

TRANSPORTATION RESEARCH BOARD

Paving the Way to Successful AASHTOWare Pavement ME Implementation

April 26, 2021

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hour (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Reggie Gillum at RGillum@nas.edu

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REGISTERED CONTINUING EDUCATION PROGRAM

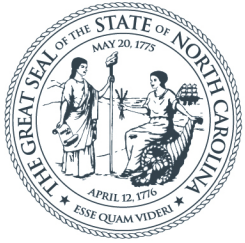
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Learning Objectives

1. Identify critical resources needed for MEPDG implementation
2. Identify the non-technical important features for MEPDG implementation
3. Anticipate challenges to MEPDG implementation

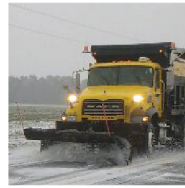
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NORTH CAROLINA

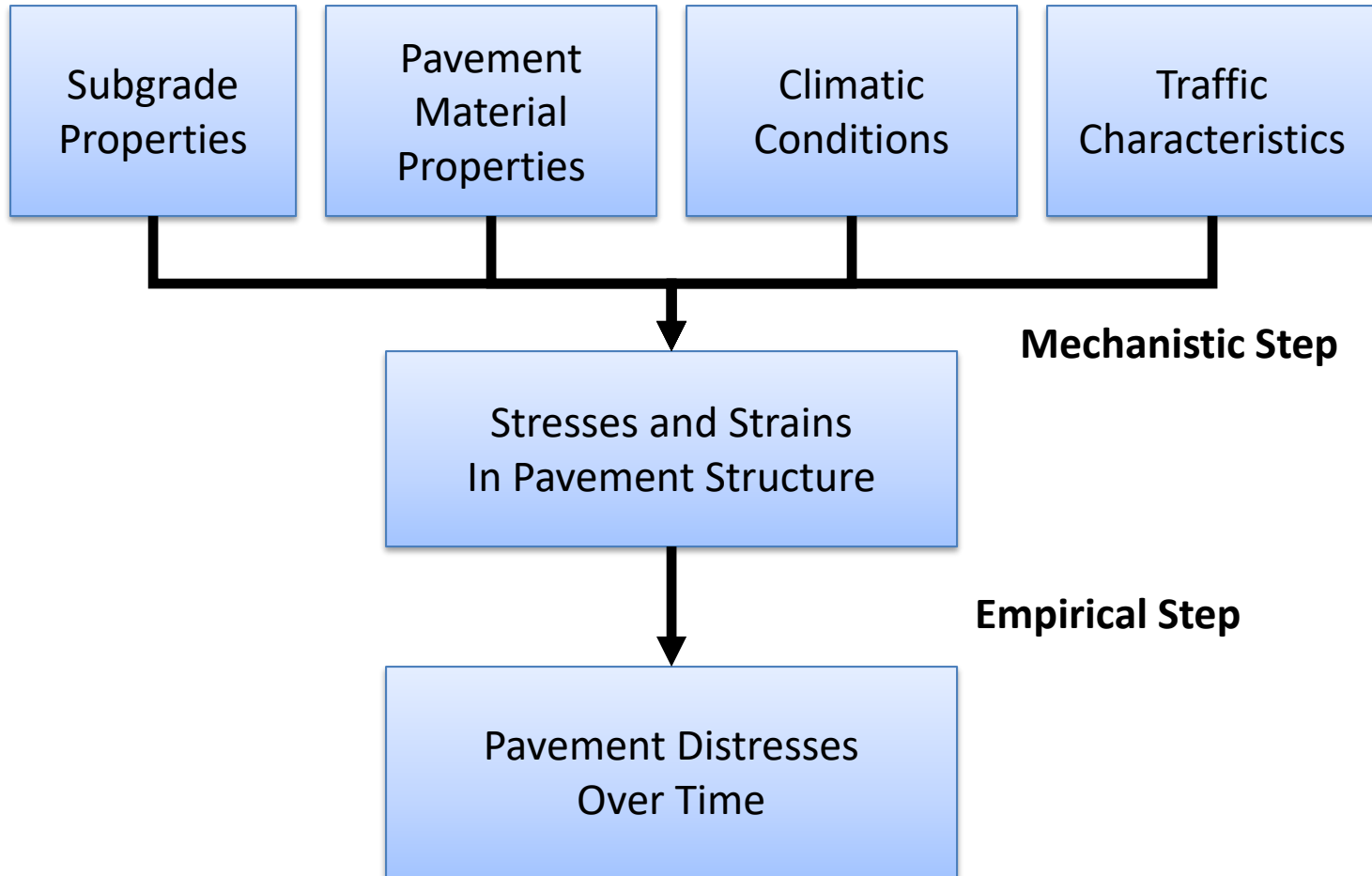
Department of Transportation



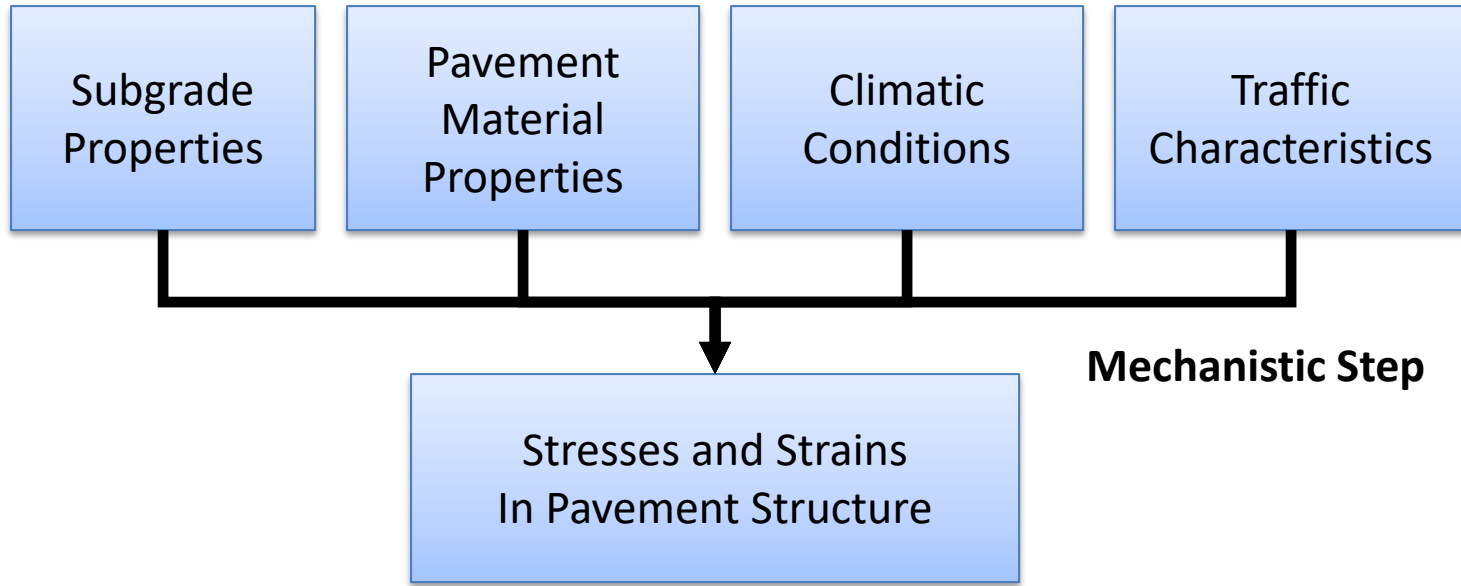
MEPDG Background

Clark S. Morrison, PE
December 8, 2021

MEPDG

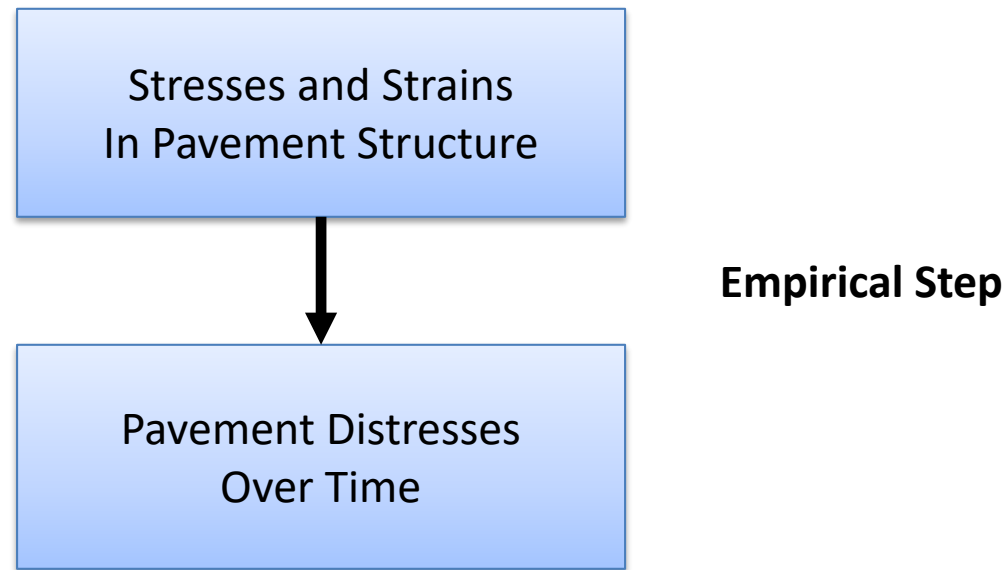


Mechanistic Step Challenge:



