques early in pavement's life



Pavement Preservation

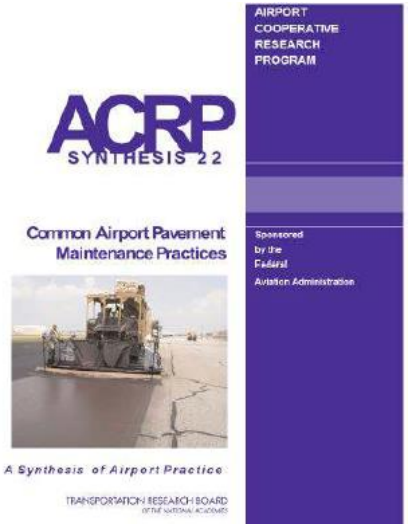
- Not new technology; treatments applied to:
  - Preserve existing pavement, slow deterioration, and maintain/improve functional condition
  - **No substantial increase to structural capacity**
- Accomplished by
  - Preventing moisture infiltration
  - Providing protection against aging
  - Restoring surface integrity
  - Improving surface texture

AC Preservation Treatments



Treatment Type		Survey Result, %					
		Usage			Performance		
		Routine	Have Tried	Total	Very Good	Good	Poor
Crack sealing with	hot-poured sealant	84	11	95	19	71	10
	cold-applied sealant	9	7	16	17	66	17
Small area (pothole) patching using	hot mix	52	16	68	42	58	0
	cold mix	43	18	61	13	50	37
	proprietary mix	9	11	20	25	50	25
Spray patching (includes manual chip seal)		5	7	11	0	100	0
Machine patching with AC		27	14	41	39	55	6
Milling and machine patching with AC		34	18	52	39	61	0
Texturization using	fine milling	7	5	11	20	80	0
	controlled shot blasting	0	16	16	0	71	29
Rejuvenators, fog seals, etc.		30	23	52	23	59	18
Surface treatment		15	18	43	6	81	13
Slurry seal		23	25	48	10	75	15
Microsurfacing		2	9	11	25	75	0
Hot-mix overlay		45	23	68	48	48	4
Milling and hot-mix overlay		45	18	64	58	42	0

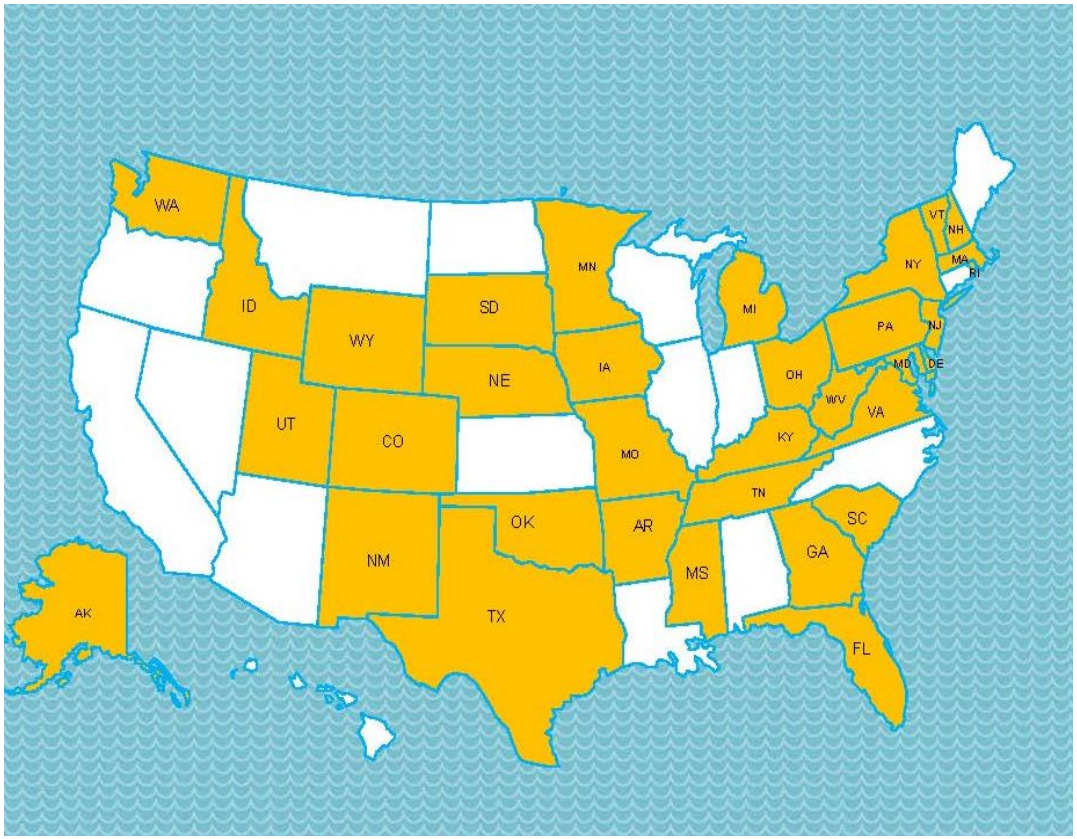
PCC Preservation Treatments



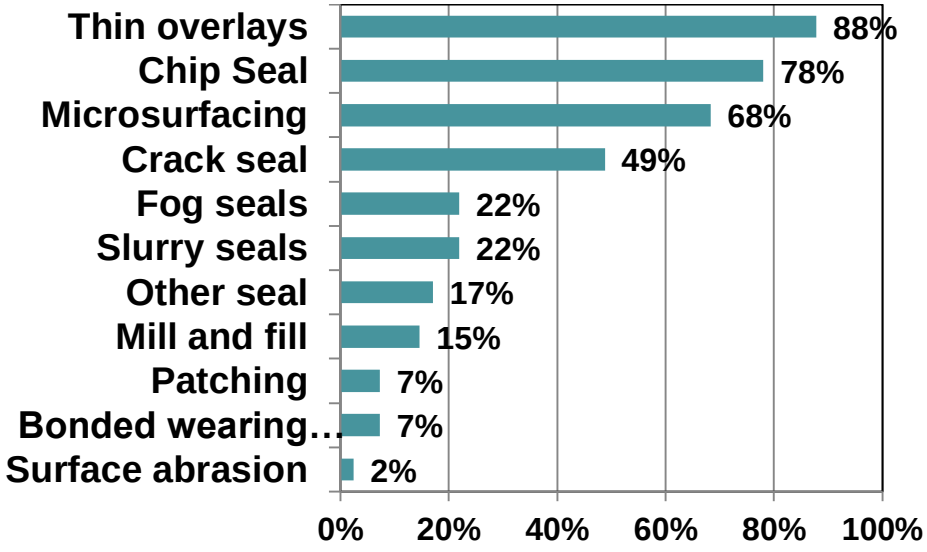
Treatment Type		Survey Result, %					
		Usage			Performance		
		Routine	Have Tried	Total	Very Good	Good	Poor
Joint/crack sealing with	bituminous sealant	29	15	44	13	80	7
	silicone sealant	39	22	61	29	71	0
	neoprene seal	7	22	29	36	36	27
Load transfer restoration	sub-sealing and slab jacking	2	5	7	N/A	N/A	N/A
	slab stitching	2	5	7	N/A	N/A	N/A
	dowel retrofit	12	5	17	60	40	0
Shallow patch repair using	PCC	34	15	49	28	67	6
	AC	29	20	49	18	65	18
	proprietary mix	17	17	34	42	42	17
Full and partial depth repairs or slab replacement using	PCC	46	15	61	47	47	6
	AC	20	39	59	31	54	15
	proprietary mix	7	17	24	30	50	20
	precast panels	2	2	5	N/A	N/A	N/A

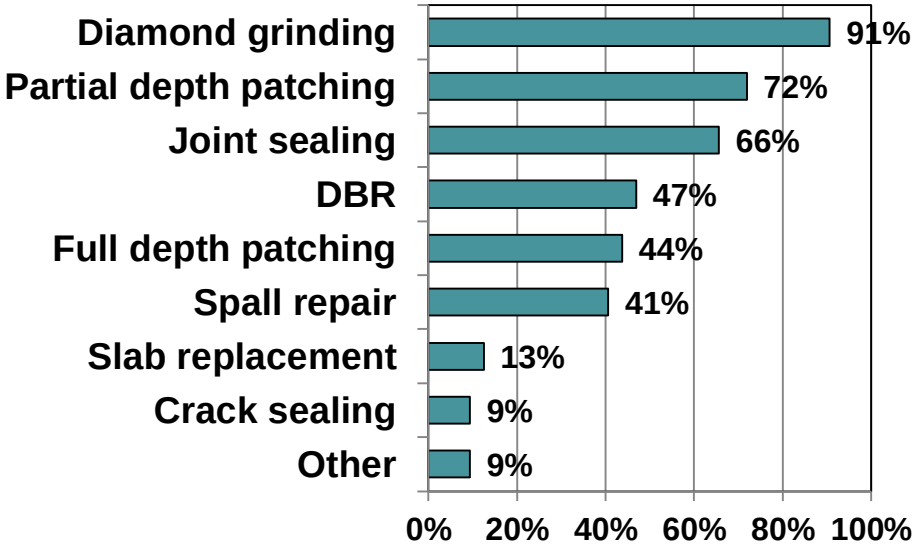
Highway P² Questionnaire

- 33 of 50 (66%) State DOTs
- 9 of 13 (69%) Canadian Provinces/ Territories
- 42 of 63 (67%) overall response



