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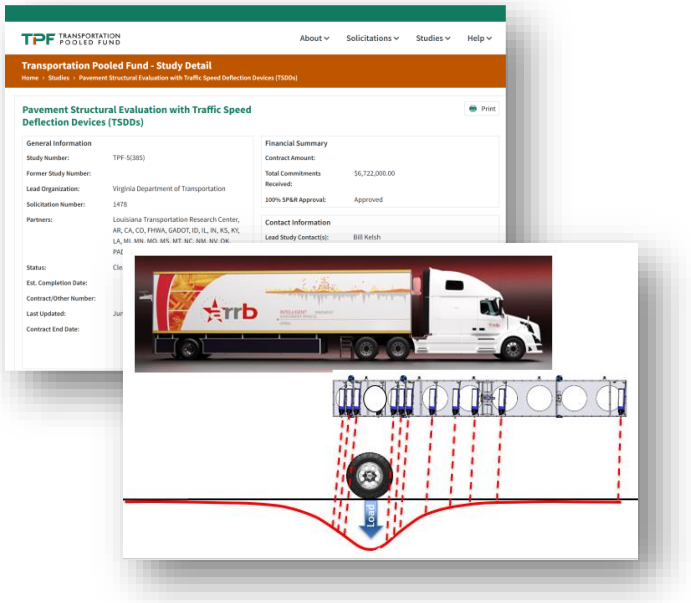

Collecting network-level structural capacity and bluring the line between network and project level pavement asset management

TPF-5(385)

Gerardo Flintsch, Dan Pletta Professor of Engineering
Director, Center for Sustainable and Resilient Infrastructure

October 25, 2023

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Contents

- ✓ Acknowledgements
  - **VDOT/ VTRC**
  - **TPF-5(385)**
  - Samer Katicha, CSRI
  - Jim Poorbaugh, MS DOT
  - Brian Diefenderfer, VTRC
  - Eugene Amarh, CSRI
  - Marin Scavone, CSRI
  - Shivesh Shrestha, CSRI

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1. Introduction

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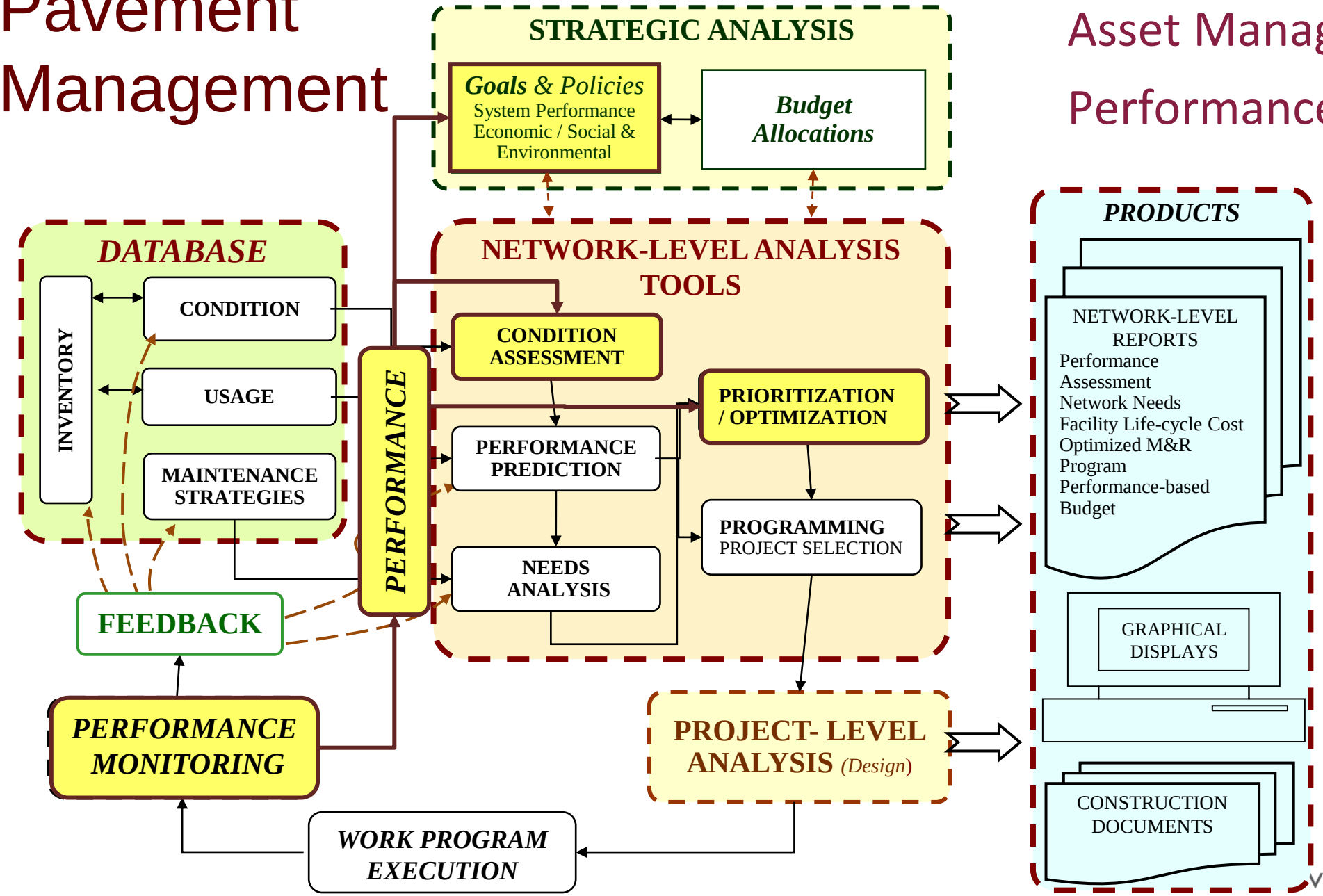
Pavement Management

Asset Management

Performance Management



Key question: In this framework, is structural capacity important at the all levels?