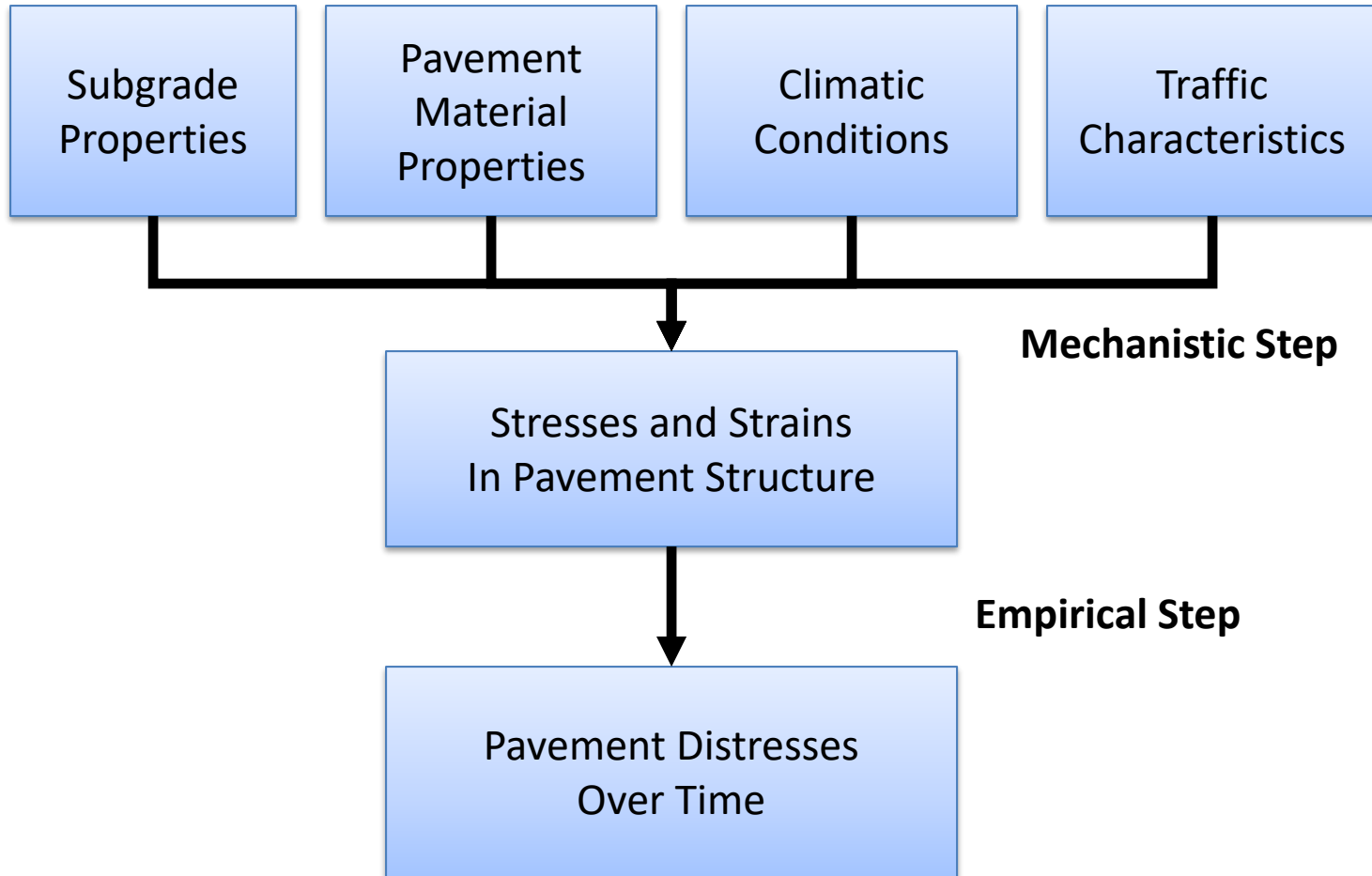
Data Gathering

Empirical Step Challenges:



**More Data Gathering
Calibration**

MEPDG



Clark Morrison, P.E.

NCDOT

State Pavement Design Engineer

cmorrison@ncdot.gov

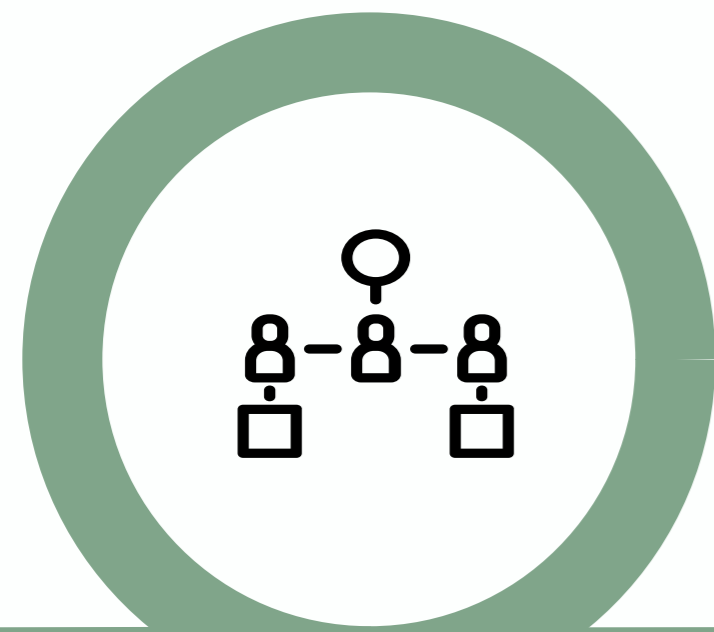
MEPDG in Indiana, 11 Years After Adoption

Tommy E. Nantung PhD PE

Division of Research and Development
Indiana Department of Transportation

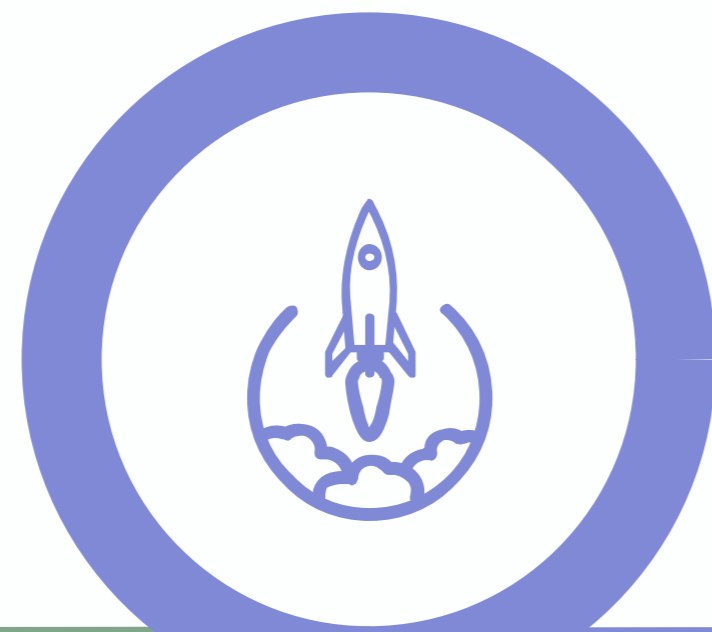
Roadmap to Presentation

From initiatives to analysis to preparation to implementation



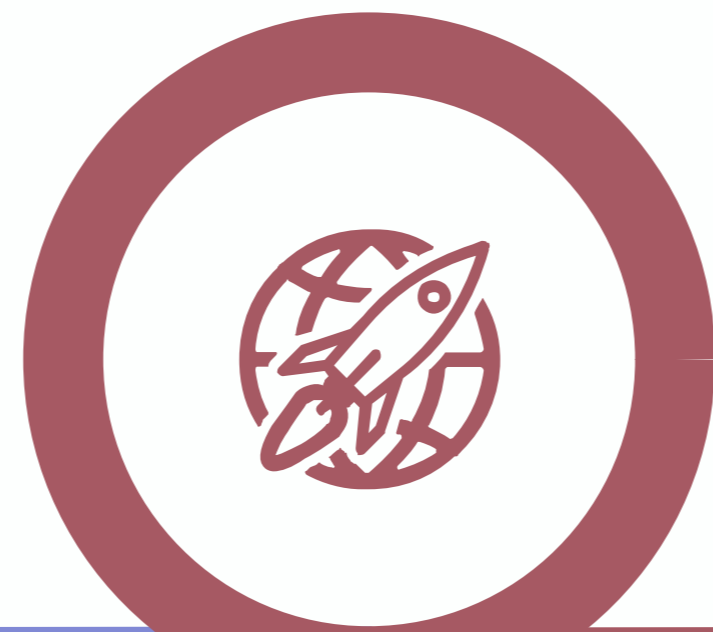
Initiatives

Pavement 2000, Newport, Rhode Island.



Resource

Readiness of the resources and facilities



Preparation

Organize and create inputs for design



Validation

Validation of the performance models.



