Application of Pavement Smoothness Benefit in Pavement Determination

By
Max Grogg, Applied Pavement Technology, Inc.
Kelly Smith, Applied Pavement Technology, Inc.
Chris Williges, HDR, Inc.
Scott Schram, Iowa Department of Transportation

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Outline

- Acknowledgements
- 2018 Iowa DOT Process
- 2019 Enhancements
- Literature Search and State Interviews
- Discussion
- Final
- Conclusions

Acknowledgement

- Project sponsored by Iowa Department of Transportation (DOT)
- “Evaluation of Pavement Determination Process”
- The review shall benchmark pavement type determination (PTD) practices in other state DOTs, review the proposed process, and identify strengths, weaknesses, and areas for improvement.

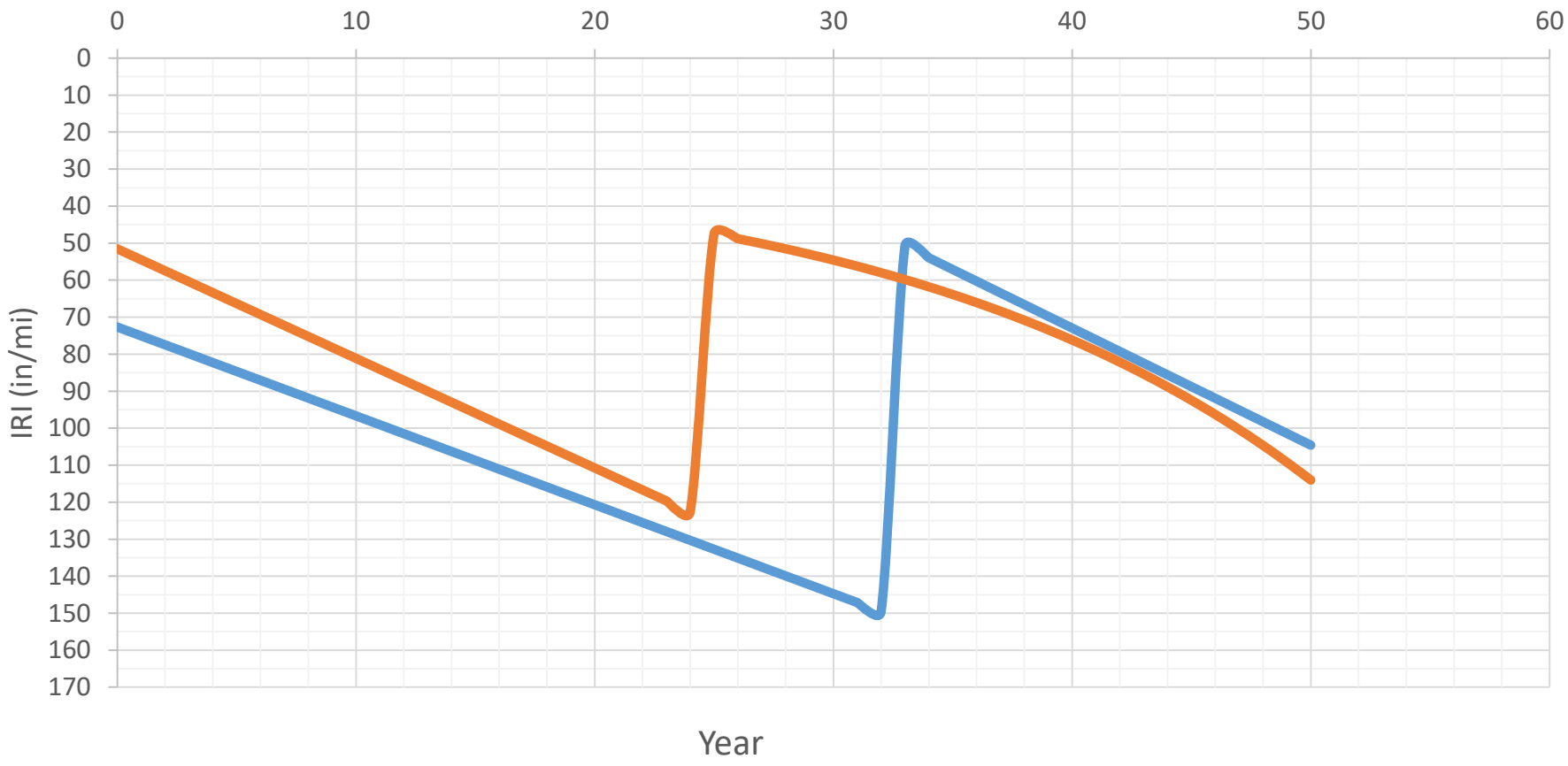
2018 Iowa DOT PTD Process

- A full-depth hot-mix asphalt (HMA) alternative, consisting of initial construction and a mill and 2-inch overlay in Year 20