[Similar question for safety/ friction]

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Pavement Performance
Project vs. Network Level Data Collection

Service and User Perception	Serviceability (IRI)
Physical Condition	Distress (PCI)
Structural Integrity / Load-Carrying Capacity	Deflection (PCI)
Safety and Sufficiency	Friction/ Macrotexture
Environmental Impact	Tire/Pav. Noise Rolling Resistance, …

Network Level

Network Level

Project Level

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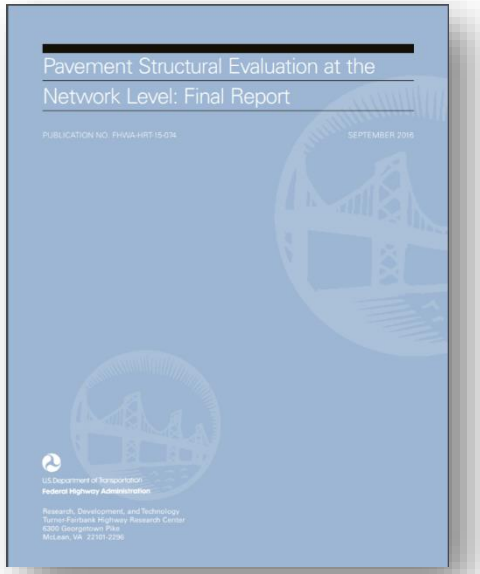
TSDD Use in the US

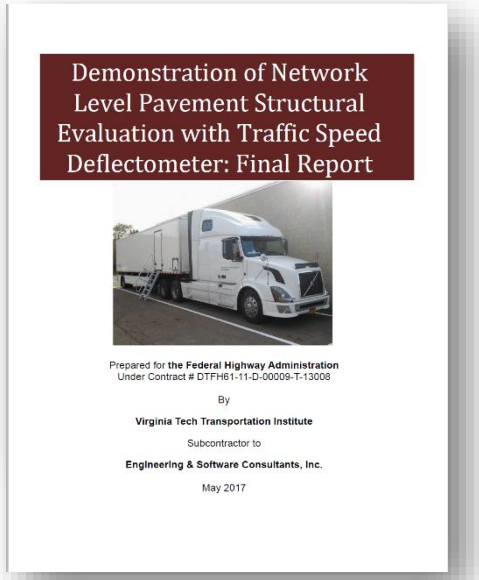
Development

2011 Rada and Nazarian

Assessment



Evaluation

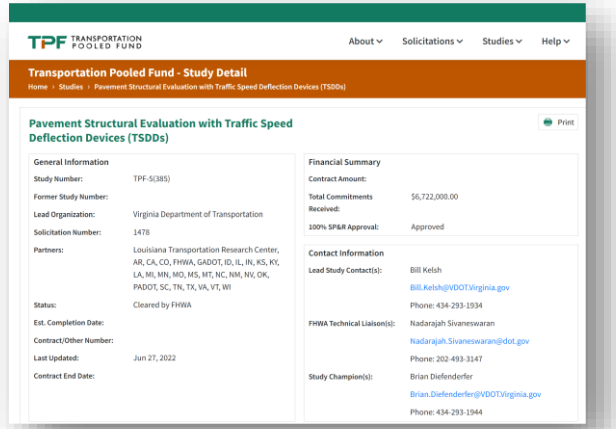


Demonstration

Implementation

Several State Efforts

- ✓ Virginia
- ✓ Louisiana
- ✓ Nationwide TPF 5-385 & 518



https://www.pooledfund.org/Details/Study/637

Verification

NCHRP 10-105

https://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP_Project_10-105_Final_Report.pdf

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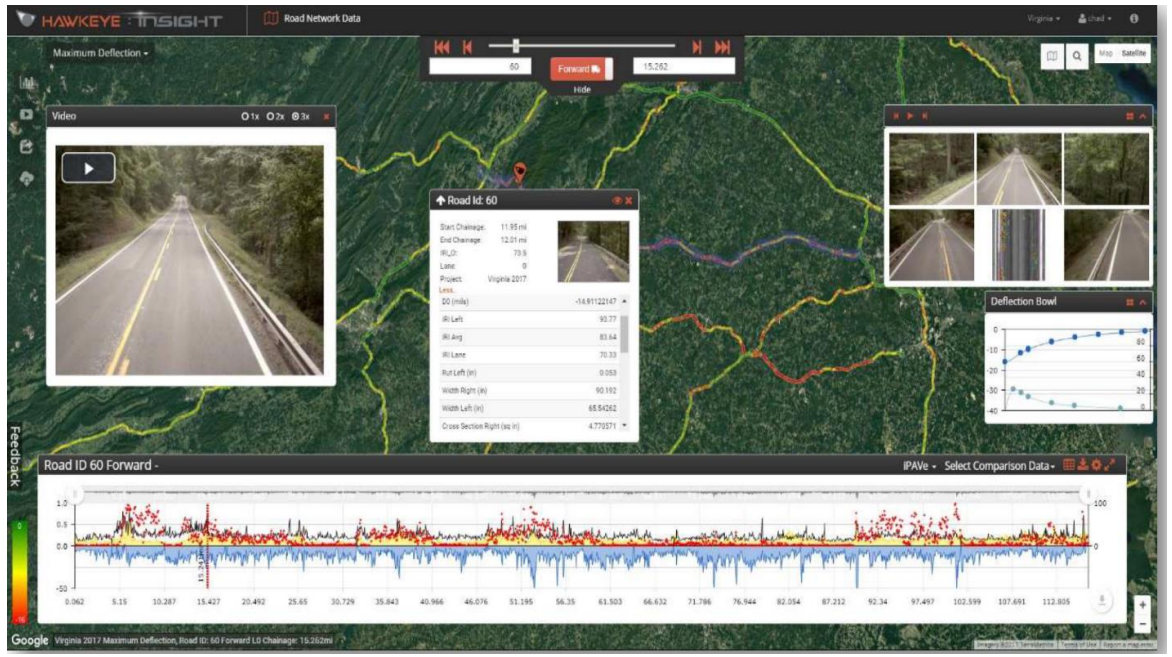
Demonstration of Network Level Pavement Structural Evaluation with Traffic Speed Deflectometer

Transportation Pooled Fund Study TPF-5(385)

Objective: Providing participating agencies guidelines on how to specify collection and **use data collected with TSDDs for network- and project-level** (if feasible) pavement management applications.