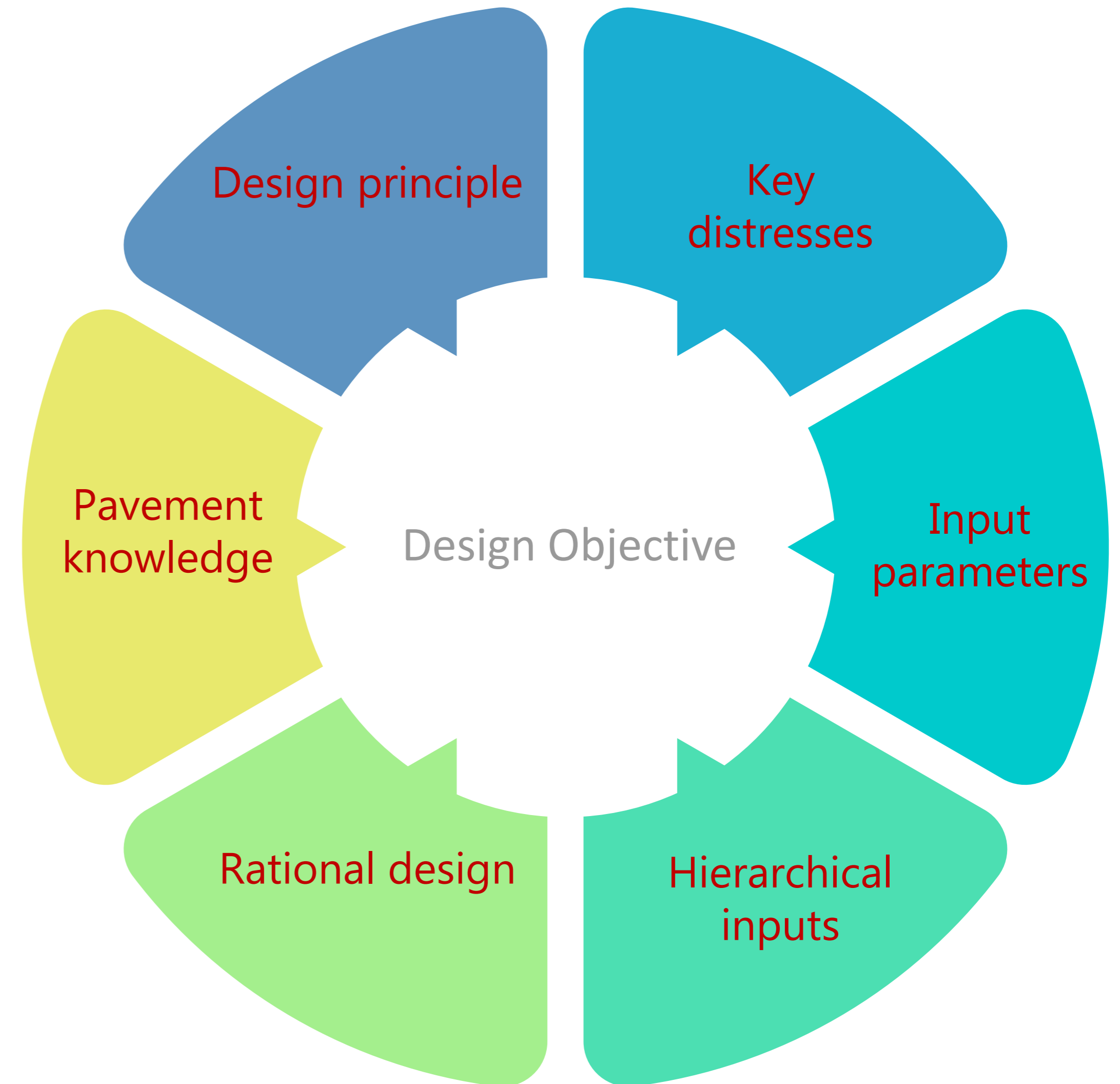
Implementation

Implementation to projects, Nov 2009.

MEPDG Design Concept

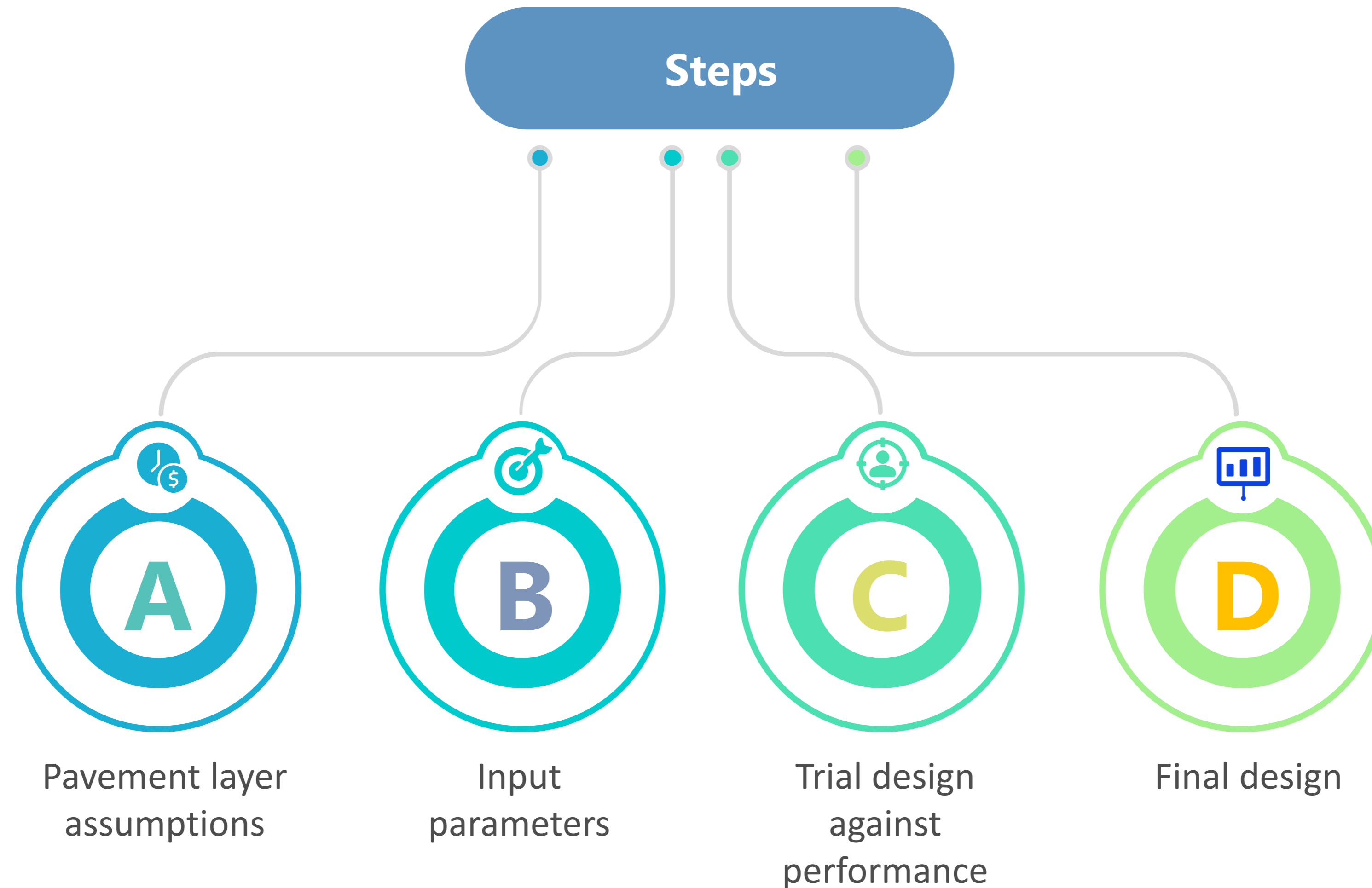
M-E Design Guides, a new paradigm

- Totally new design concept, may not be easily understood.
- Based on key distresses and pavement performance
- A large numbers of design input parameters
- Hierarchical design inputs, inputs are inter-related
- Based on rational design inputs of the pavement layers
- A thorough knowledge of pavement and pavement performance is crucial