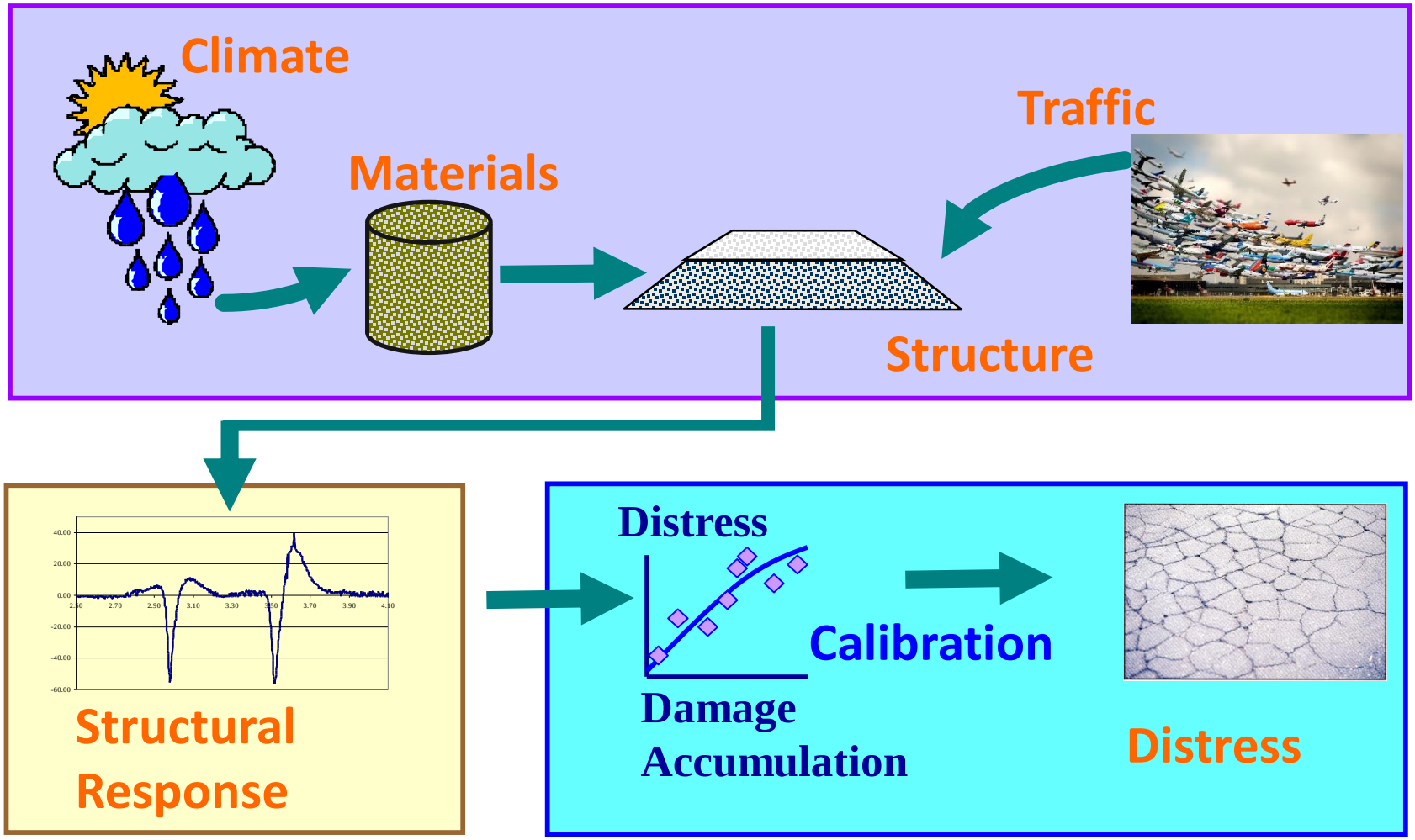
Highway P² Questionnaire





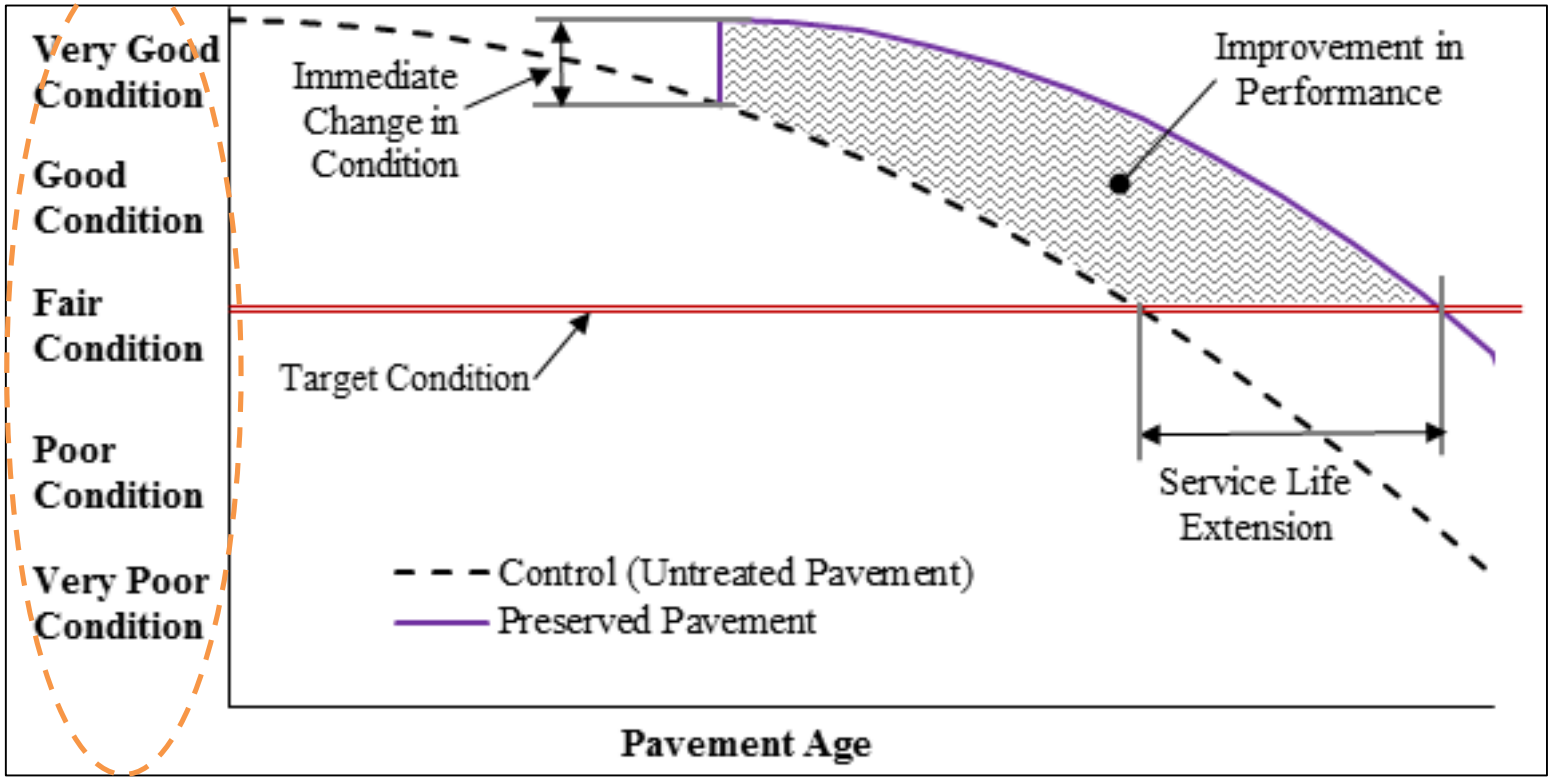
Presentation Outline

1. Background
2. **Performance Modeling**
3. Performance Measures
4. Treatment Timing & Remaining Service Interval



Modeling Pavement Performance

Modeling P² Performance



- **P² decision-making often based on anecdotal information**
- **Data does exist to support performance evaluation**

Service Life Extensions

Treatment	Good Condition (PCI=80)	Fair Condition (PCI=60)	Poor Condition (PCI=40)
Crack Fill	1 - 3	0 - 2	0
Crack Seal	1 - 5	0 - 3	0
Fog Seal	1 - 3	0 - 1	0
Chip Seal	4 - 10	3 - 5	
Micro-Surfacing	4 – 8	3 - 5	
Thin HMA	4 - 10	3 - 7	

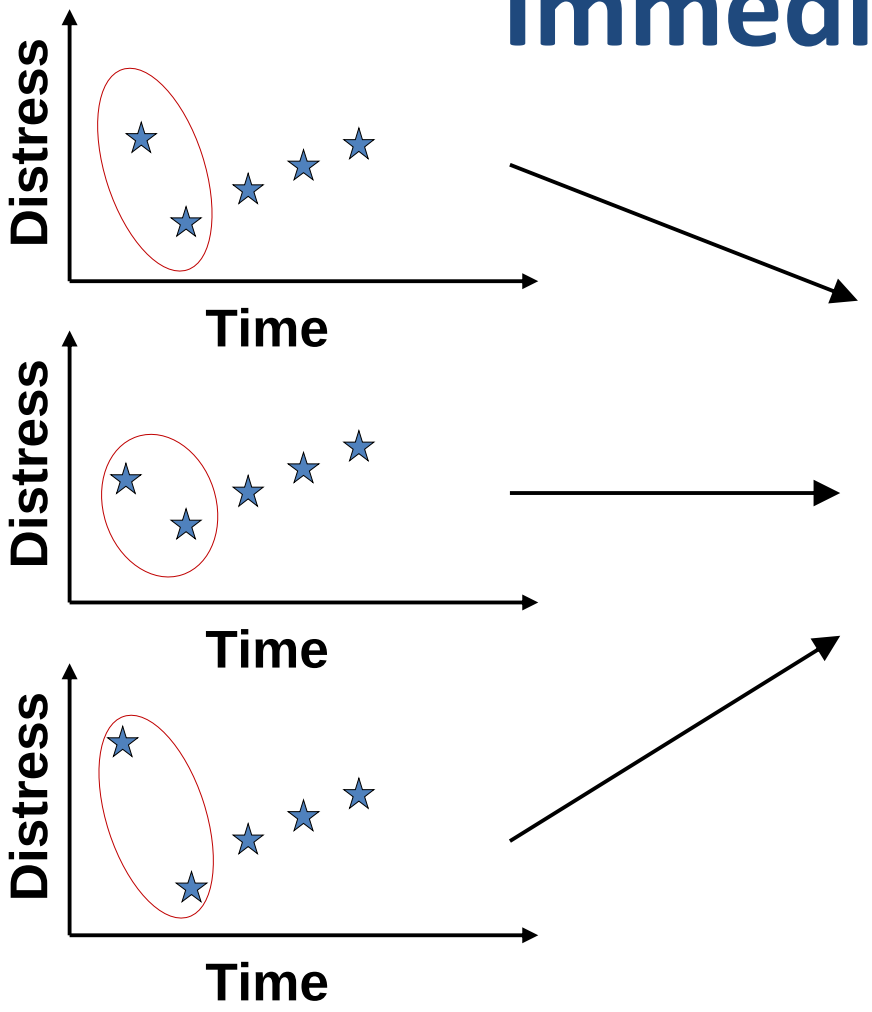
Table 2.2. Typical Unit Costs and Expected Life of Typical Pavement Maintenance Treatments