- A full-depth portland cement concrete (PCC) alternative, consisting of initial construction only (no rehabilitation)
- No future maintenance costs for either alternative
- A 3 percent discount rate
- A 40-year analysis period
- Salvage value is considered equal for the two alternatives, equal rehabilitations at the end of the analysis period
- No user costs
- 5% uncertainty buffer

Enhancement for 2019

- Iowa DOT wanted to consider user benefit in the process
  - 23 CFR 490, *National Performance Management Measures for the Assessing Pavement Condition*
  - IRI to define benefit from normal operating conditions
  - IRI used by Iowa DOT and FHWA
- Iowa DOT's PMS
  - History
  - Projection curves
- FHWA has established performance cutoffs
  - <95 inches/mile is good
  - >170 inches/mile is poor

Example IRI Projections from dTIMS



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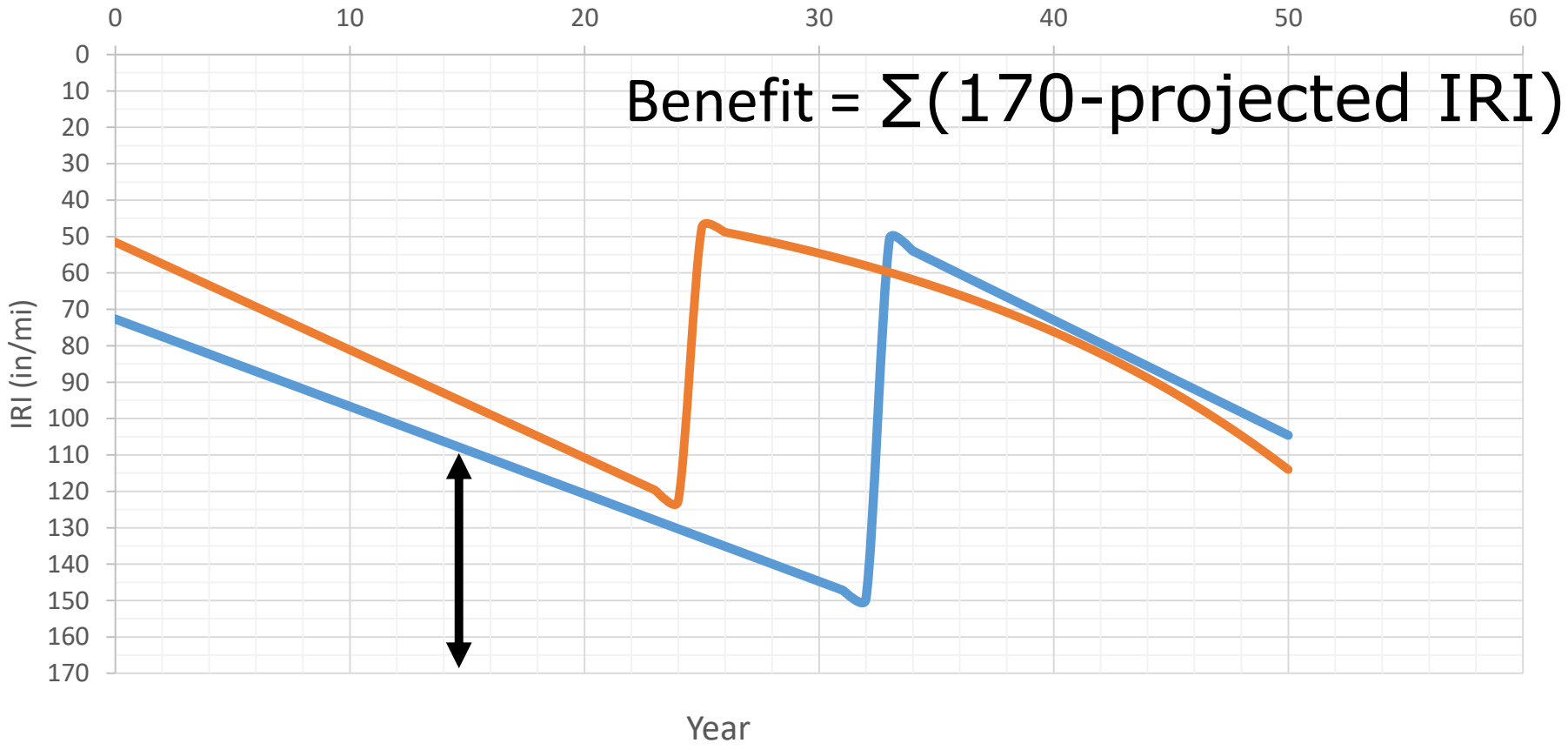
IRI Projections