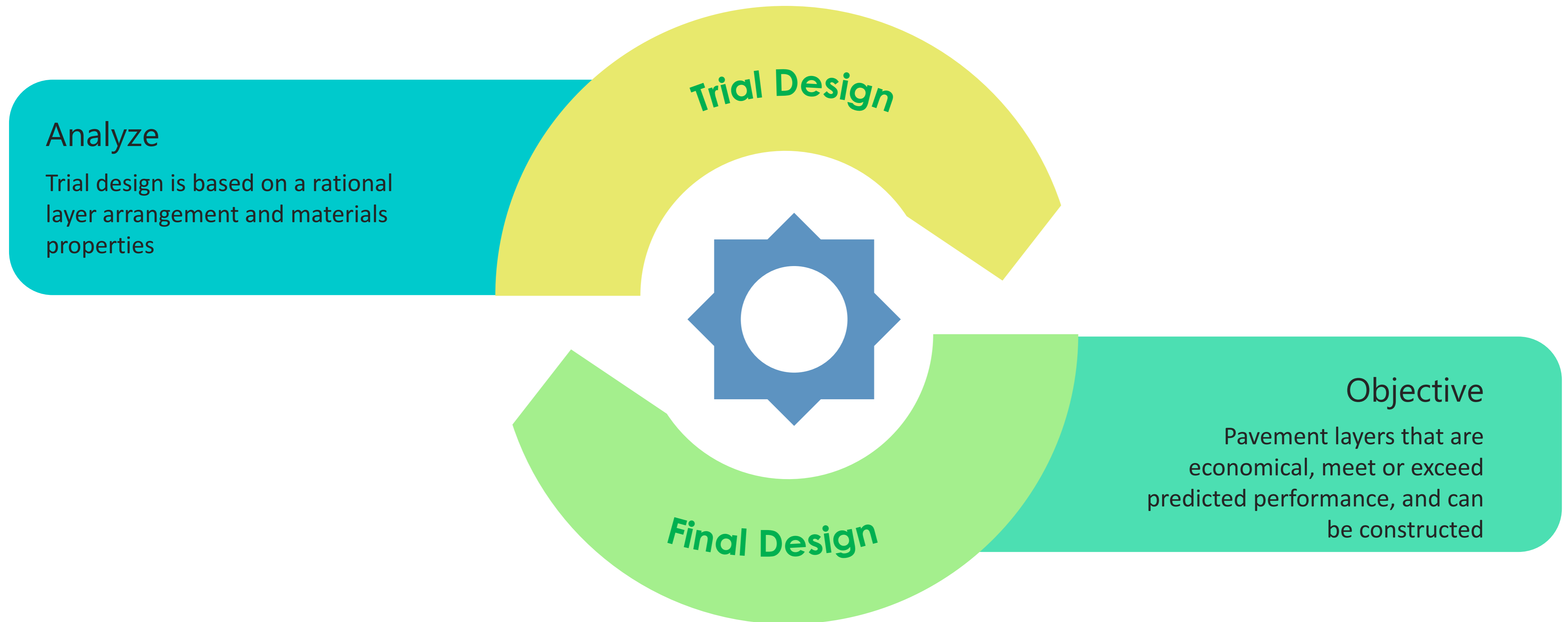
Design Steps

Design steps are very crucial to achieve the design objective, the process begins with a rational pavement layer assumptions and design input parameters.



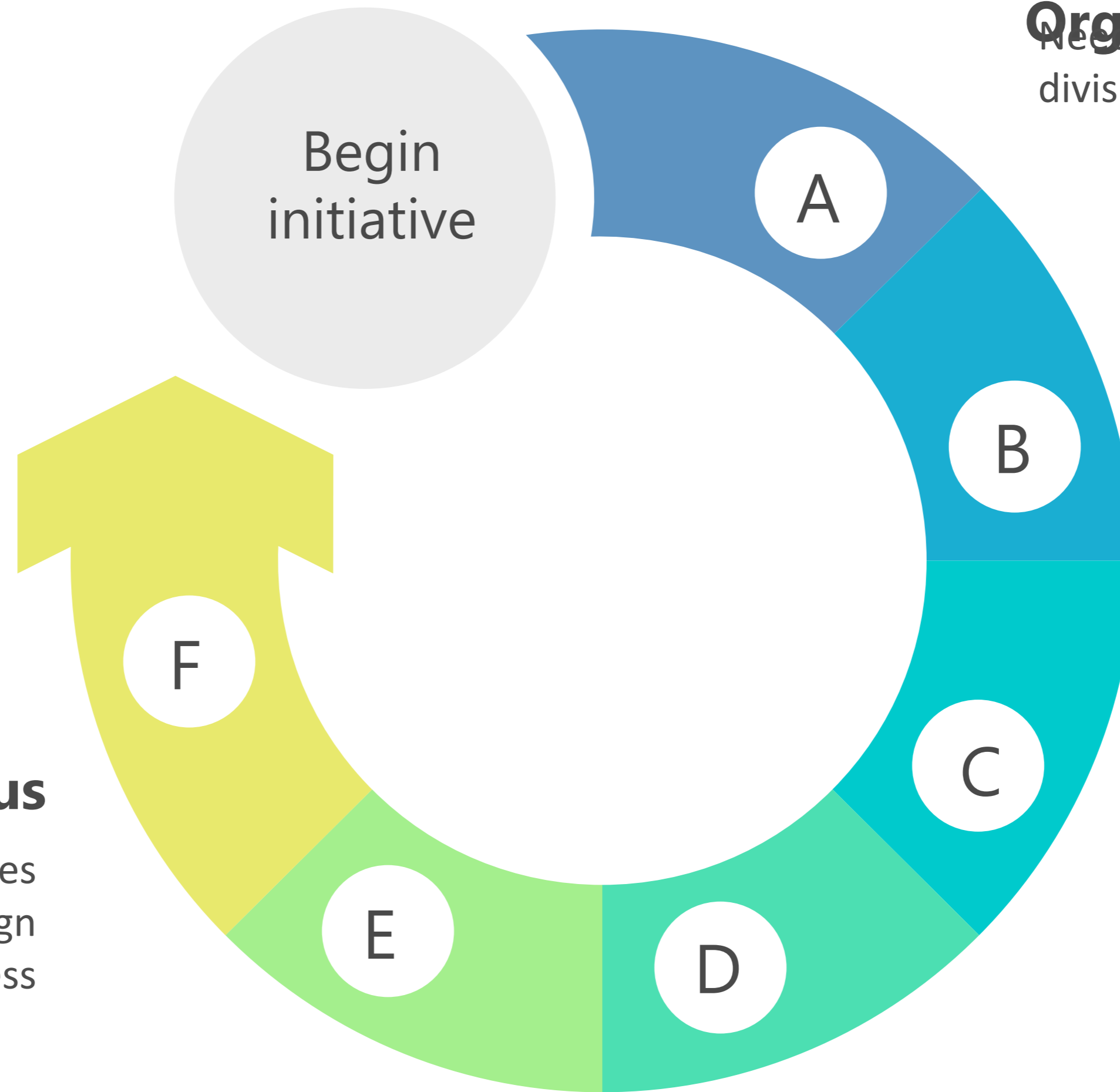
Design Process

The concept is to test the pavement layers against a set of pavement performance parameters.



Resources and Commitment

Resources and commitment are very important for the Department to buy-in.



Know the State DOT Organization

Need coordination with many divisions and offices

Commitment from upper management

There are people who have a significant number of followers in every business

Teamwork

Teamwork is important to achieve better input parameters and design

Focus

Focus on the State design practices to initially adopt the new design process

Level the playing field

Level the playing field between the scoping, programming, design engineers and the design consultant

State of knowledge

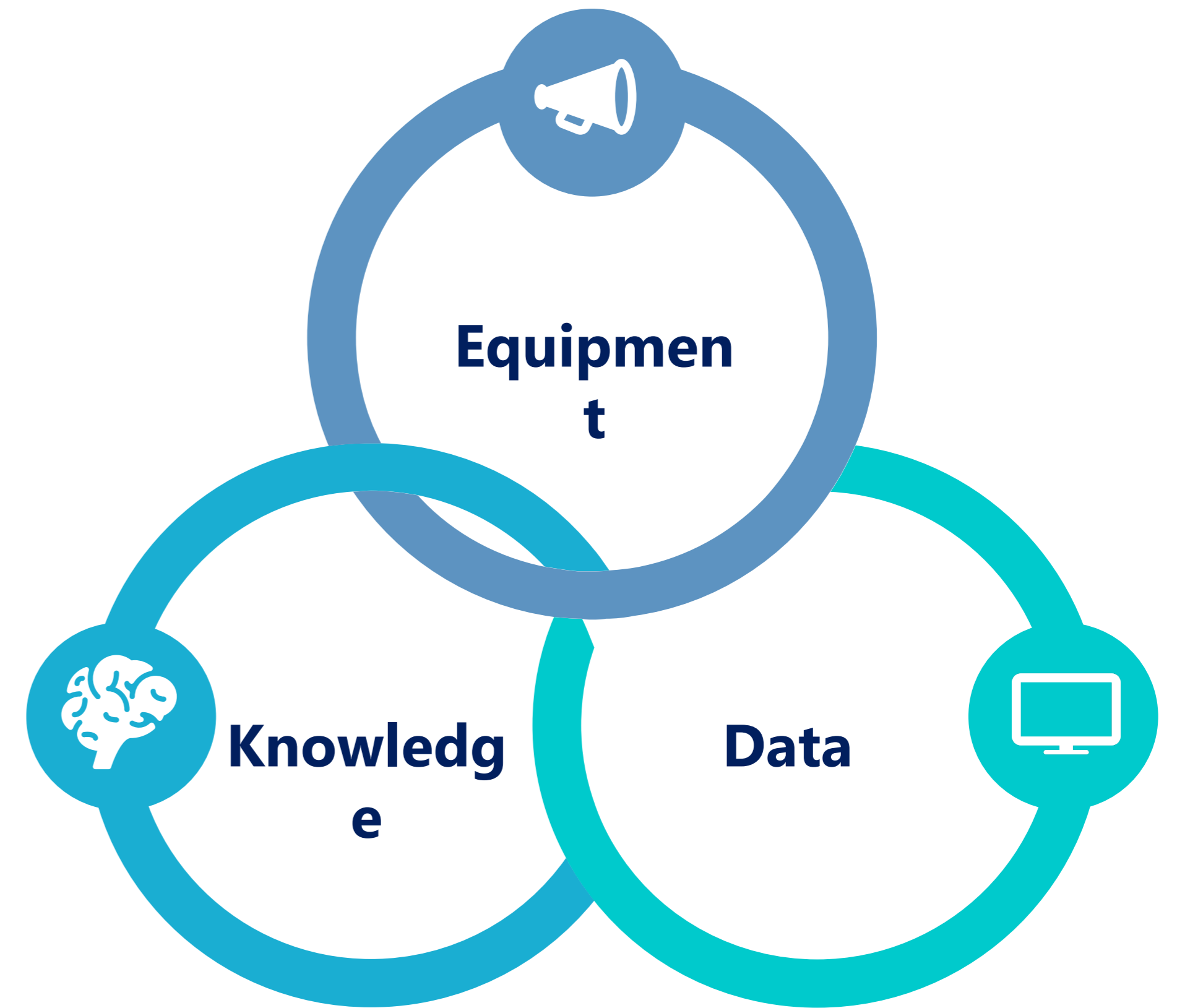
The state of knowledge in the Department is very crucial to the execution of the design process



Resource Evaluation

The capability of a Department to implement the new MEPDG design process depends on the readiness of the three important resources.