http://www.pooledfund.org/Details/Study/637

Partners: AR, CA, CO, FHWA, GA, ID, IL, IN, KS, KY, LA, MI, MN, MO, MS, MT, NC, NM, NV, OK, PA, SC, TN, TX, VA, VT, WI

Research Team:

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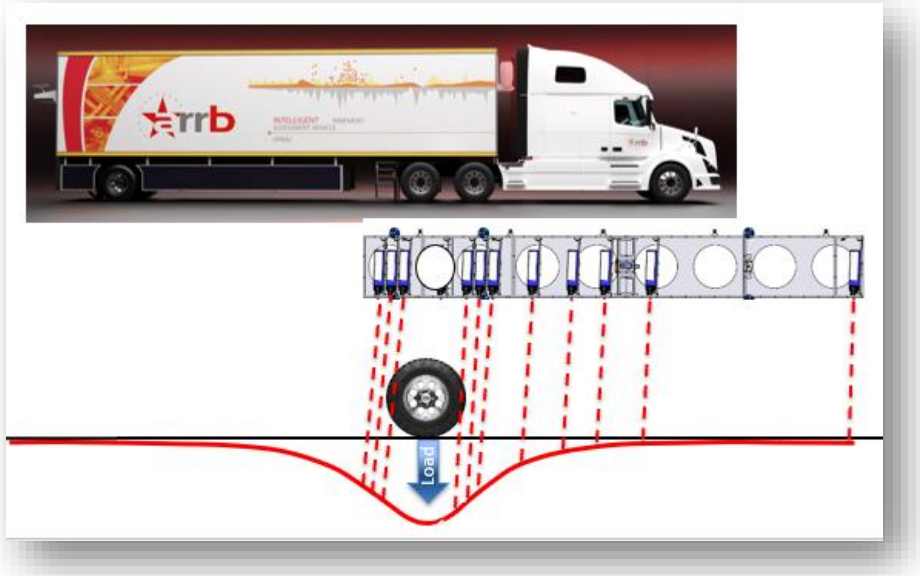

Applications

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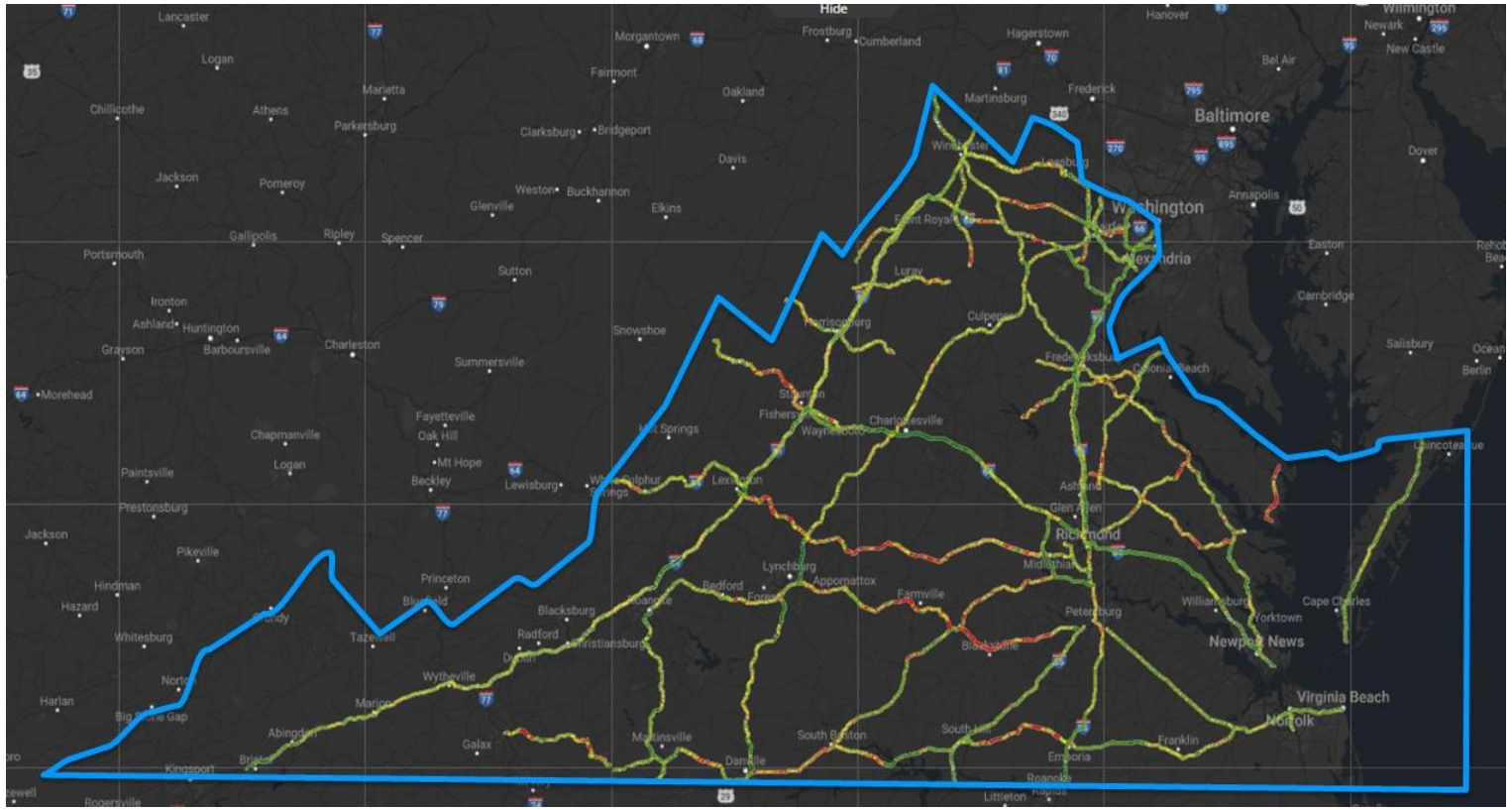
Example Applications/ Case Studies

- ✓ Network-level
  - Virginia DOT
- ✓ Project Level
  - Mississippi DOT
- ✓ Other case studies available from pooled fund (but not covered).
  - Idaho DOT
  - FHWA Eastern Federal Lands
  - Wisconsin DOT