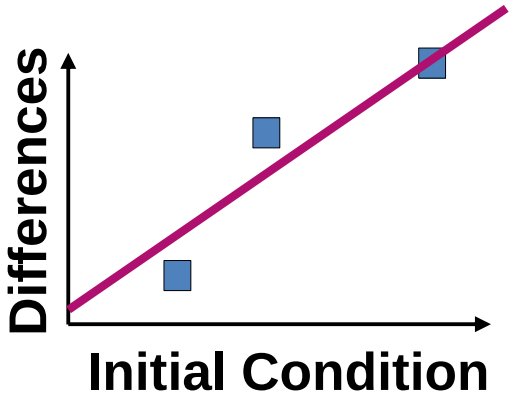
Treatment	Cost/m^2	Cost/yd^2	Expected Life of Treatment		
			Min.	Average	Max.
Crack Treatment[a]	0.60	$0.50	2	3	5
Fog Seals[b]	0.54	$0.45	2	3	4
Slurry Seals[c]	1.08	$0.90	3	5	7
Microsurfacing[d]	1.50	$1.25	3	7	9
Chip Seals[e]	1.02	$0.85	3	5	7

Treatment	Good condition (PCI = 80)	Fair condition PCI=60	Poor condition PCI = 40
Fog seal	3-5	1-3	1-2
Chip Seal	7-10	3-5	1-3
Slurry seal	7-10	3-5	1-3
Microsurfacing	8-12	5-7	2-4
Thin HMA	8-12	5-7	2-4

Could/should we use these numbers? Why?