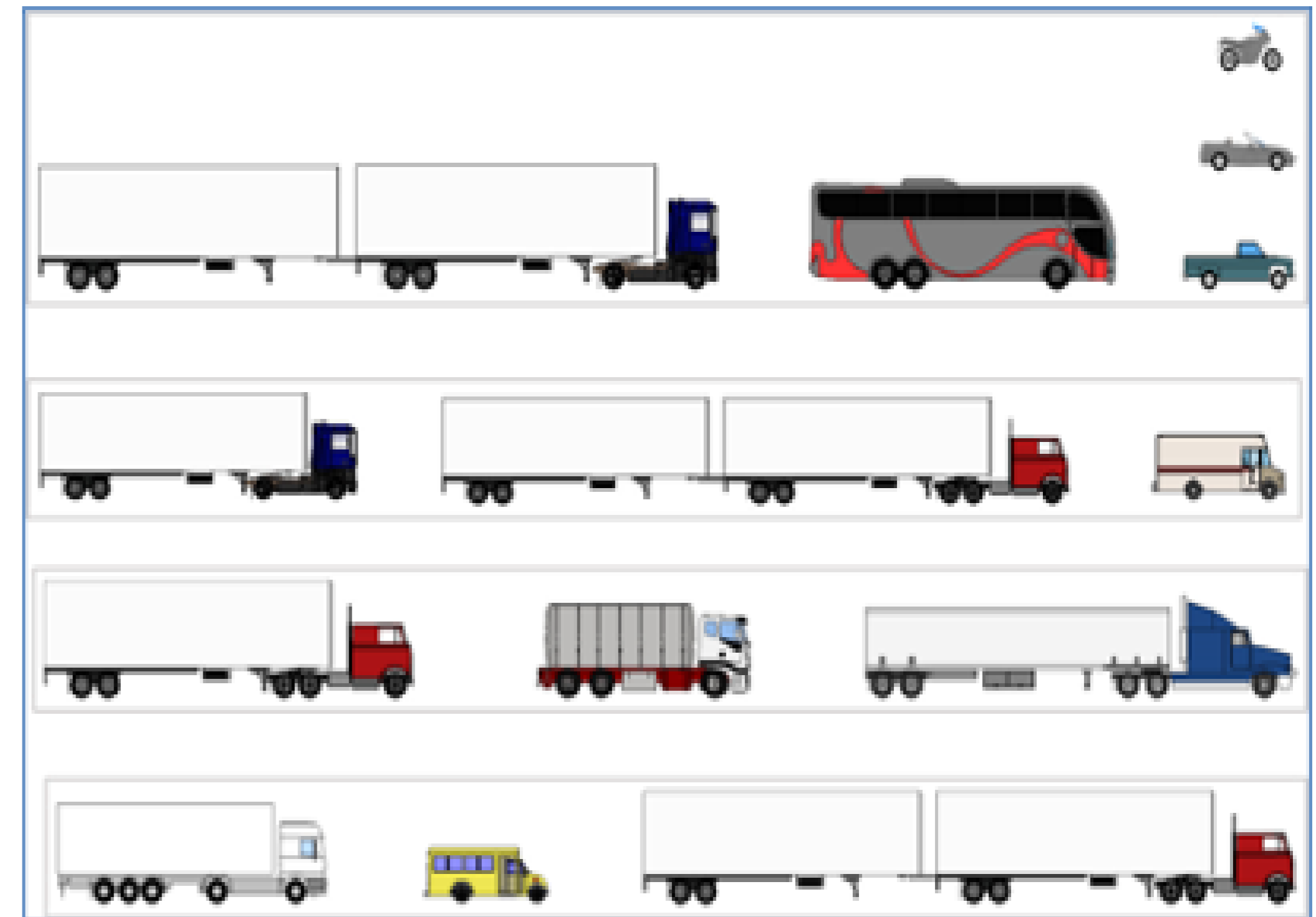
	Data	Equipment	Knowledge
Level 1	✗ Some might exist	✓	✓
Level 2	✗ Some might exist	✓	✓
Level 3	✓	✓	✓



Resource Evaluation

Traffic data inputs are the most sensitive to the design process. Therefore, very special concentration has to be developed to resolve issues with traffic. Traffic for transportation planning purposes is not similar to traffic for pavement design.

- Regional or Statewide default input values provide poor accuracy for medium- and high-volume roads
- Weigh-In-Motion (WIM) and Automatic Vehicle Classification (AVC) systems differ from vendor to vendor
- WIM and AVC raw data are usually encrypted
- WIM and AVC data are usually very large
- WIM and AVC sites are distributed Statewide, geographical and functional regions and segments are needed



Resource Evaluation

Coordination with other Divisions and Office are very crucial to understand the availability of the data on hand and data that each particular Division/Office must provide. Some are not in a very specific level.

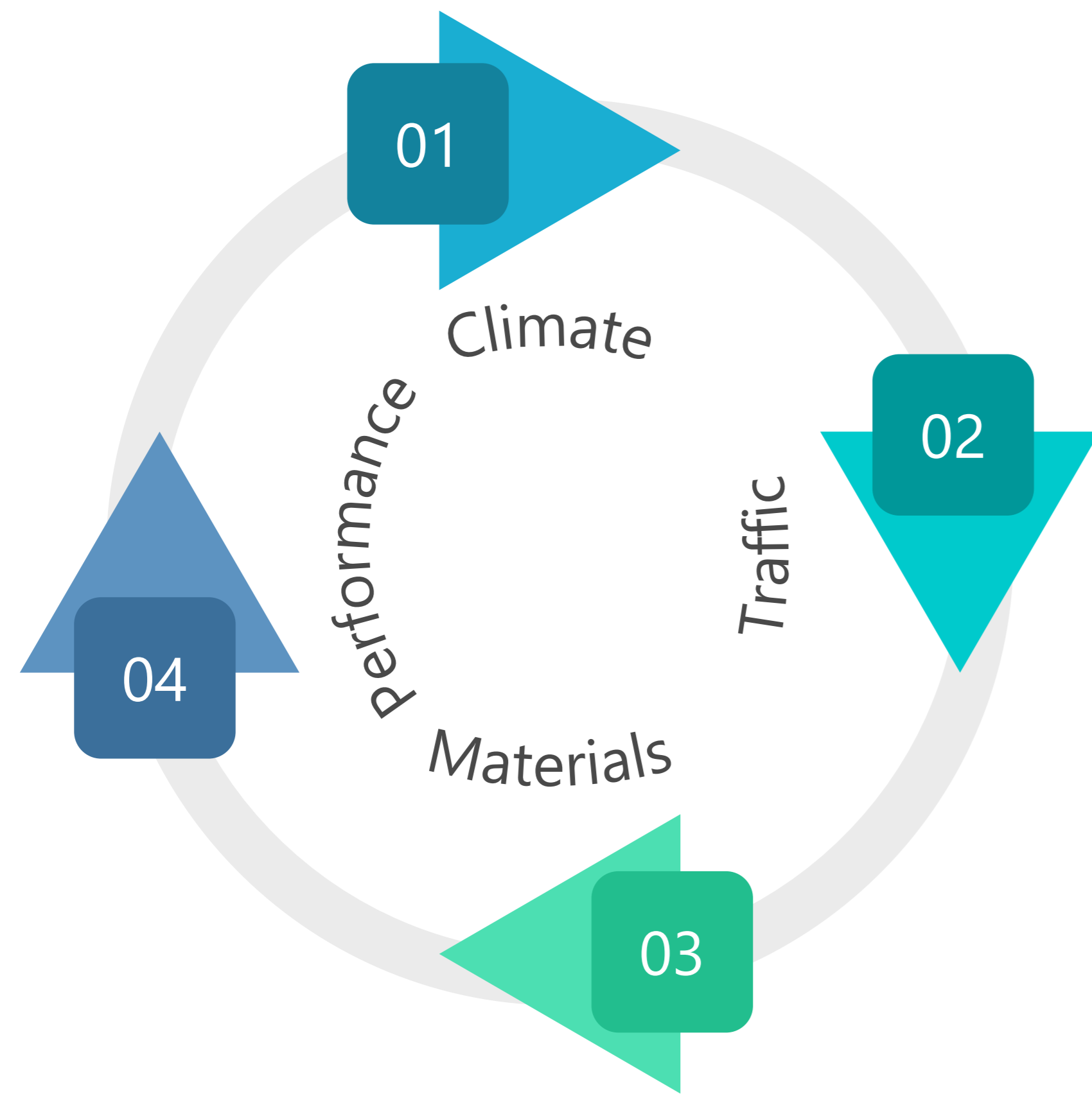
Flex	Data AC - Mix	Equipment	Knowledge
Level 1	✓ x	✓ 2 offices	✓
Level 2	✓ ✓	✓ 2 offices	✓
Level 3	Default	N/A	✓

Rigid	Data	Equipment	Knowledge
Level 1	Design built	✓ 2 offices	✓
Level 2	Conversion	✓ 2 offices	✓
Level 3	Default	✓	✓

Soil	Data	Equipment	Knowledge
Level 1	Specific soil boring	✓ 2 offices	✓
Level 2	Soil mapping	✓ 2 offices	✓
Level 3	Default	✓	✓

Preparation

Balance of inputs must be reviewed carefully so one group will not dominate the sensitivity of the pavement performance.