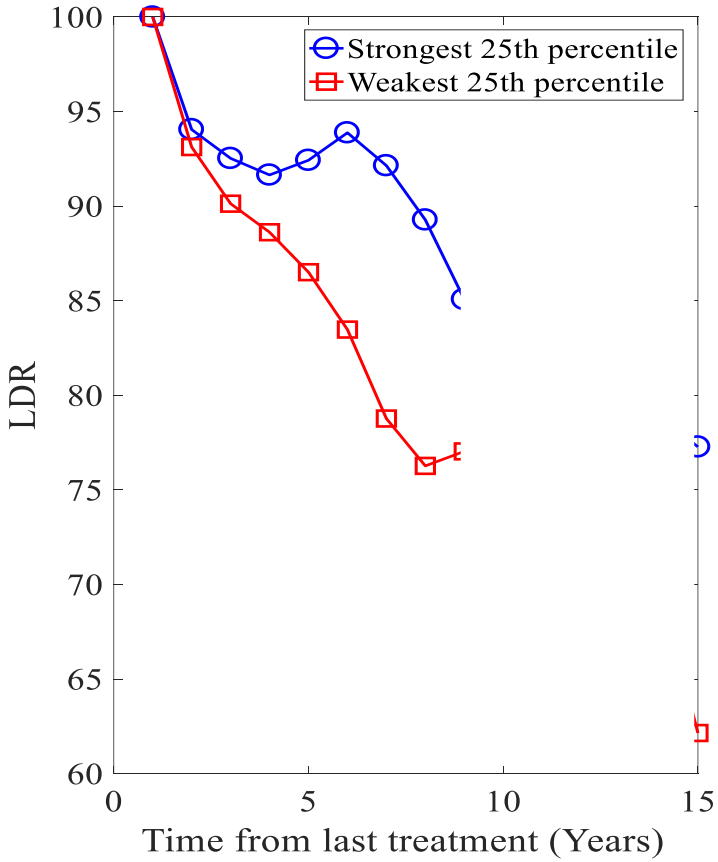
✓ Although we still have a few technical questions

→ The main question for widespread implementation is a business case: **What is the return on the investment in traffic-speed structural capacity data collection**

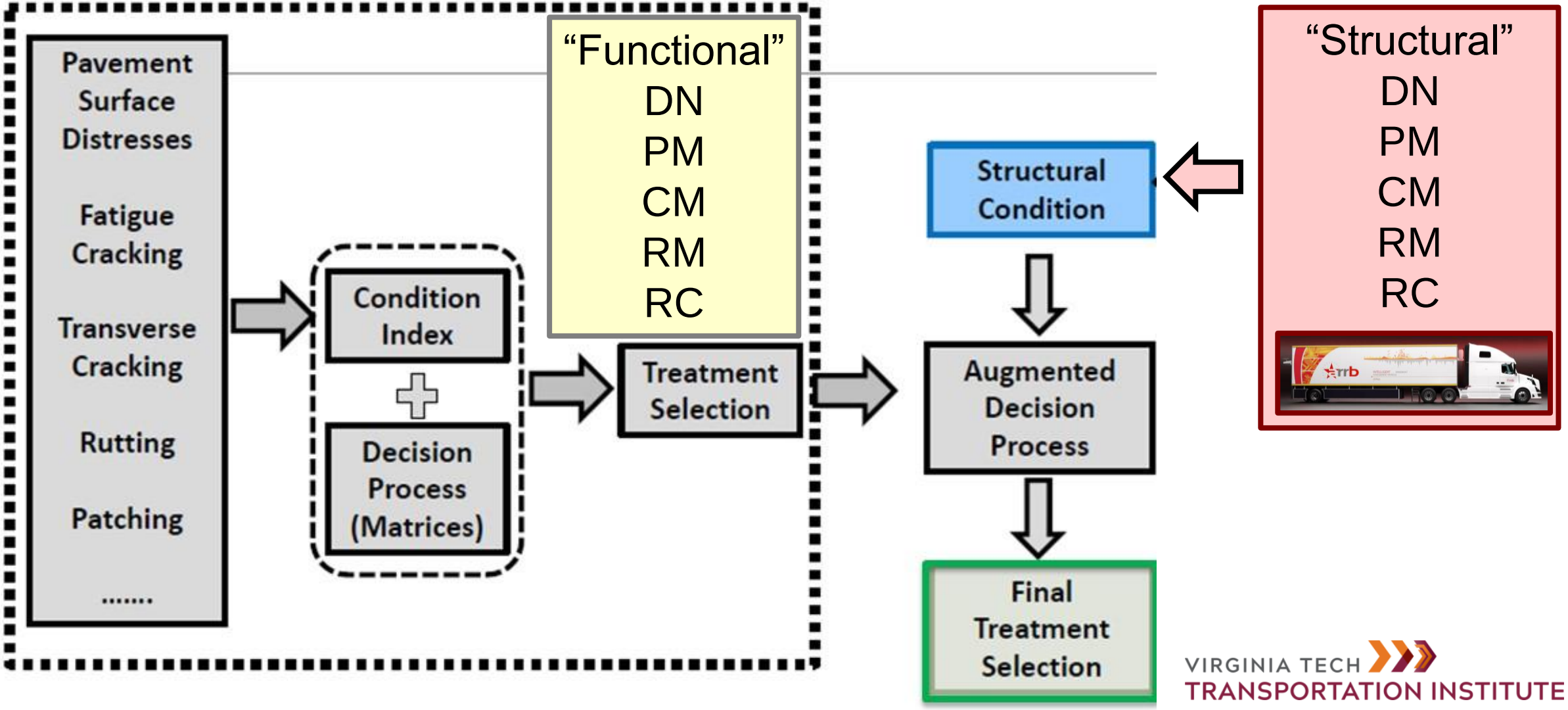
Virginia Case Study - Motivation for Network Structural Assessment



SCI_{300} and Deterioration



Structural Data Use by VDOT



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Approach

- ✓ AASHTO method for SNeff and Mr → $SN_{eff} = 0.0045 H_p \sqrt[3]{E_p}$
- ✓ RSSL using AASHTO design equation → ESALs = f(SN)
- ✓ Convert RSSL to treatment category (similar to functional):