Immediate Change

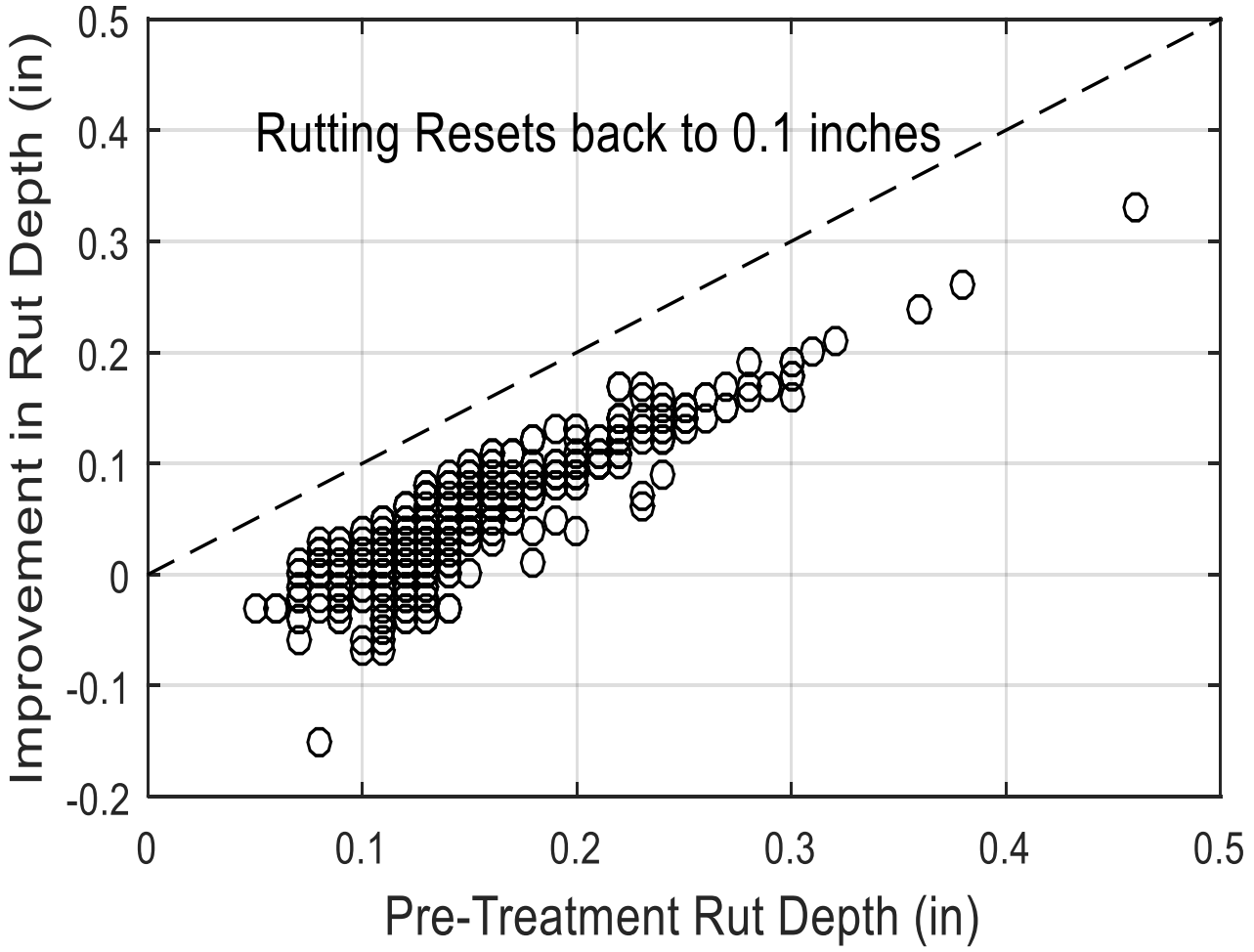




In some cases, differences do not depend on initial condition

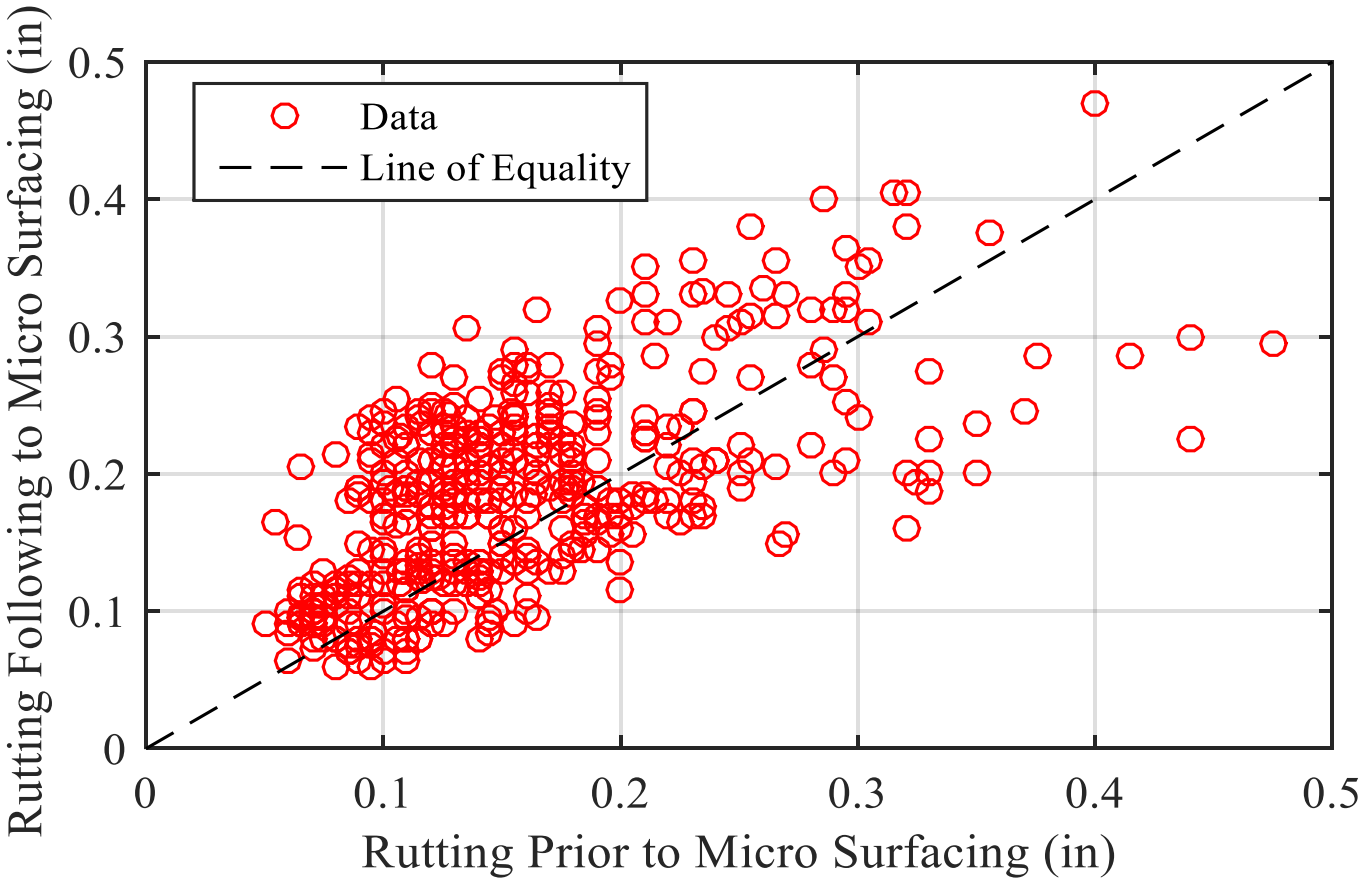
Immediate Change

Rutting – Thin AC Overlay of AC Pavements



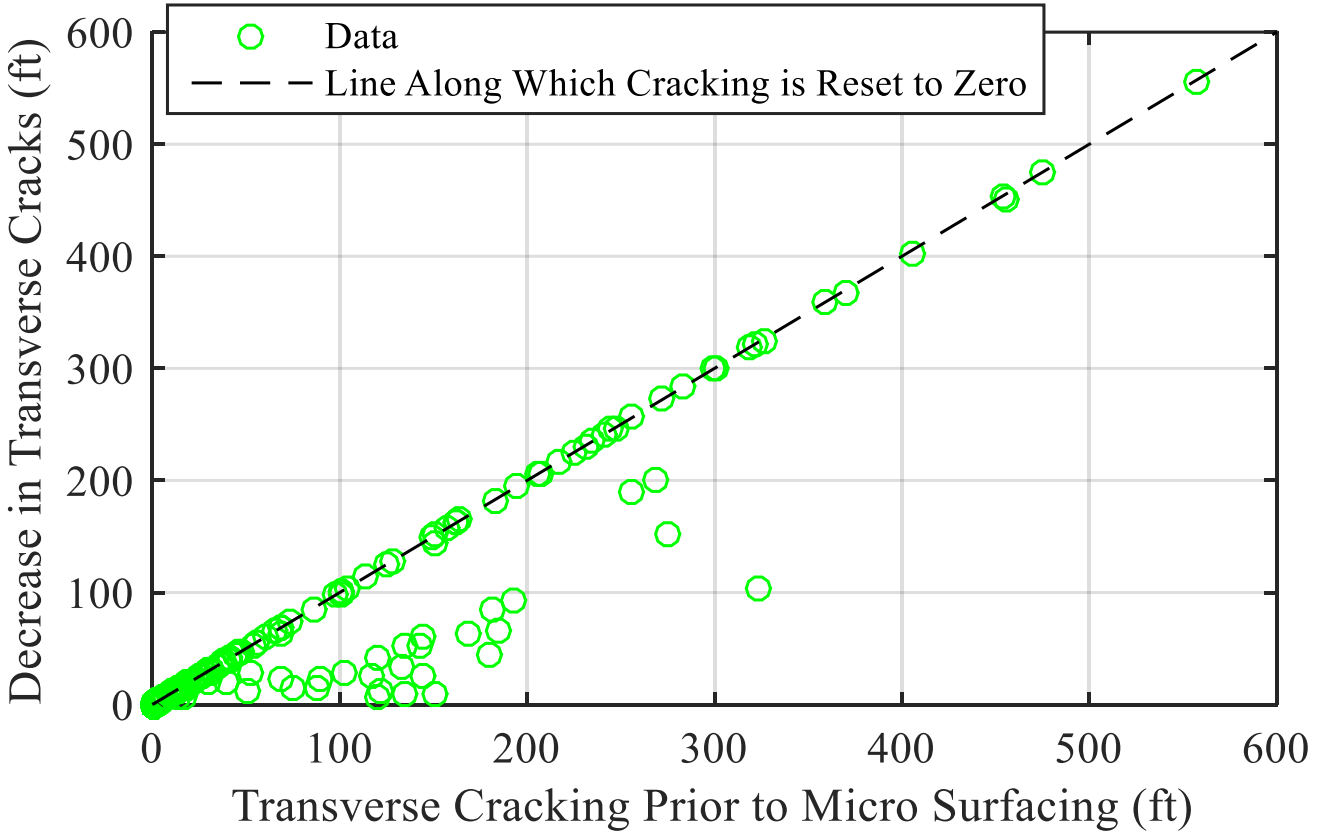
Immediate Change

Rutting – Micro Surfacing of AC Pavements



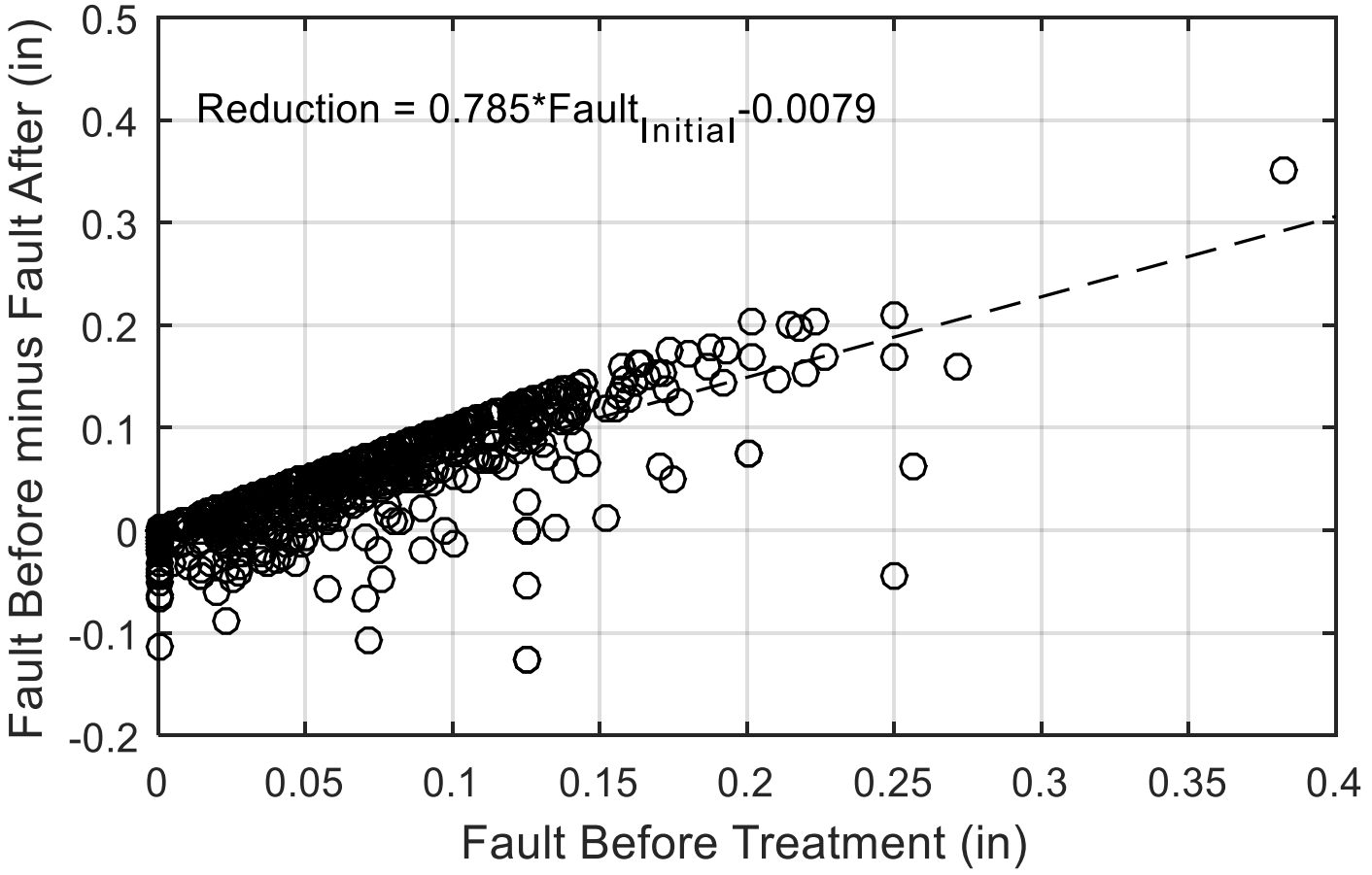
Immediate Change

Transverse Cracking – Micro Surfacing of AC Pavements



Immediate Change

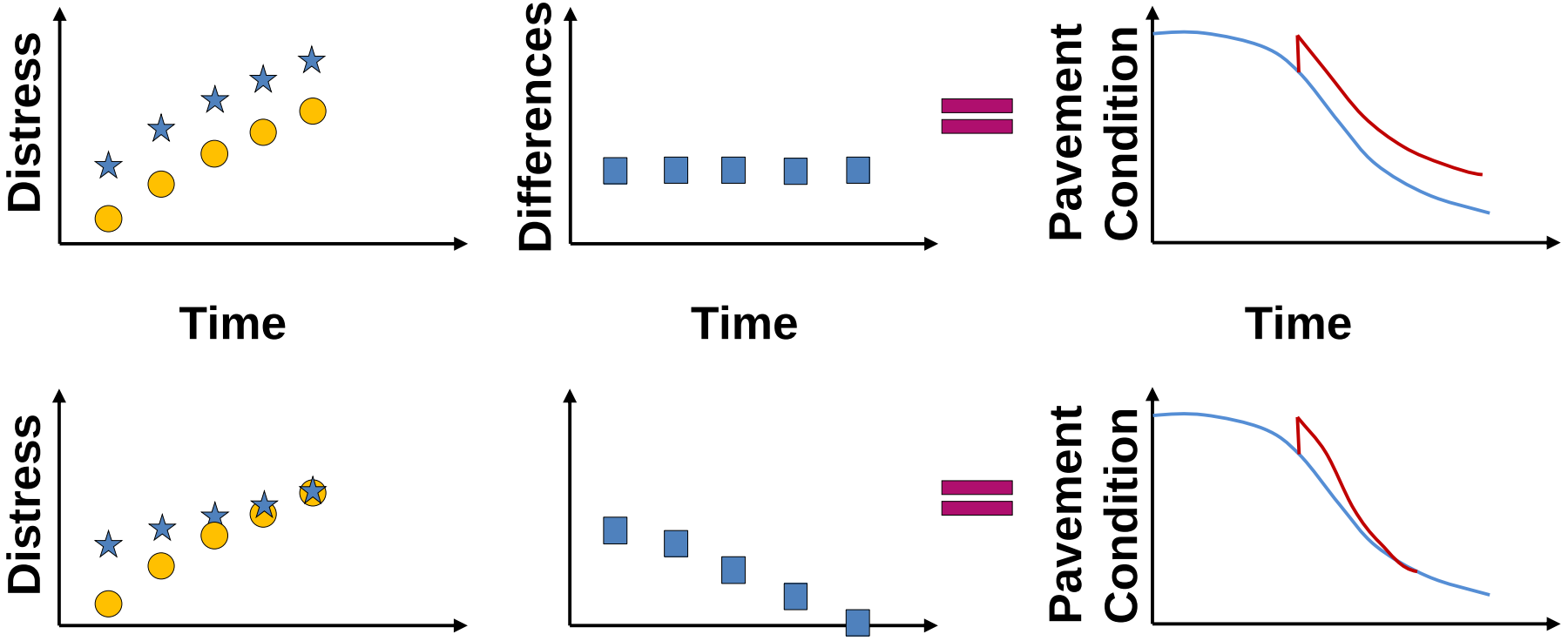
Faulting – Diamond Grinding of PCC Pavements