01. Climate

Climate will trigger certain distresses

03. Materials

Some material properties are so sensitive to the distresses

02. Traffic

Hourly traffic distribution can be sensitive to a certain pavement type

04. Performance and Reliability

Performance expectation cannot be too high to avoid unnecessary overdesign

Validation and Verification

Validation of the pavement performance prediction and verification of the outcomes of the design trials, along with the sensitivity of the design inputs, are the most important steps toward implementation.

Parameter	Roughness	Faulting	Percent Slabs Cracked
Level 3			
Modulus of Rupture	S	NS	VS
Compressive Strength	S	NS	VS
Level 2			
Compressive Strength	S	NS	VS
20-year/28-day Ratio	S	NS	VS
Level 1			
Modulus of Rupture	S	NS	VS
Modulus of Elasticity	S	NS	VS
20-year/28-day Ratio	S	NS	VS

Validation and Verification

Jointed Plain Concrete Pavement (JPCP)

Parameter	Roughness	Faulting	Percent Slabs Cracked
Permanent Curl/Warp Effective Temperature Difference	VS	VS	VS
Joint Spacing	VS	VS	VS
Dowel Bar Diameter	MS	MS	NS
Pavement Thickness	S	MS	VS
Poisson's Ratio	MS	MS	S
Coefficient of Thermal Expansion	VS	VS	VS
Thermal Conductivity	S	MS	VS

Validation and Verification

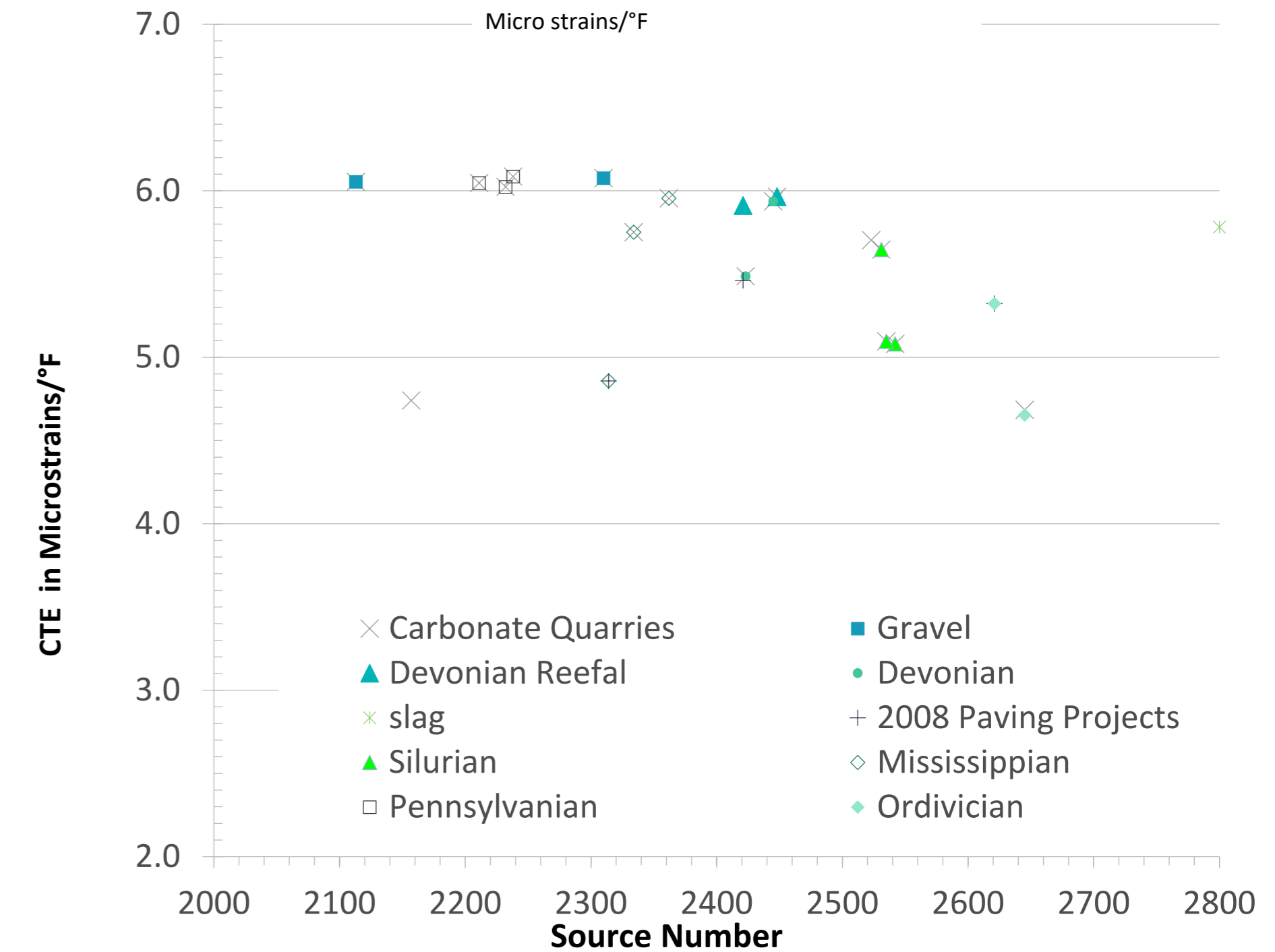
Hot-Mixed Asphalt (HMA) Pavement

Parameter	IRI	Alligator Cracking	Permanent Deformation	AC Thermal Fracture
AC Thickness	S	VS	S	VS
PG-Grade	NS	S	S	S
E*	NS	S	S	NS
Poisson's Ratio	NS	NS	NS	NS
Air voids (L1)	NS	S	NS	NS
Effective Binder Content (L1)	NS	NS	NS	NS
Surface Short Wave	S	NS	S	S
Average Tensile Strength	NS	NS	NS	S
D*	NS	NS	NS	VS
Coefficient of Thermal Contraction	NS	NS	NS	NS
Thermal Conductivity	NS	NS	NS	NS
Heat Capacity	NS	NS	S	VS

Validation and Verification

Finding the sensitive input parameters is the first task to resolve conservatism in the design