- Use Iowa DOT's dTIMS
- Dummy pavement sections
  - Interstate PCC and HMA
  - Primary PCC and HMA
- IRI cannot exceed 170 inches/mile
- Minimum one rehabilitation per alternative
- Rehabilitation timing realistic to prevent
  - Overlay every year
  - Diamond grind every year

Benefit Calculation
Area Under the Curve



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Units

- Construction and rehabilitation costs - $
- IRI benefit – (inches/mile)*years
  - There are conversions to dollars in literature
  - Using ratios so unitless
  - Benefits are also discounted to present worth like construction costs
  - All vehicles treated equally

Initial Calculation

$$\frac{PCC\ Construction\ Cost}{HMA\ Construction\ Cost} X \frac{HMA\ IRI\ Benefit}{PCC\ IRI\ Benefit}$$

<0.95 select PCC

>1.05 select HMA

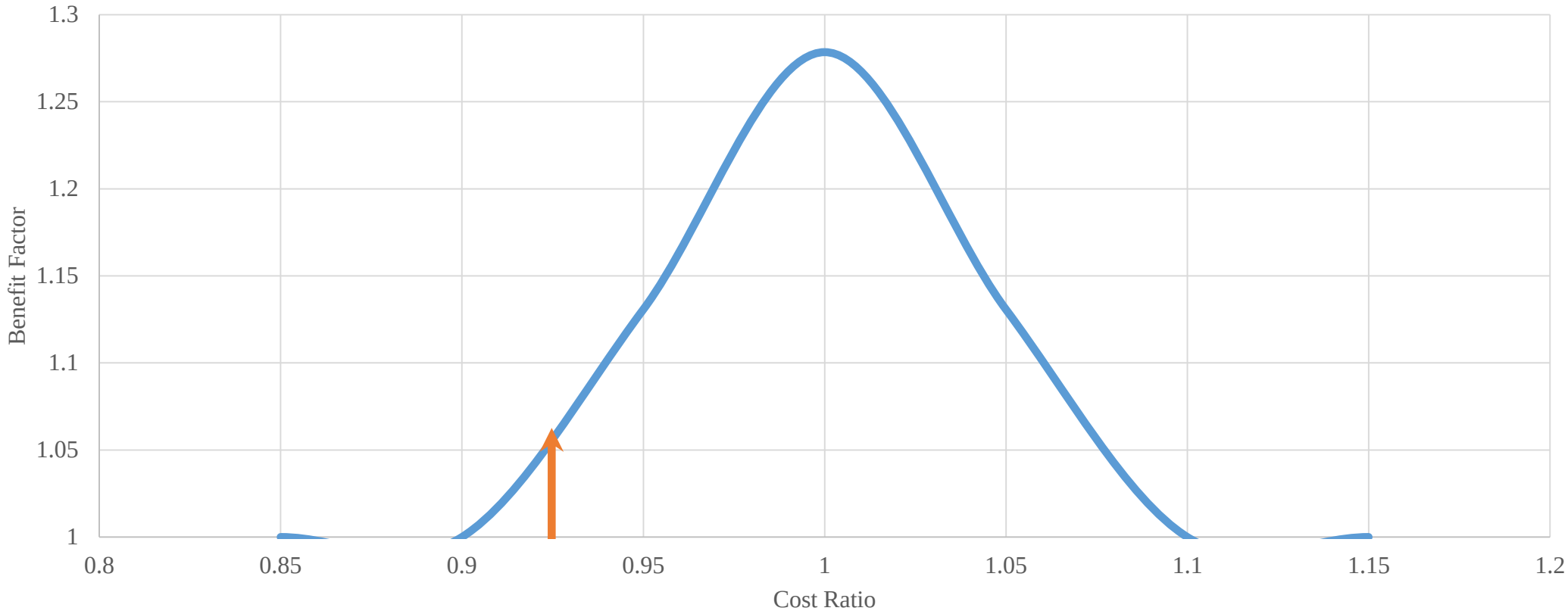
Literature Search and State Interviews

- 12 states (5 interviewed), 4 other countries, FHWA, AASHTO, and NCHRP publications
- No state agency including user benefit
  - Too complex
  - Alternatives defined as equal in benefit
- States using