Long-Term Effect

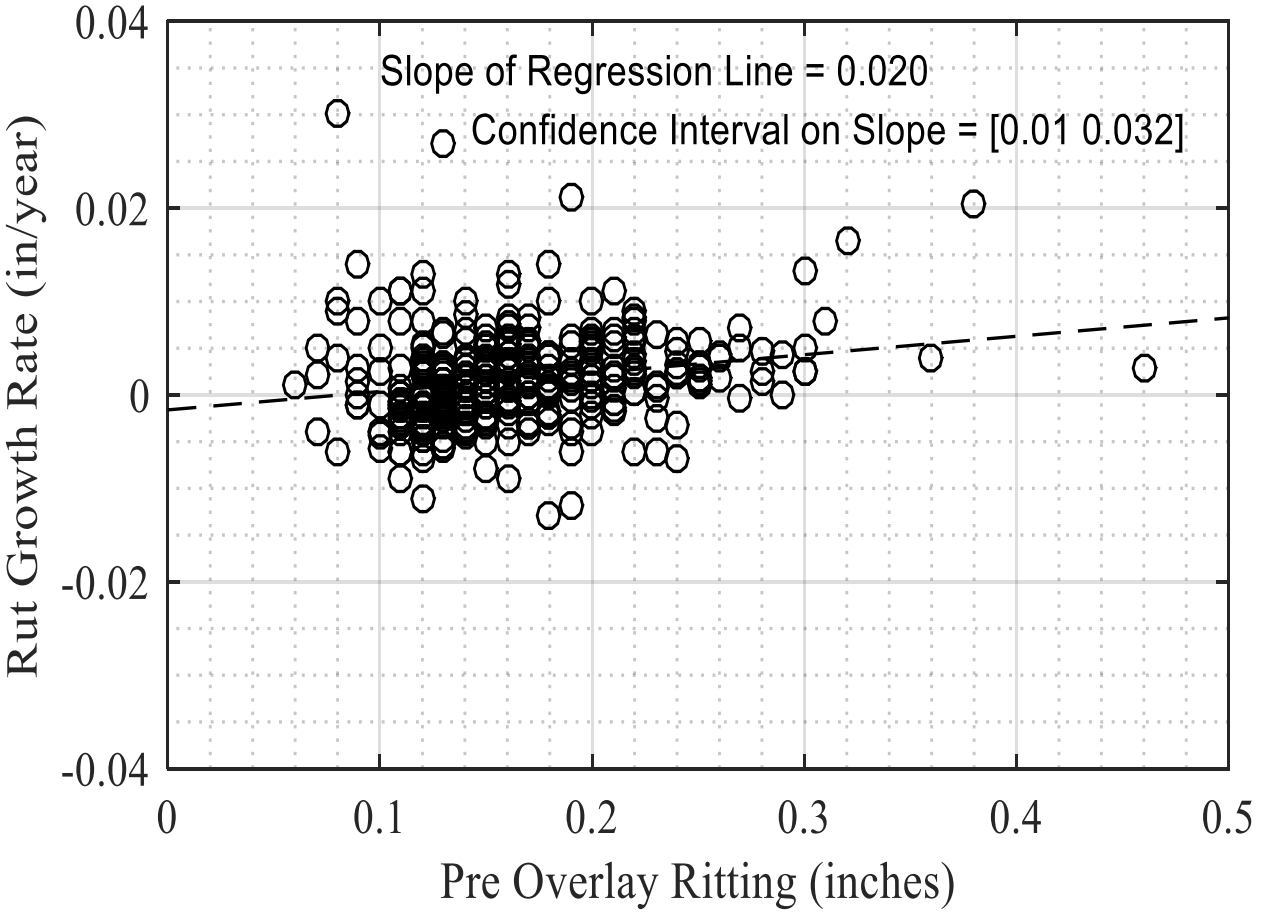
★ Control Section

● Treatment Section



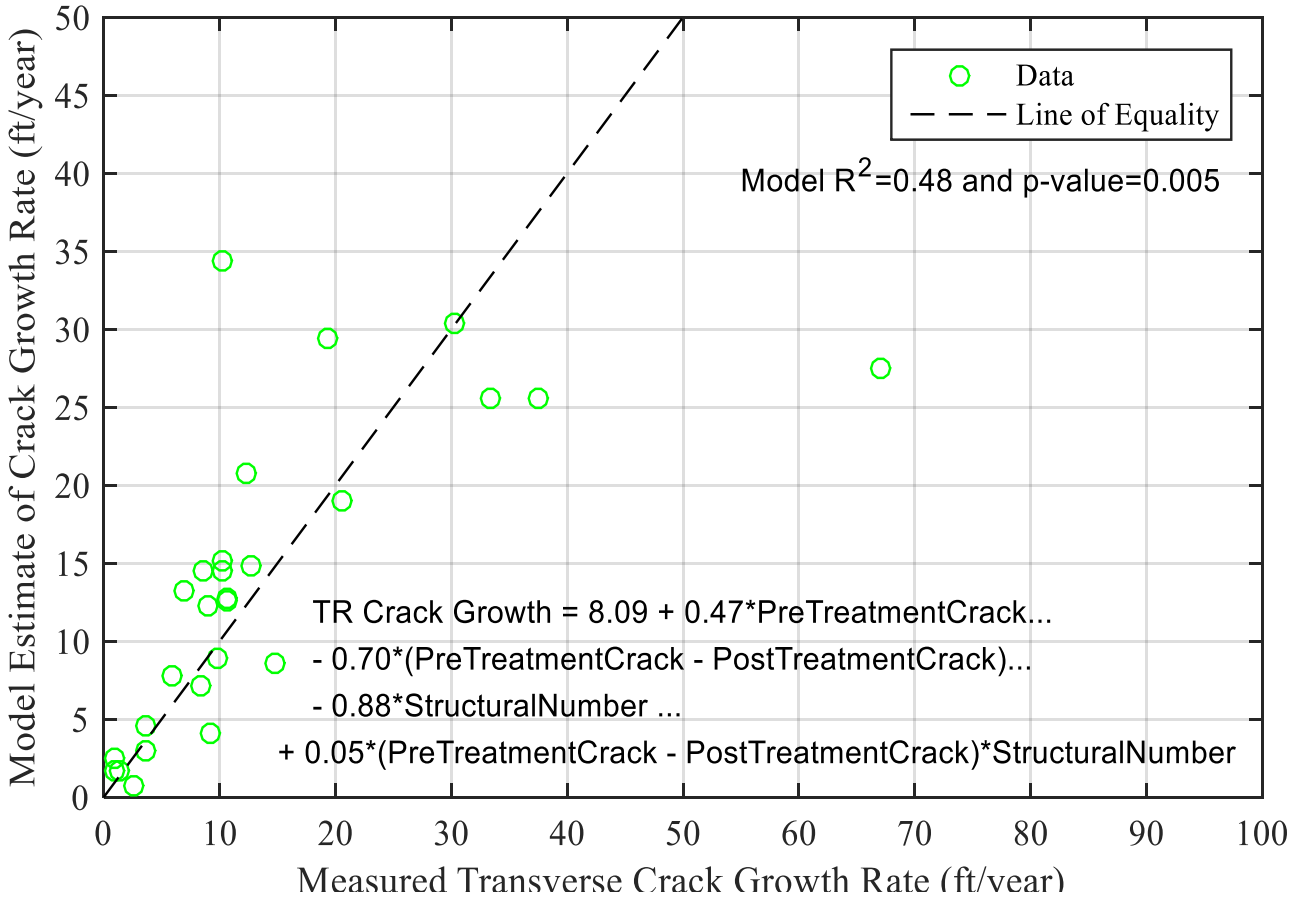
Long-Term Effect

Rutting – Thin AC Overlay of AC Pavements

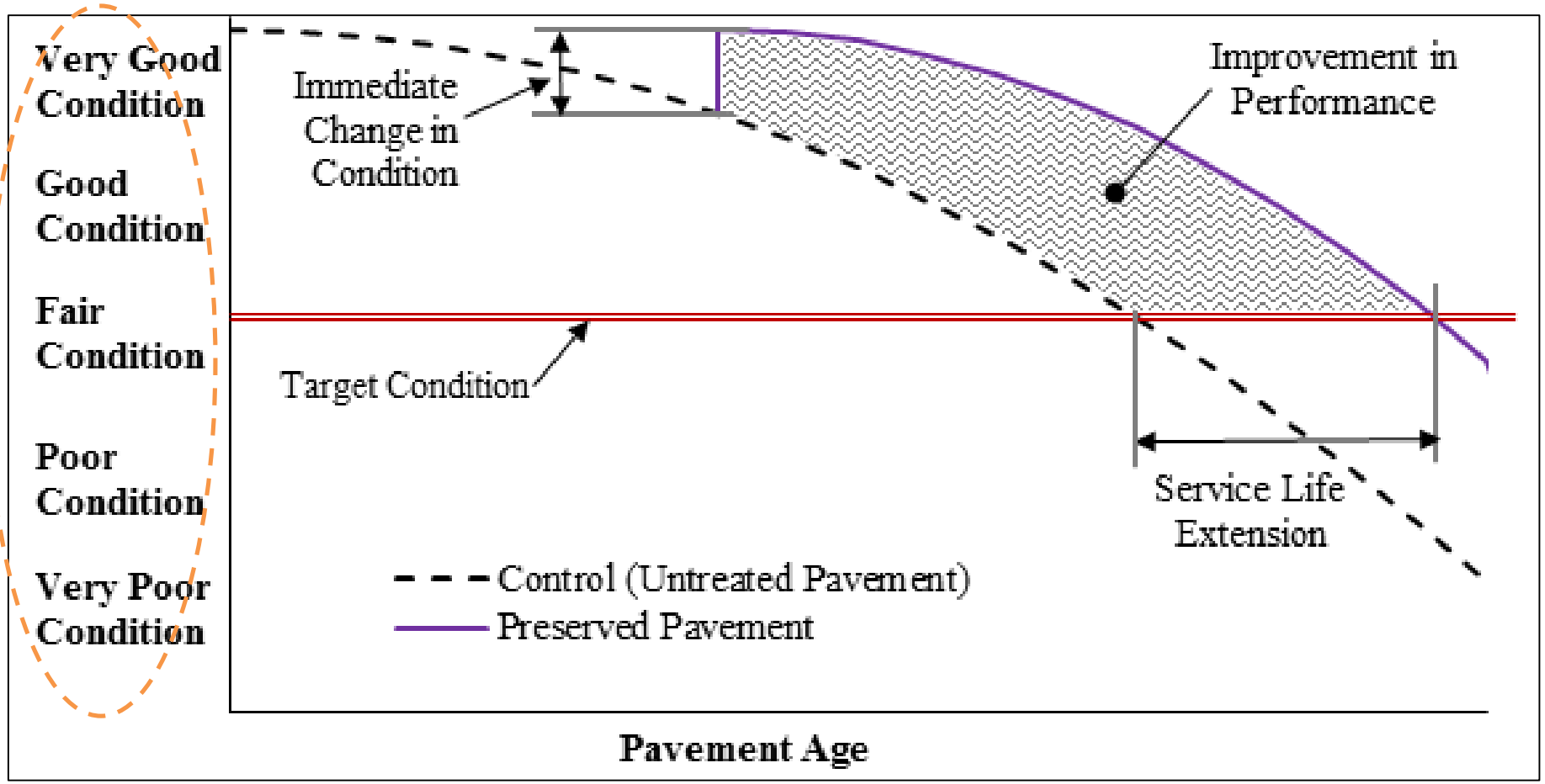


Long-Term Effect

Transverse Cracking – Micro Surfacing of AC Pavements



Modeling P² Performance



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Performance Measures

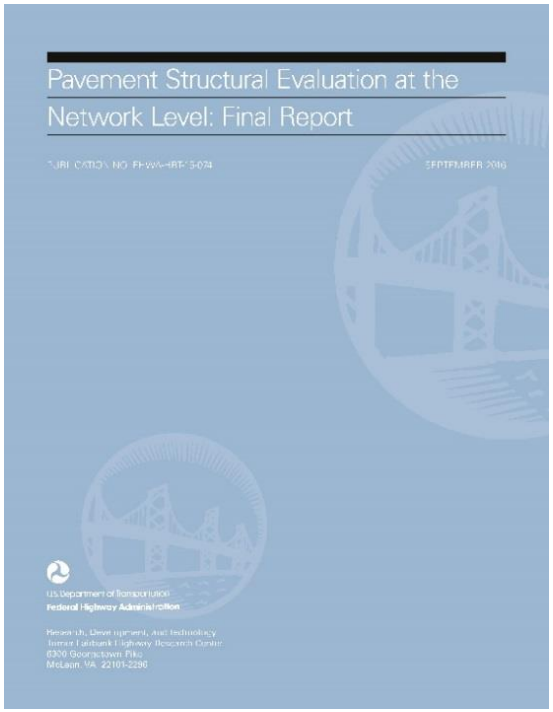
Metrics that reflect degree of achievement of pavement asset towards meeting specific goals

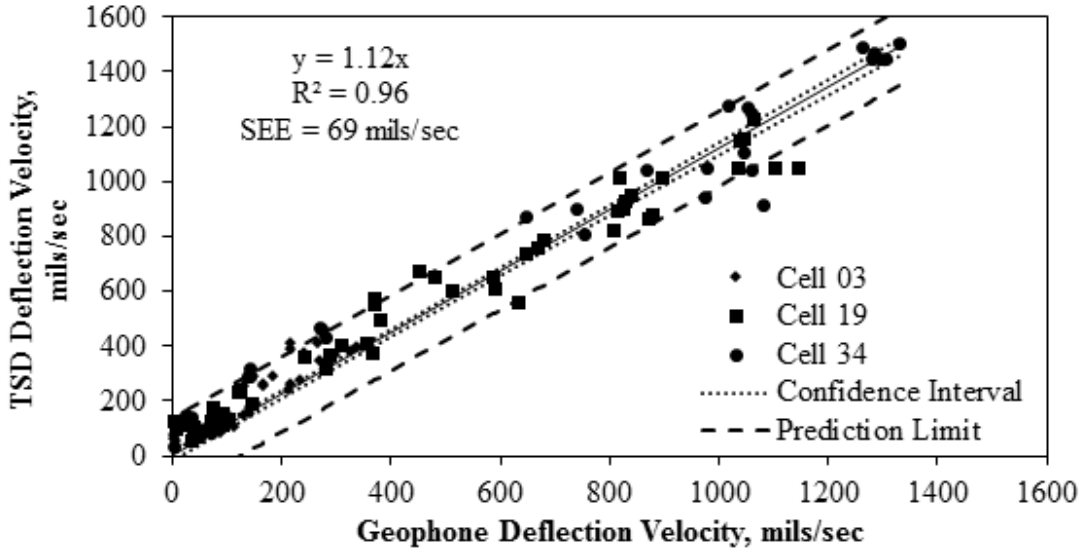
- Evaluation of current condition of pavements
- Long-term trends in pavement condition
- Assessment of decisions made to achieve specific goals (e.g., minimize LCC)

Performance Measures

Category	Performance measures