Structural Based Treatment	Remaining Structural Life
DN: Do Nothing	>20
PM: Preventive Maintenance	20 – 12
CM: Corrective Maintenance	12 – 8
RM: Restorative Maintenance	8 – 3
RC: Reconstruction	<3

Combine Structural and Surface Decision Matrices

	Treatments																									
Func.	DN					PM					CM					RM					RC					
Struct.	DN	PM	CM	RM	RC	DN	PM	CM	RM	RC	DN	PM	CM	RM	RC	DN	PM	CM	RM	RC	DN	PM	CM	RM	RC	
Final	DN	DN	DN	DN	DN	PM	PM	PMDN*	DN	DN	PM/CM	PM/CM	CM	RM	RC	CM	CM	CM	RM	RC	CM	CM	RM	RM/RC	RC	

- ✓ Cost of surface condition only: $175 mil.
- ✓ Enhanced (surf. condition + traffic and age): $194.4 mil.
- ✓ Surf. condition + structural condition: $130.9 mil. **(25% reduction)**
  - Caveat: some treatments are deferred to the future

→ **LCCA**

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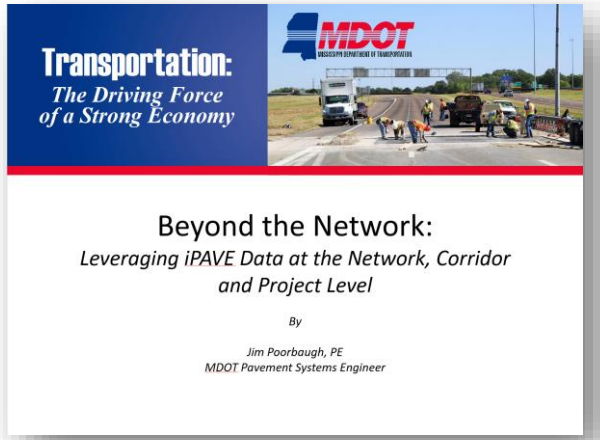
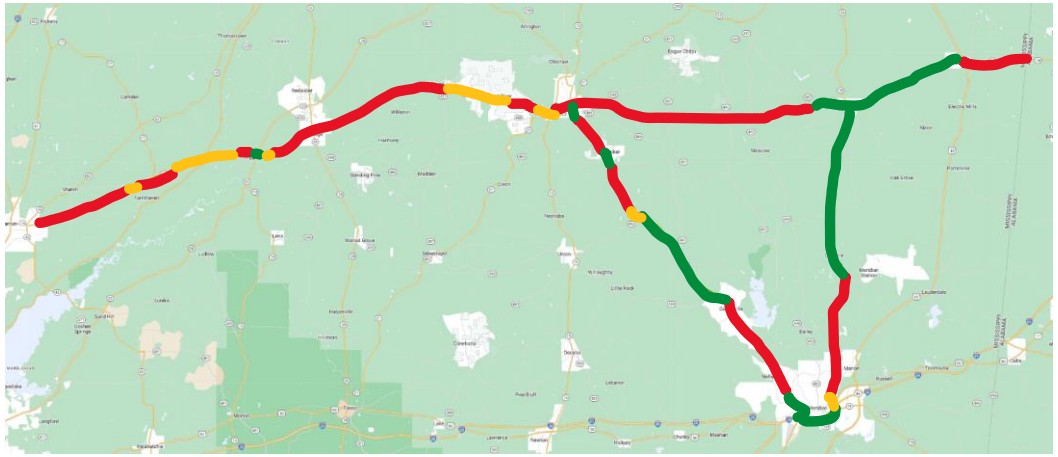
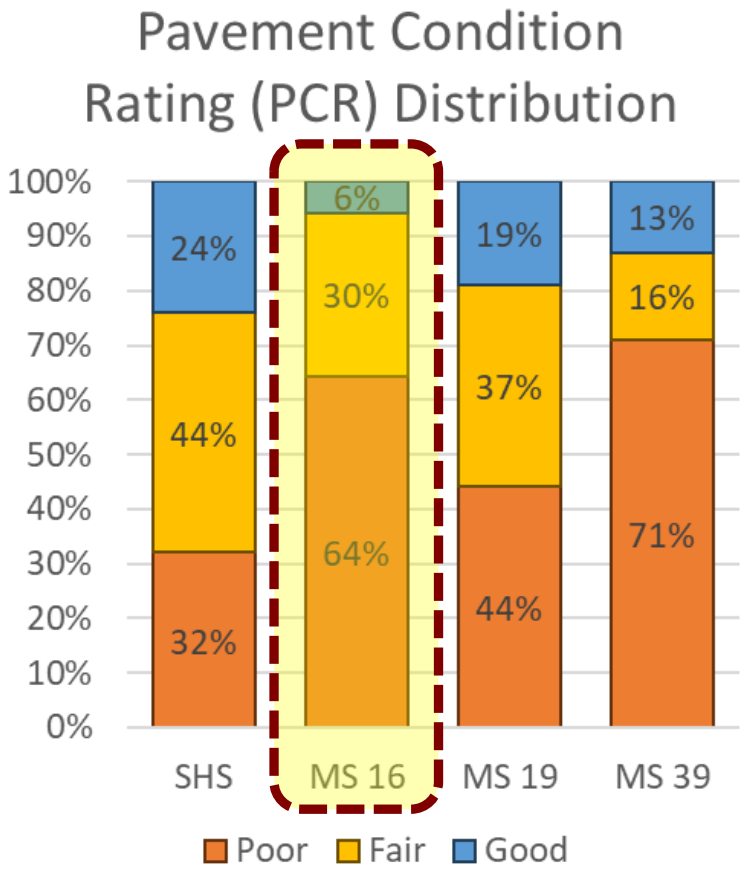
Mississippi DOT Case Study – Mississippi Triangle