  - Work zone user costs
  - Alternate designs/alternate bids
  - 10 percent uncertainty buffer
  - Analysis period varied from 35-50 years but leaning toward 50 years with longer life pavements
  - Probabilistic analysis

Discussion

Not All $ are Considered Equal

Weighting Factor



Revised Calculation

$$\frac{PCC\ Construction\ Cost}{HMA\ Construction\ Cost}\ X\ Weighted\ Benefit\ Factor$$

<0.90 select PCC

>1.10 select HMA

Final

- IRI and dTIMS used to calculate benefit using generic pavement sections
- Weighting factor to account user versus agency dollars
- Bracketing treatments to maintain realistic approach
- Increased uncertainty buffer to 10 percent
- Increased analysis period to 50 years
- Include salvage value (serviceable life)

Excel Spreadsheet

- Calls on dTIMS library for projections
- Multiple treatment options
- Vary analysis period
  - Benefit period could be different than analysis
- Vary discount rate
- Sensitivity of thickness delta

Version 0.9

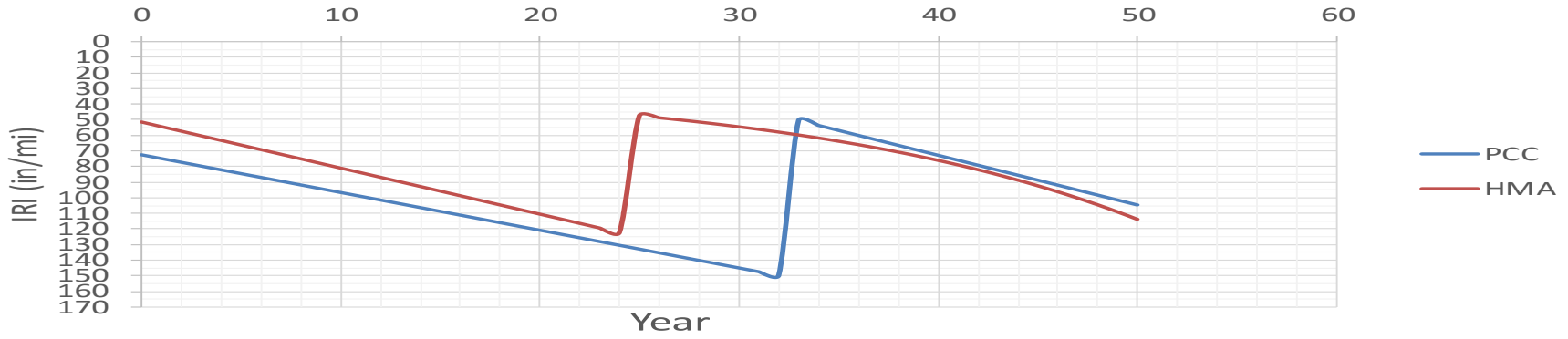
Iowa DOT Pavement Determination
Life Cycle Cost-Benefit Analysis