Individual pavement condition measures	• Roughness • Cracking • Rutting • Bleeding • Raveling • Oxidation • Spalling • Faulting • Pumping • Friction • Surface texture • Noise • Deflection/Structural adequacy
Composite pavement condition measures	• **Pavement Condition Index** • Pavement Quality Index • Distress index • Remaining service life • Overall pavement condition • Condition Rating Service

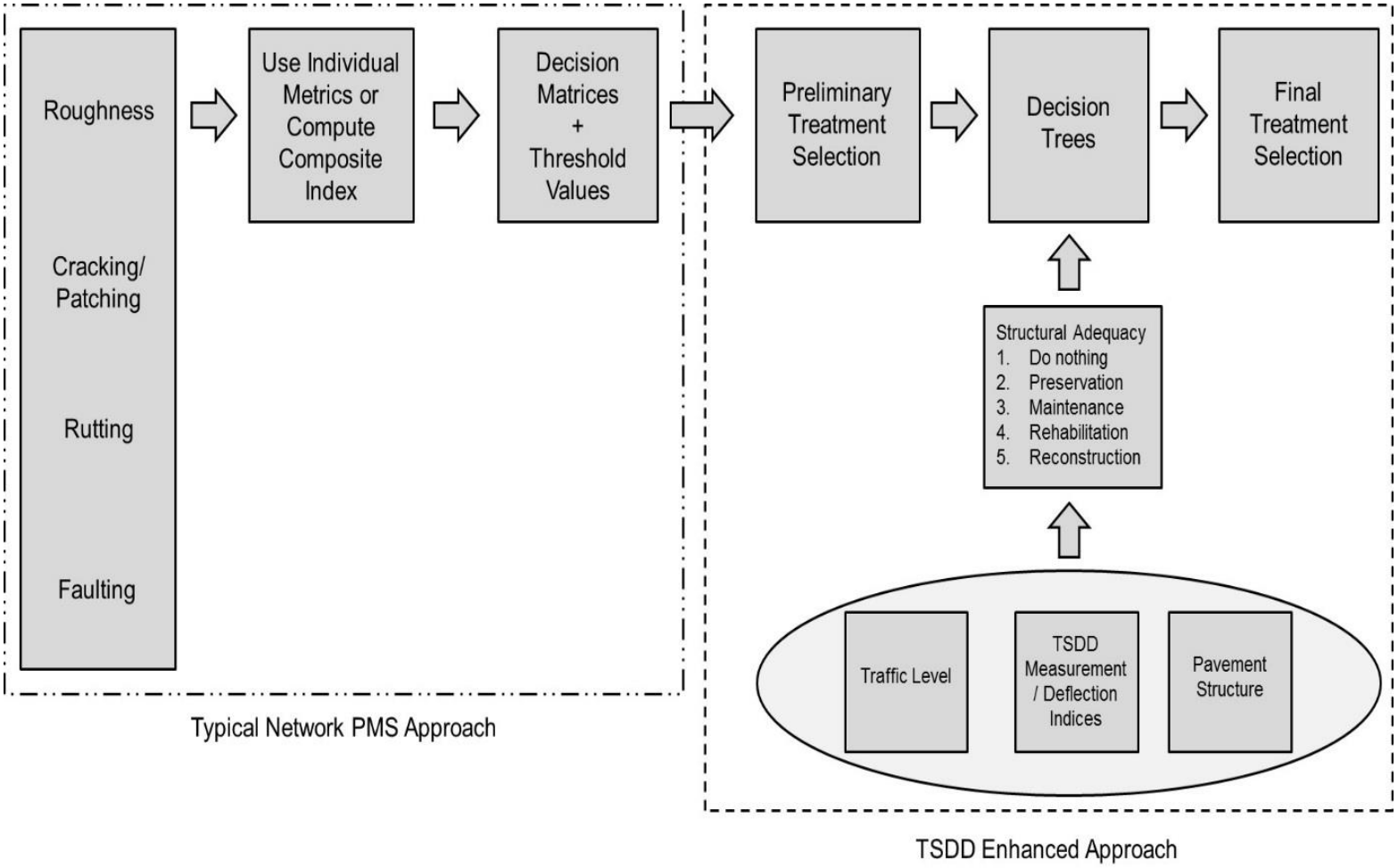
Category	Performance measures
Cost measures	• Life cycle costs • Deferred maintenance costs • Depreciated replacement costs • Investment backlog • Deferred Preservation liability • Expected cost of future pavement rehab
Other asset measures	• Asset Sustainability index • Asset consumption ratio • Asset renewal funding ratio • Pavement sustainability index • Sustainability gap • Average section decline • Equivalent failure factor