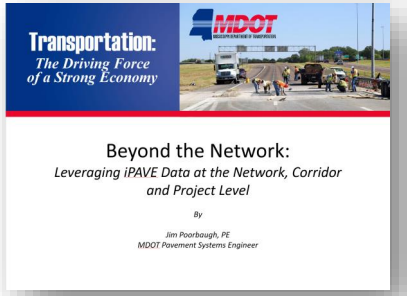


Quick Stats	MS16	MS19	MS39	SHS
Total Lane Miles	349	265	127	28,065
Ave PCR Ranking out of 341	243	200	221	-
% SHS LM	1.24%	0.94%	0.45%	-
% SHS Poor LM	2.5%	1.3%	1.0%	-
Ave Corridor PCR	70	72	71	76
Average IRI	130	106	140	110
Average Rut	0.13	0.11	0.08	0.10
Average % Cracking	23	23	18	16

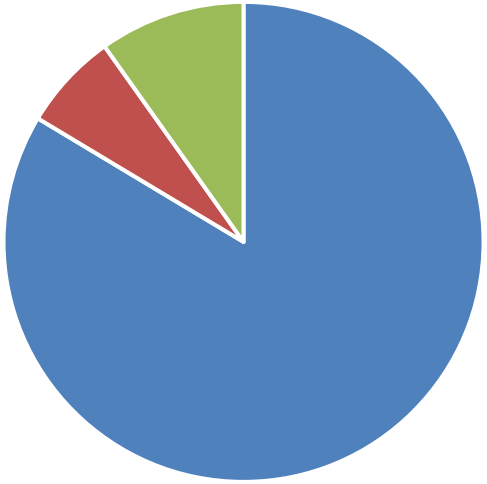




PMS vs iPAVE

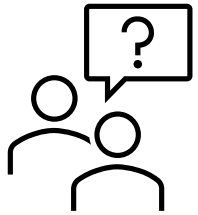


M16 PMS Recommendation



Major Minor Resurfacing - Thin

Estimated Cost: $61 million