Date
Project

Calculate

Inputs

Rate (%)	3
Analysis Period (years)	50
Benefit Period (years)	50
Terminal IRI (in/mi)	170
dTIMS Library Table Name	MIS.LCCA_STRATIG
Costs	click
System	Non-Interstate
Model Year	2017
Tolerance (%)	10



RIGID ALTERNATIVE

Treatment	Treatment Year	Present Value ($)	Benefit (in/mi*years)	Ending IRI (in/mi)
RECON	0	$ 8,087,693.57	1,904.40	152.0
STR1	33	$ 1,932,112.00	591.77	104.6
END	50		-	
			-	
			-	
SALVAGE		$ (289,816.80)		
TOTAL		**$ 9,729,988.77**	2,496.17	

FLEXIBLE ALTERNATIVE

Treatment	Treatment Year	Present Value ($)	Benefit (in/mi*years)	Ending IRI (in/mi)
RECON	0	$ 8,911,156.42	2,036.41	125.6
CIR	25	$ 1,213,812.55	1,154.99	114.0
END	50		-	
			-	
			-	
SALVAGE		$ -		
		$ 10,124,968.97	3,191.39	

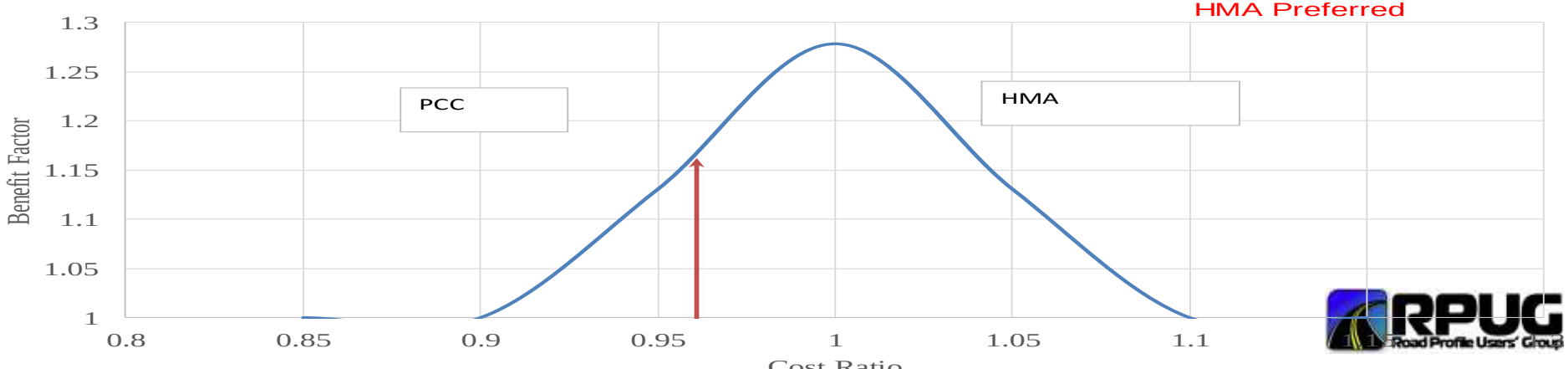
THICKNESS DELTA
3
COST THRESHOLD (%)
10
Discount Benefits
1

C/B HMA	3172.585
C/B PCC	3897.962
Rigid/Flex Rat	1.228639

Rigid/Flexible Cost Ratio
0.96

Benefit Factor
1.16

Adjusted Rigid/Flexible Ratio
1.120
HMA Preferred



PE 2019

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Conclusions

- Provides Iowa DOT with more robust PTD
- Other states may benefit as they embrace performance management but will need to consider
  - Metric and measures
  - Weighting
- Iowa DOT considering other improvements to their PTD that will require additional research

Questions