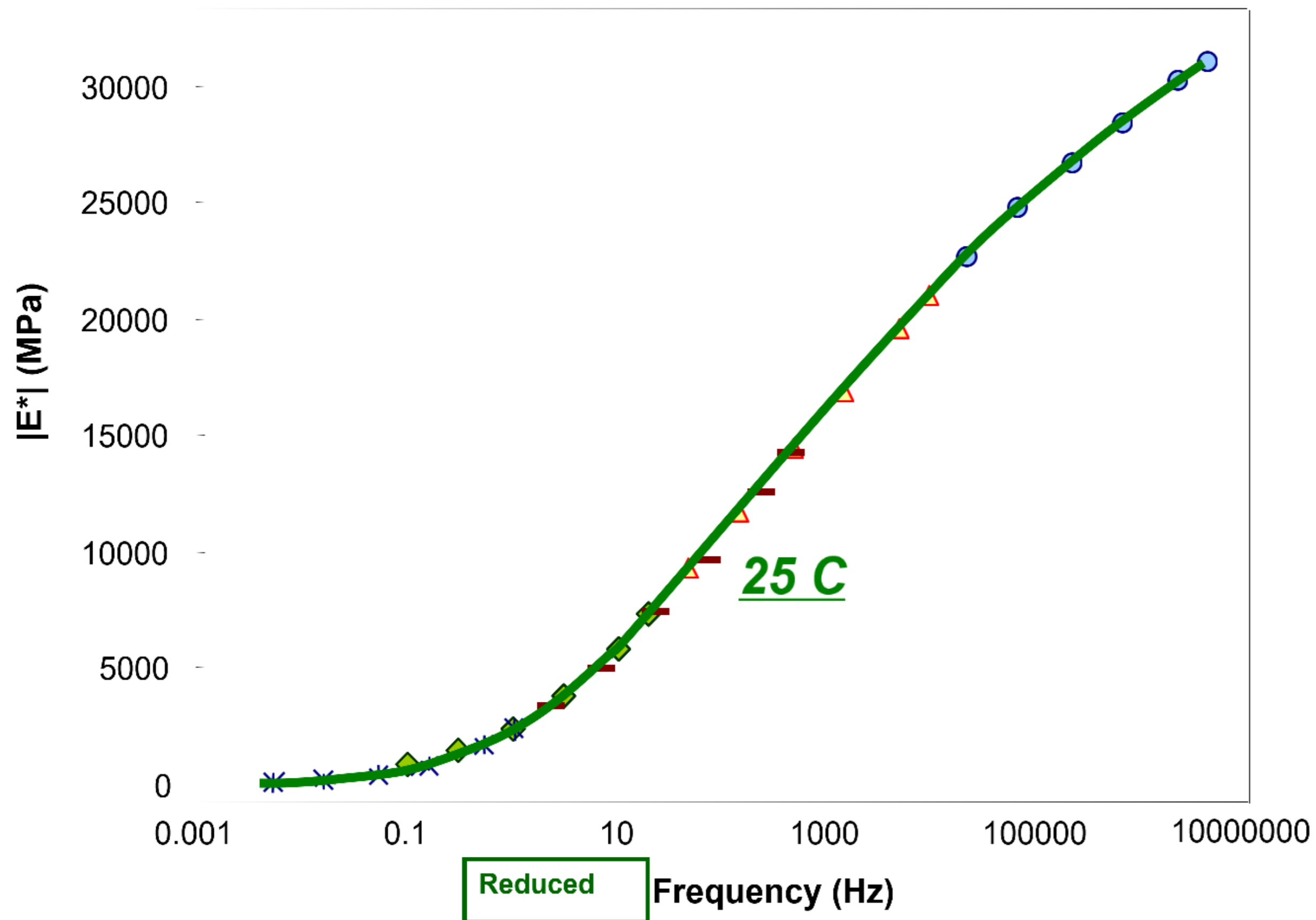
Source #	Micro strain/C° Max	Micro strains/°F	Aggregate Source		District
2645	8.354	4.653	Ordivician Period	Rogers Grp Mitchell,	Vincennes
2238	10.926	6.086	Raccoon Creek Grp - Pennsylvanian	Stone St. Poe,	Ft. Wayne,
2645	8.409	4.684	Ordivician Period	Rogers Grp Mitchell,	Vincennes
2157	8.511	4.740	????	MM Cloverdale	Crawfordsville
2542	9.121	5.080	Silurian	Sellersburg Stone	Seymour
2535	9.148	5.095	Silurian	Meshberger Columbus,	Seymour
2423	9.850	5.487	Devonian	Engr Aggregates Logansport,	LaPorte
2531	10.138	5.647	Bainbridge Grp - Silurian	Meshberger Flat Rock	Seymour
2523	10.239	5.703	Gravel	Rogers Group - Martinsville	Seymour
2334	10.326	5.752	Hardinsburg Fm, Stephensport Grp - Miss	Barrett Paving Richmond,	Greenfield
2445	10.659	5.937	Devonian	Rogers Group Kentland,	Crawfordsville - Meteor Impact site
2362	10.691	5.955	Sanders Grp - Mississippi	IMI Muncie	Greenfield
2448	10.708	5.965	Devonian- Reefal Fm	Heidleberg/Hanson Rensselear	
2232	10.815	6.024	Raccoon Creek Grp - Pennsylvanian	Lehigh-Hanson Ardmore	Ft. Wayne,
2211	10.857	6.047	McLeansboro Grp - Pennsylvanian	IMI Huntington,	Ft. Wayne,
2113	10.869	6.054	Gravel	S&G Excavating	Crawfordsville - Terra Haute
2310	10.909	6.076	Gravel	MM	Greenfield
2238	10.926	6.086	Raccoon Creek Grp - Pennsylvanian	Stone St. Poe,	Ft. Wayne,
2421	10.613	5.912	Devonian - Reefal Fm	Delphi	Crawfordsville
2421	9.807	5.462	Devonian - Reefal Fm	Delphi	Crawfordsville
2621	9.510	5.322	Ste Genevieve Fm - Ordivician		
2314	8.721	4.858	Mississippian		



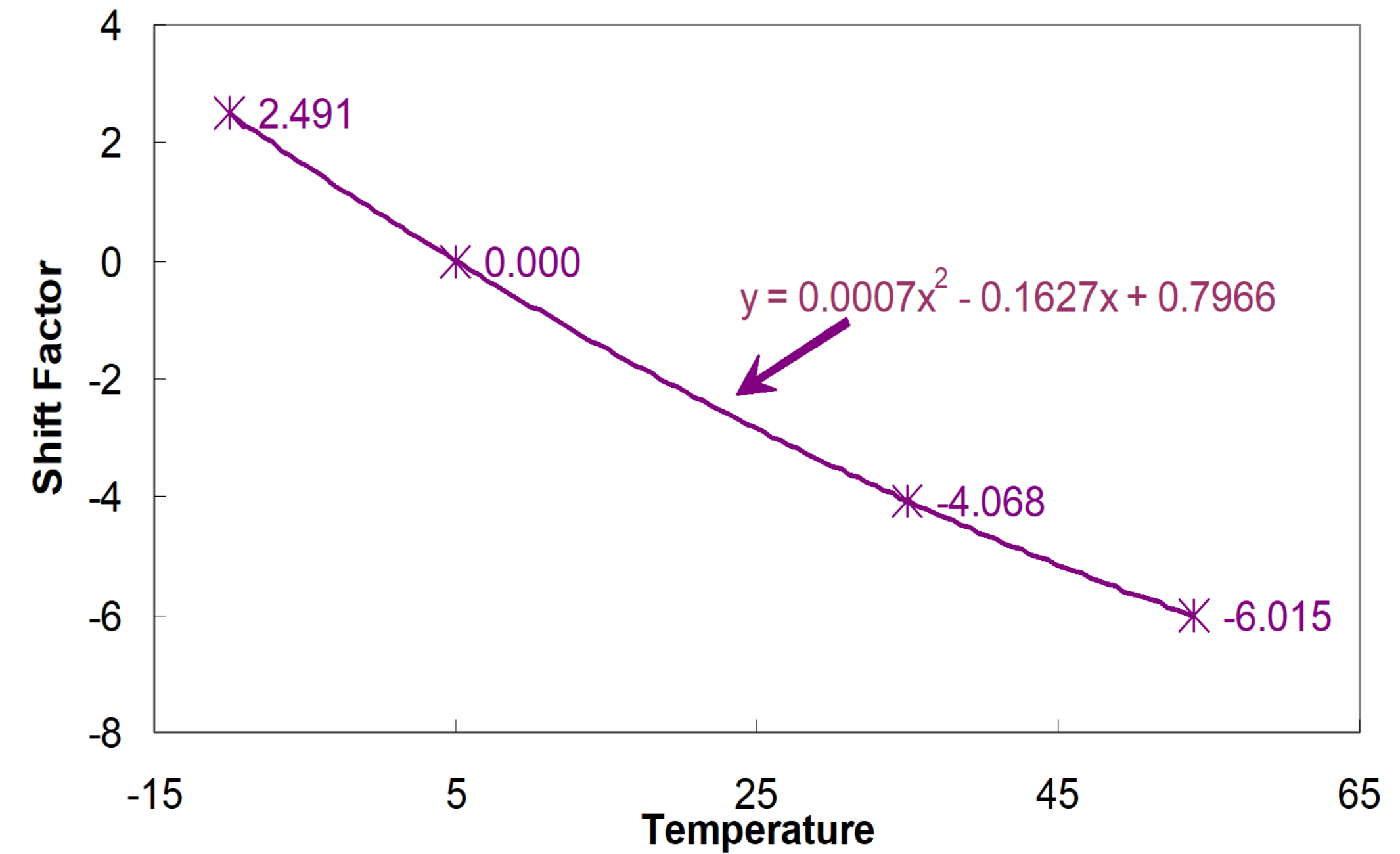
Validation and Verification

Finding the sensitive input parameters is the first task to resolve conservatism in the design.