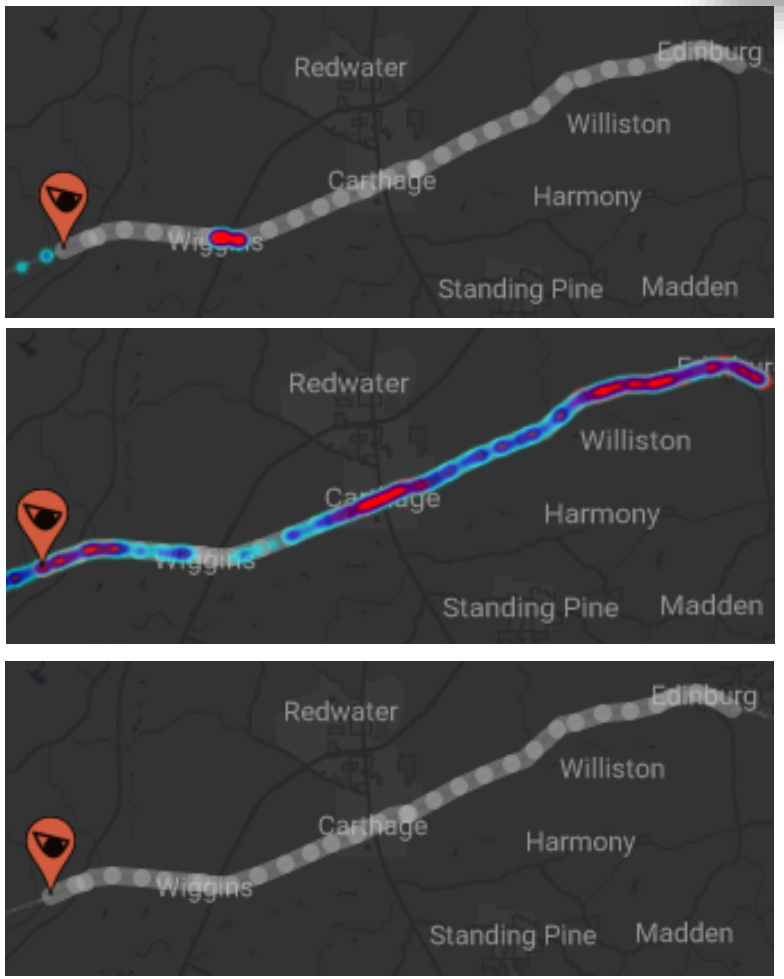


Good: PM

Bad: Resurface or Minor

Ugly: Major

iPave Filters



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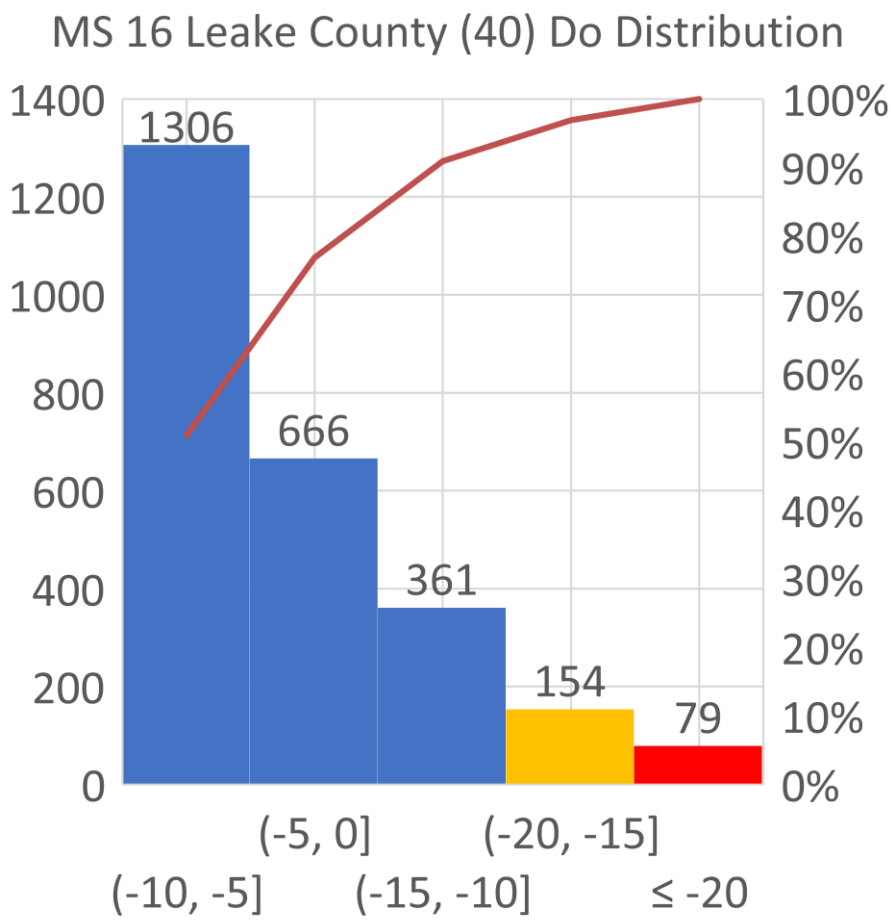
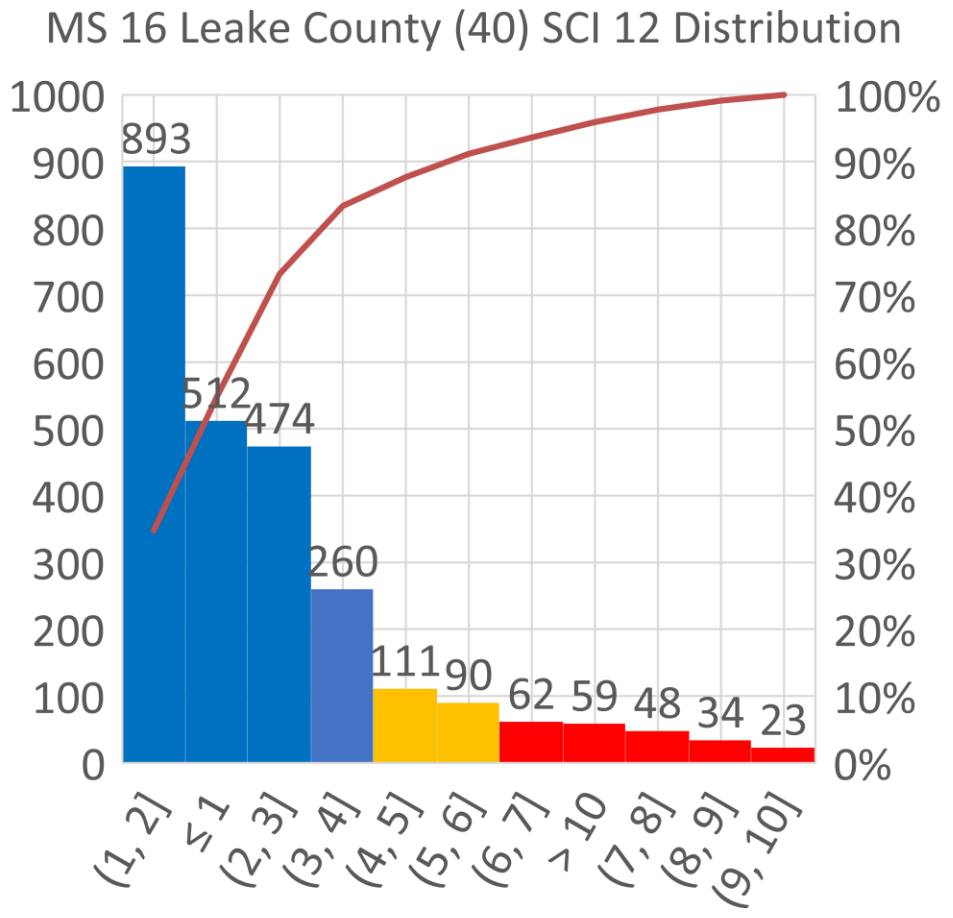
Distribution of Structural Measures





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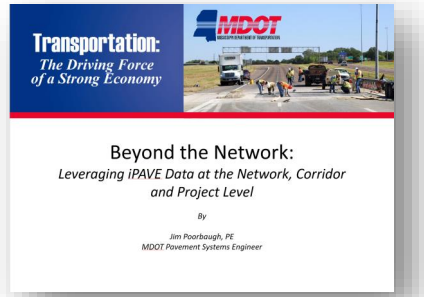
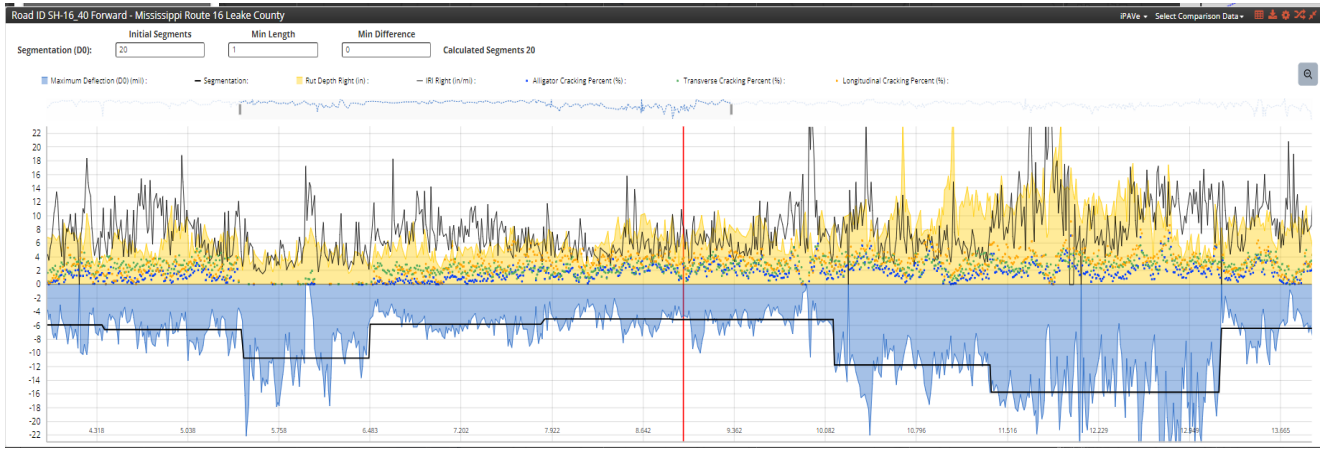
Segmentation and Core Locations



Hawkeye Segmentation tool is very useful for corridor project planning!