Deflection Testing

PMS Integration



Performance Measures

	Pavement Performance Measures Subject Matter Expert		Asset Management Subject Matter Expert		Members of the government project technical panel	
	Relative Rank of Average Weights	Average Weight Within Group	Relative Rank of Average Weights	Average Weight Within Group	Relative Rank of Average Weights	Average Weight Within Group
Measure is (or can be) analytically linked to user safety.	4	0.56	3	0.61	1	0.83
Measure is (or can be) analytically linked to user satisfaction.	7	0.47	7	0.47	4	0.53
Performance measure can be implemented with relative ease.	8	0.44	4.5	0.54	8	0.40
Providing an indication of cost effectiveness over the long term.	2	0.82	2	0.71	3	0.68
Providing an indication of where the network system is heading, future trends.	1	0.94	8	0.36	2	0.70
The measure data can be collected accurately and with known precision.	3	0.67	4.5	0.54	5	0.46
The measure is able to provide quantifiable results or indexes.	6	0.47	1	0.71	6	0.44
The measure is unambiguously defined and understandable by all stakeholders.	5	0.49	6	0.51	7	0.43

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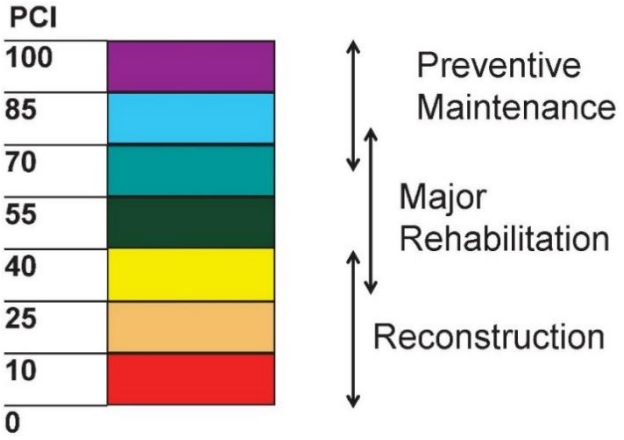
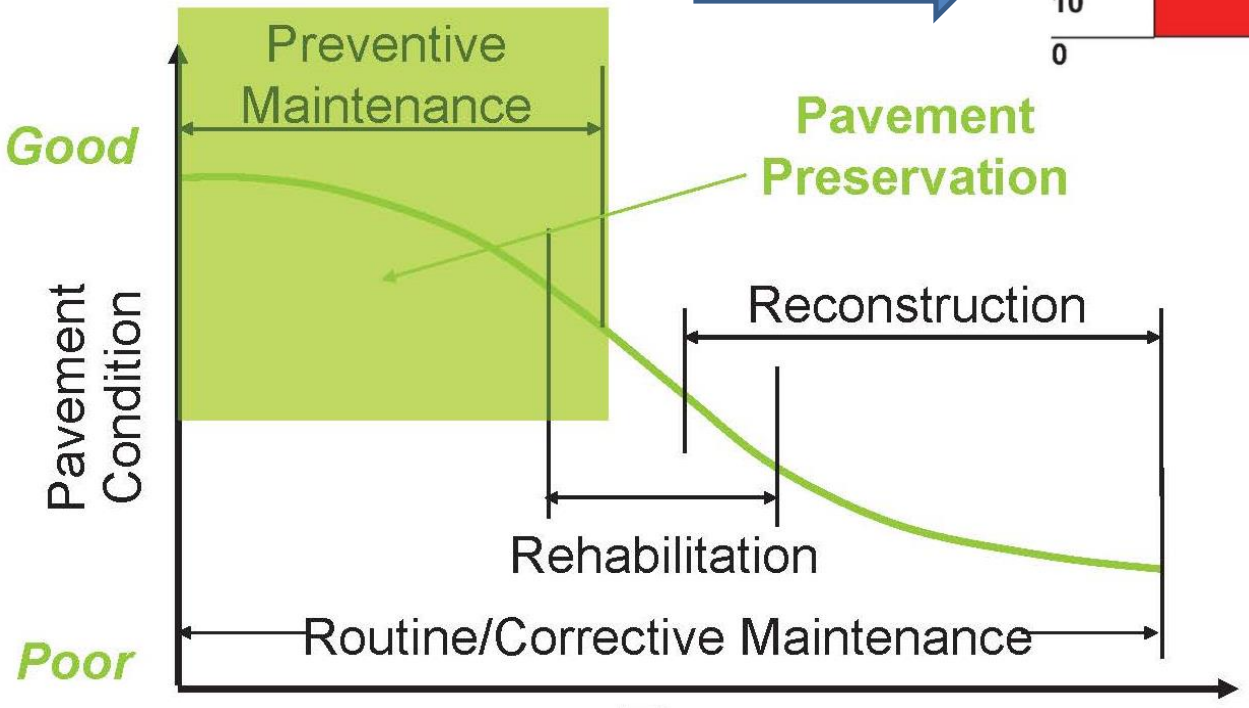
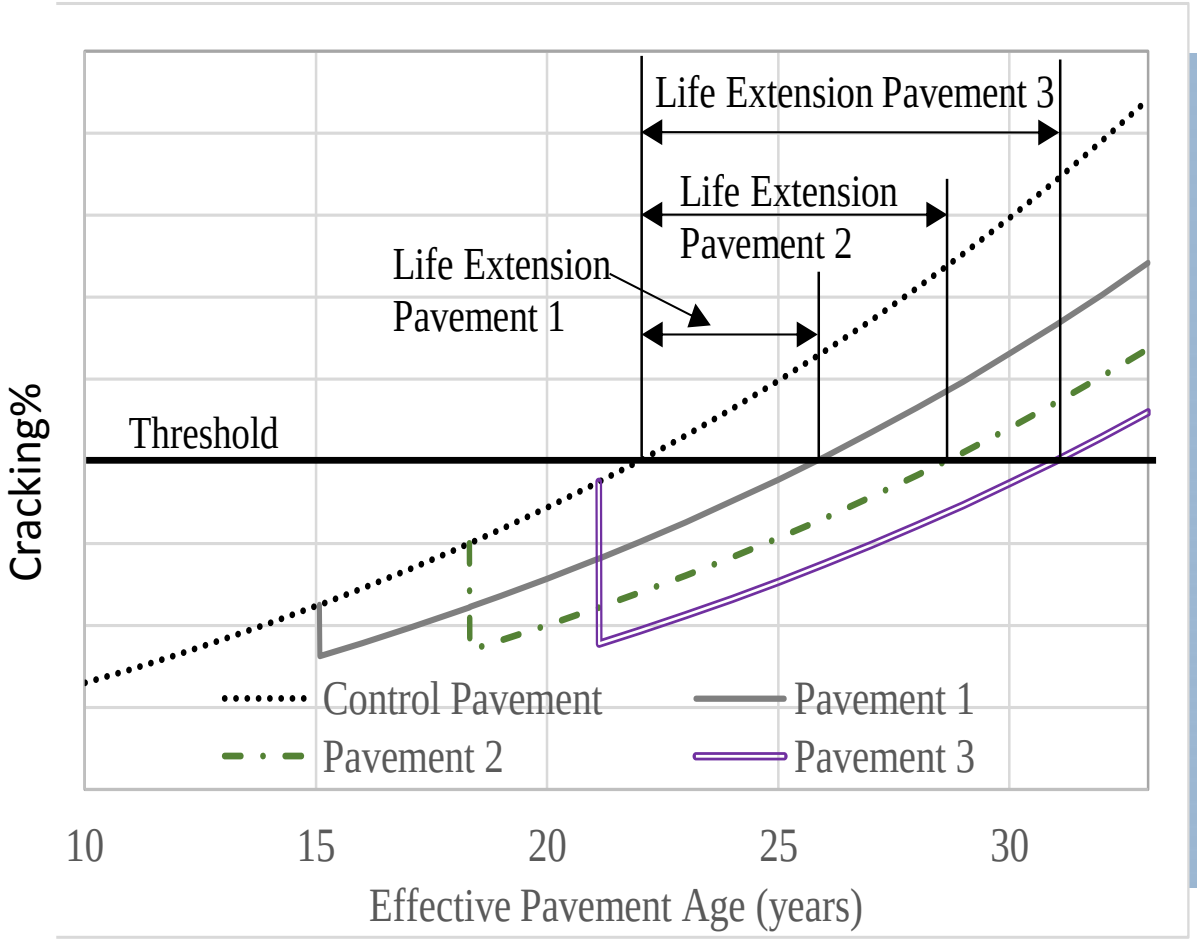
P² Timing

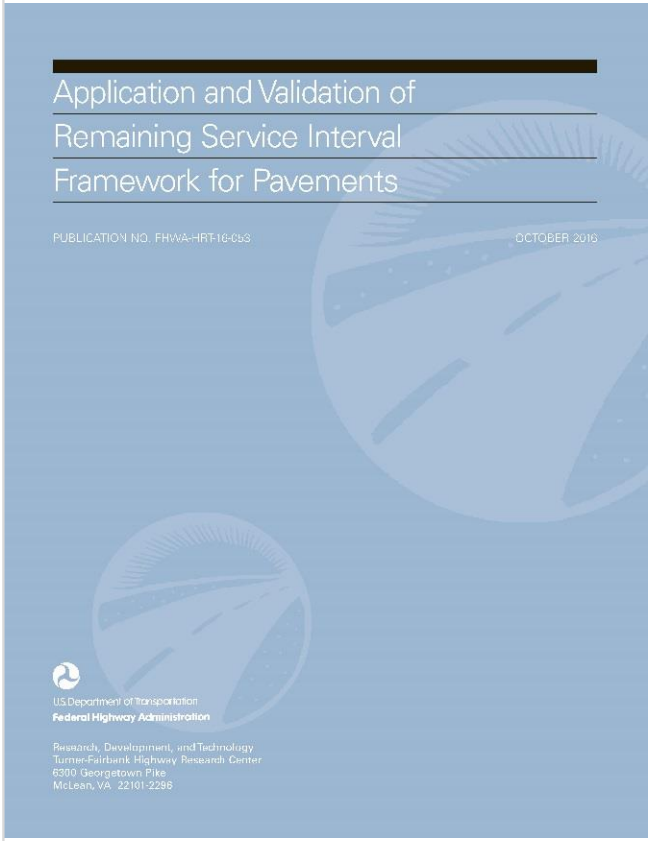
What is the right time?