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	Statio	Lat	Long	(lbs)	W1	W2	W3	W4	W5	W6	W7	SURF(E	BASE(E	SUBB(E	SUBG(E	ERR/Sens	Bedroc	High Error in Back C	Sub Grade Mod too High	Subbase Modulus too hig	Base too High	AC Modulus too hig	Not used in Modulus calcs
2	14.043	32.6236	-89.9542	9,140	4.4	3.7	2.9	1.9	1.3	0.9	0.6	1040	1105.3	15.4	52.7	12.16	82.6 *					x	1040
3	14.053	32.6237	-89.9541	9,011	3.8	3.1	2.4	1.5	1	0.6	0.4	1040	1123.4	15.4	72.3	13.52	69.5 *					x	1040
4	14.113	32.624	-89.9531	9,246	4.7	3.9	3	2	1.4	0.9	0.6	1040	669.8	38.7	41.3	9.52	76.9 *					x	1040
5	14.233	32.6246	-89.9512	9,283	3.6	3	2.4	1.7	1.2	0.8	0.5	1040	1780.4	150	47.7	7.51	71.6 *			x	x	x	1040
6	14.243	32.6247	-89.951	9,129	4.1	3.5	2.8	2	1.5	1	0.7	1040	2000	15.4	51.1	13.68	78.8 *				x	x	1040
7	14.253	32.6247	-89.9509	9,130	4.3	3.6	2.8	1.9	1.4	1	0.7	1040	2000	10	50.7	9.08	87.1 *				x		1040
8	14.303	32.625	-89.9501	9,354	2.6	2.1	1.6	1.1	0.8	0.6	0.4	1040	1987.5	23.7	117.8	25.72	71.5 *	x			x		1040
9	14.323	32.6251	-89.9497	9,251	2.6	2.3	1.8	1.2	0.9	0.6	0.4	1040	2000	150	66.9	9.69	74.3 *		x	x	x		1040
10	14.356	32.7708	-89.0837	9,152	1	4.4	7.5	2.7	0.9	0.4	0.3	0.2	340	100	10	65.3	43.24	41.2 *	x					340
11	14.366	32.7707	-89.0835	9,458	1	5.6	8.6	3.7	1.7	1	0.6	0.4	340	100	10	40.2	24.79	52.0 *	x					340
12	14.466	32.7706	-89.0818	9,347	1	7.8	12.1	6.8	3.5	2	1.2	0.7	340	100	10	21.1	21.4	65.6 *	x					340
13	14.566	32.7706	-89.0801	9,588	7.3	5.6	4.1	2.8	2	1.4	0.9	1040	393.1	24.4	30.9	4.65	81.4 *						1040
14	14.616	32.7705	-89.0792	9,553	1	9.4	13.6	8.4	4.5	2.5	1.5	0.9	340	100	10	17.6	20.26	72.2 *	x					340
15	14.706	32.7704	-89.0777	9,487	1	1.5	8.4	5.1	2.5	1.3	0.7	0.4	517.4	100	10	34.7	20.64	60.4 *	x					517.4

- Where to take cores?
- Converted iPAVE data to use Modulus 7
- Excluded A LOT of points

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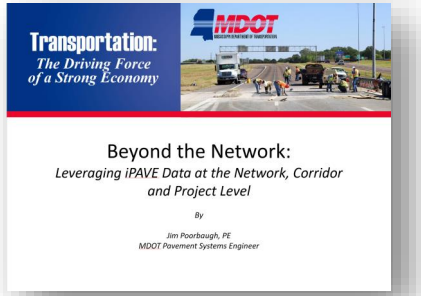
Mississippi Case Study Conclusions



Changed construction scope:

- ✓ Initially planned as “Major” (i.e.,Full Depth Reclamation)
- ✓ Estimate $61 mill from PMS
- ✓ Structural Numbers indicate that “Minor” is appropriate
- ✓ Estimate $10-15 million for Construction.
- ✓ **75% reduction is cost.**
- ✓ Grant received as part of the FHWA Climate Challenge
- ✓ Cold In Place Recycling.

CLIMATE CHALLENGE

Source: Jim Poorbaugh

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Invitation: Third Symposium on Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)

→ Spring/ Summer 2024

→ Location TBD (maybe Washington DC)

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Conclusions

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Conclusions

- ✓ The technology is **mature for network-level pavement management**
  - – Accuracy and precision is adequate
  - – Useful information to make better (more cost-effective) decisions
- ✓ It looks **very promising for project/ corridor analysis**
  - – May need better calibration/ verification/ QA
  - – Device specific analysis methods may produce even better results
- ✓ We can make a strong business case for collecting structural condition at the network, corridor, and project level showing **very high returns on investment**

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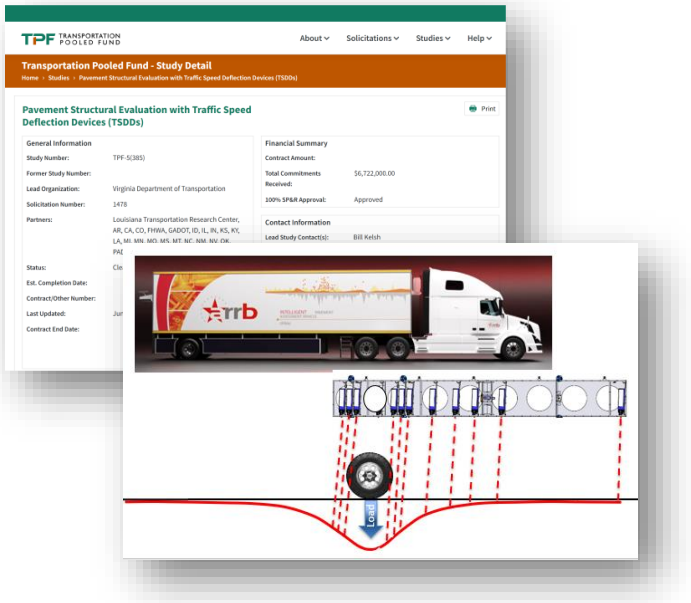

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