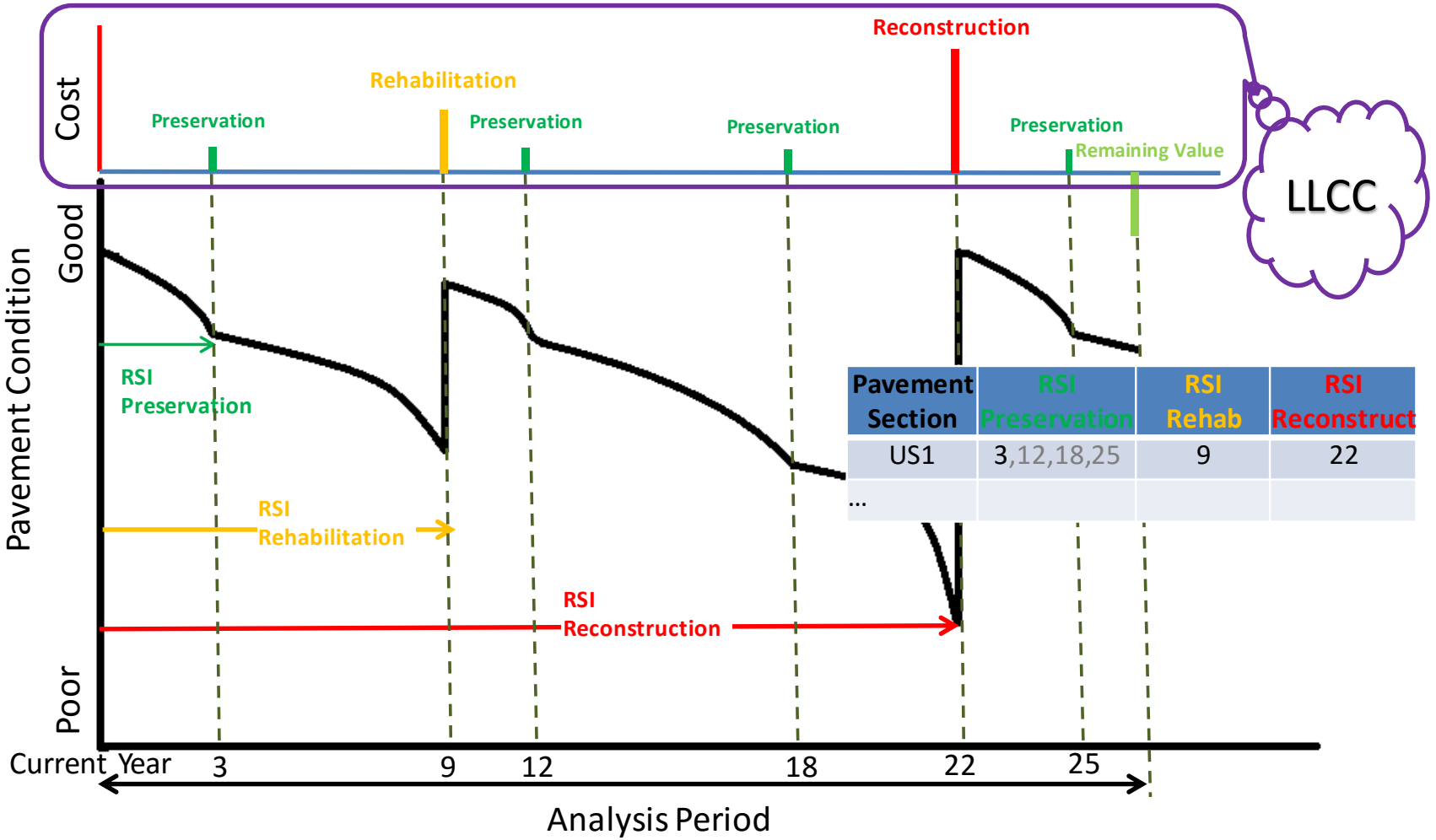


P² Timing


Life Extension Pavement 3
Life Extension
Pavement 2
Life Extension
Pavement 1
Threshold
Cracking%
Control Pavement
Pavement 1
Pavement 2
Pavement 3
10
15
20
25
30
Effective Pavement Age (years)


Application and Validation of
Remaining Service Interval
Framework for Pavements
PUBLICATION NO. FHWA-HRT-16-063
OCTOBER 2016
U.S. Department of Transportation
Federal Highway Administration
Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

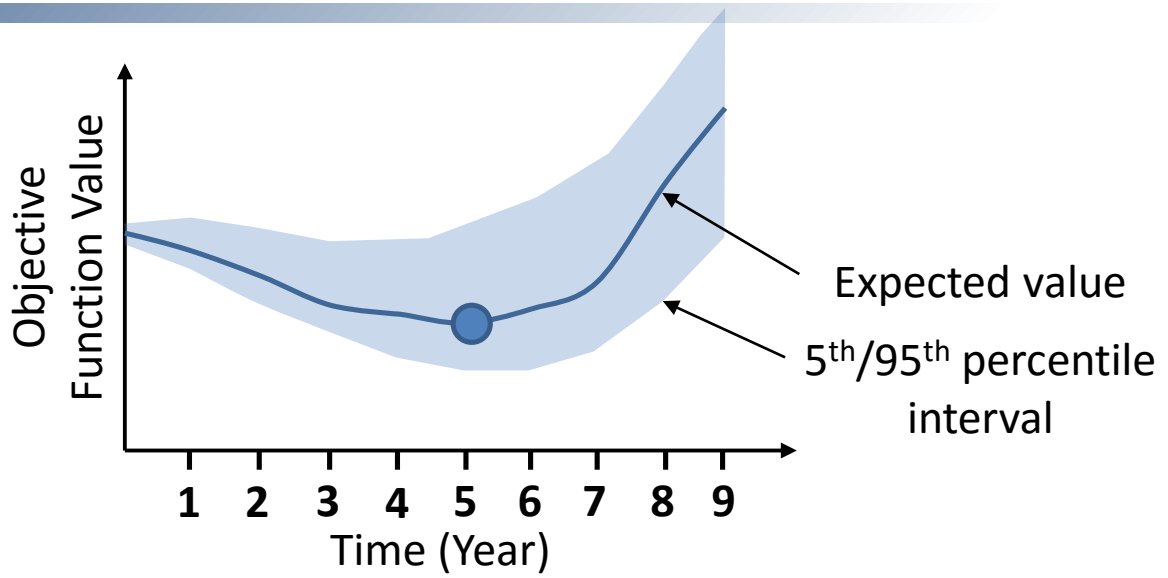
Pavement RSI Concept

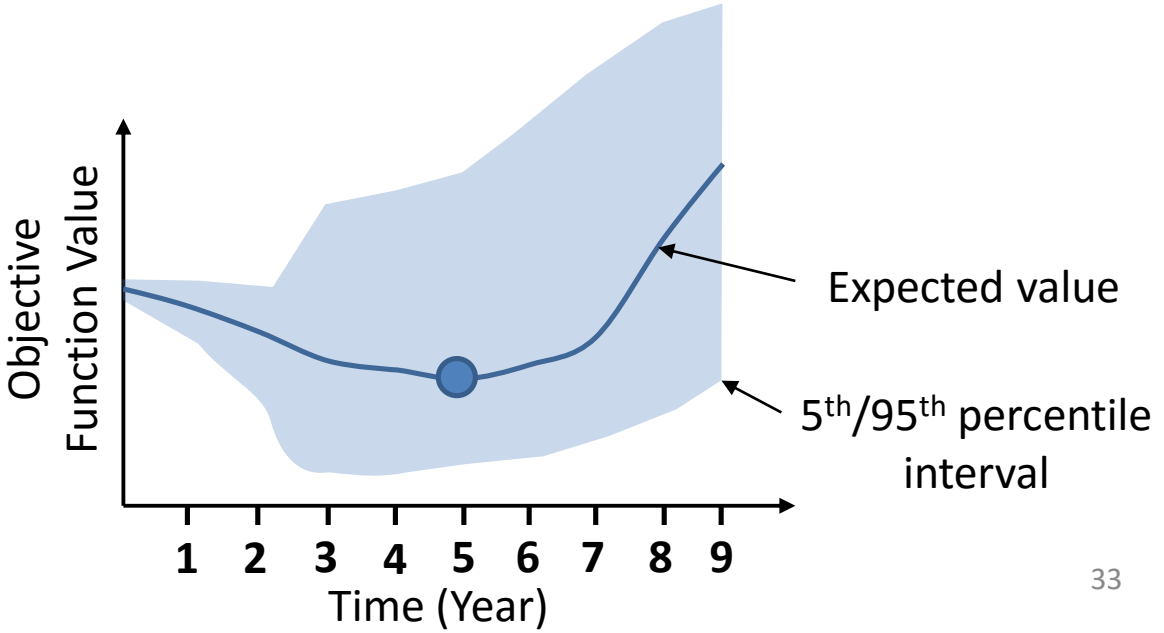


Pavement Section	RSI Preservation	RSI Rehab	RSI Reconstruct
US1	3,12,18,25	9	22
…			

P² Timing

Goal is to minimize objective function, but….





Thank You!