Dynamic Modulus Mastercurve



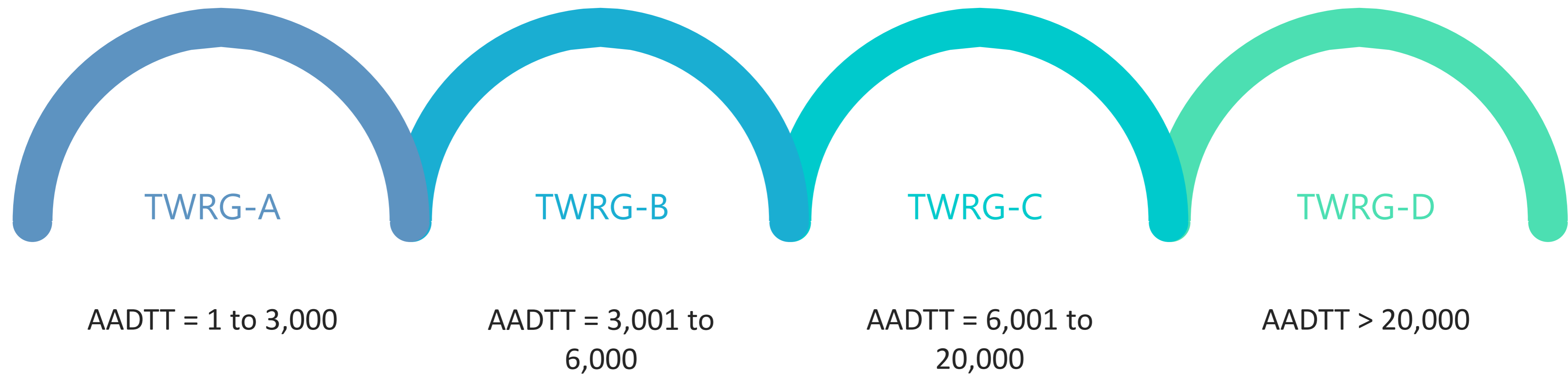
Shift Factor



$$\text{Shift Factor} = \frac{\text{Reduced Frequency}}{\text{Frequency}}$$

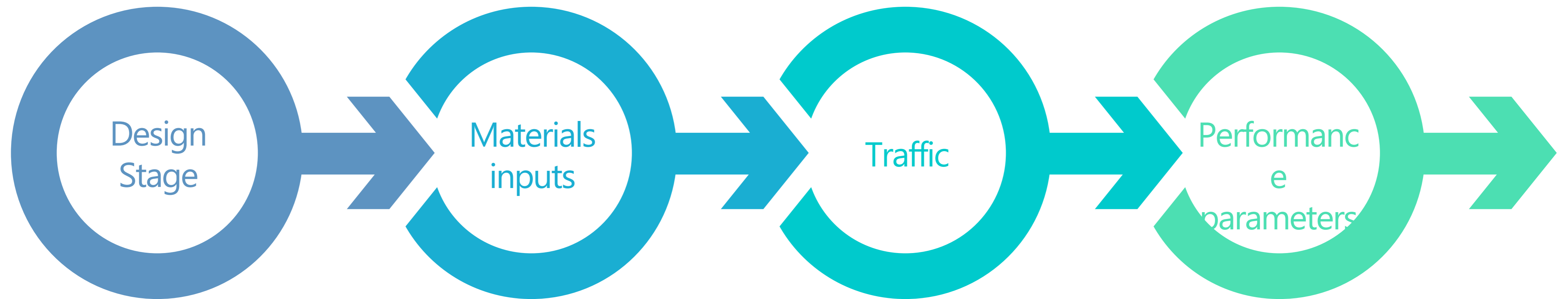
Validation and

Verification
Traffic data are the most important and the most difficult to resolve. Monthly Adjustment Factor, Vehicle Class Distribution, Hourly Distribution, and Axle Load Distribution.



Notes from Validation

Coordination and knowledge are the keys.



Pavement design is for future construction. Suppliers and contractors are unknown

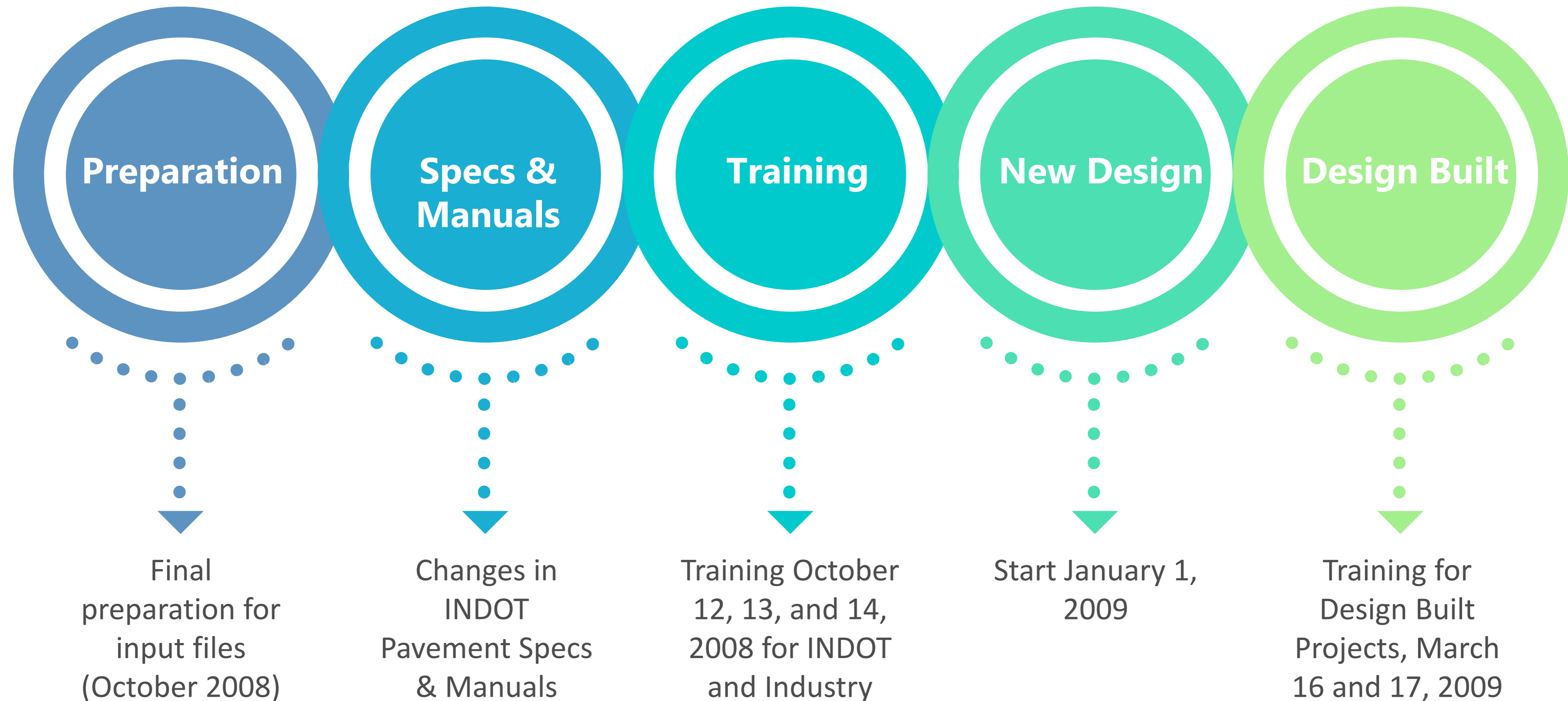
Materials properties depend on the strength of the standard specifications

Traffic inputs are the most difficult. QC/QA and standard procedures needed.

Choose the performance parameters wisely to avoid conservatism

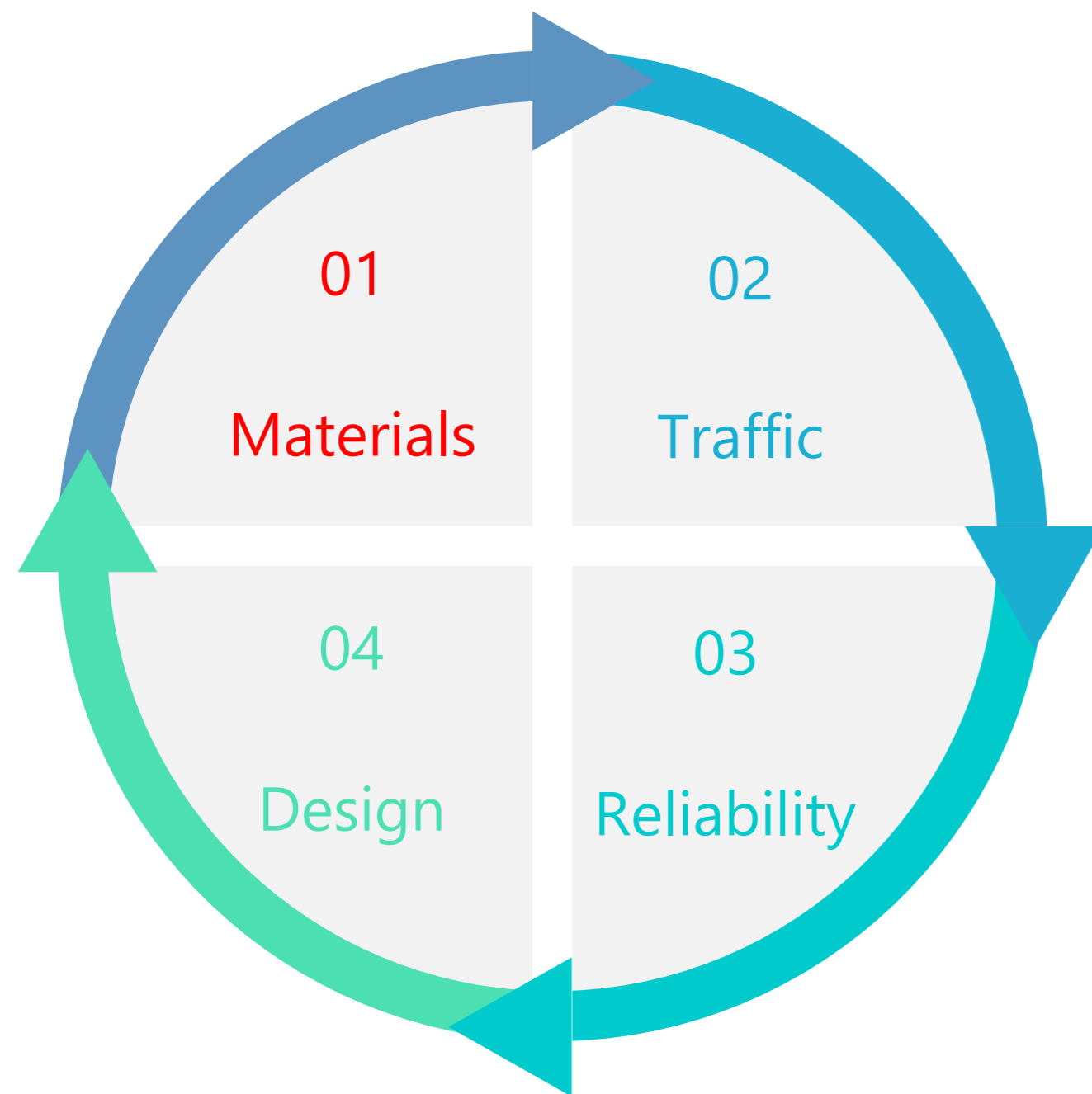
Timeline of Deployment

The infrastructures for deployment had to be ready before deployment. Deployment needs coordination from intra-offices and the industry associations and their members.



Technical

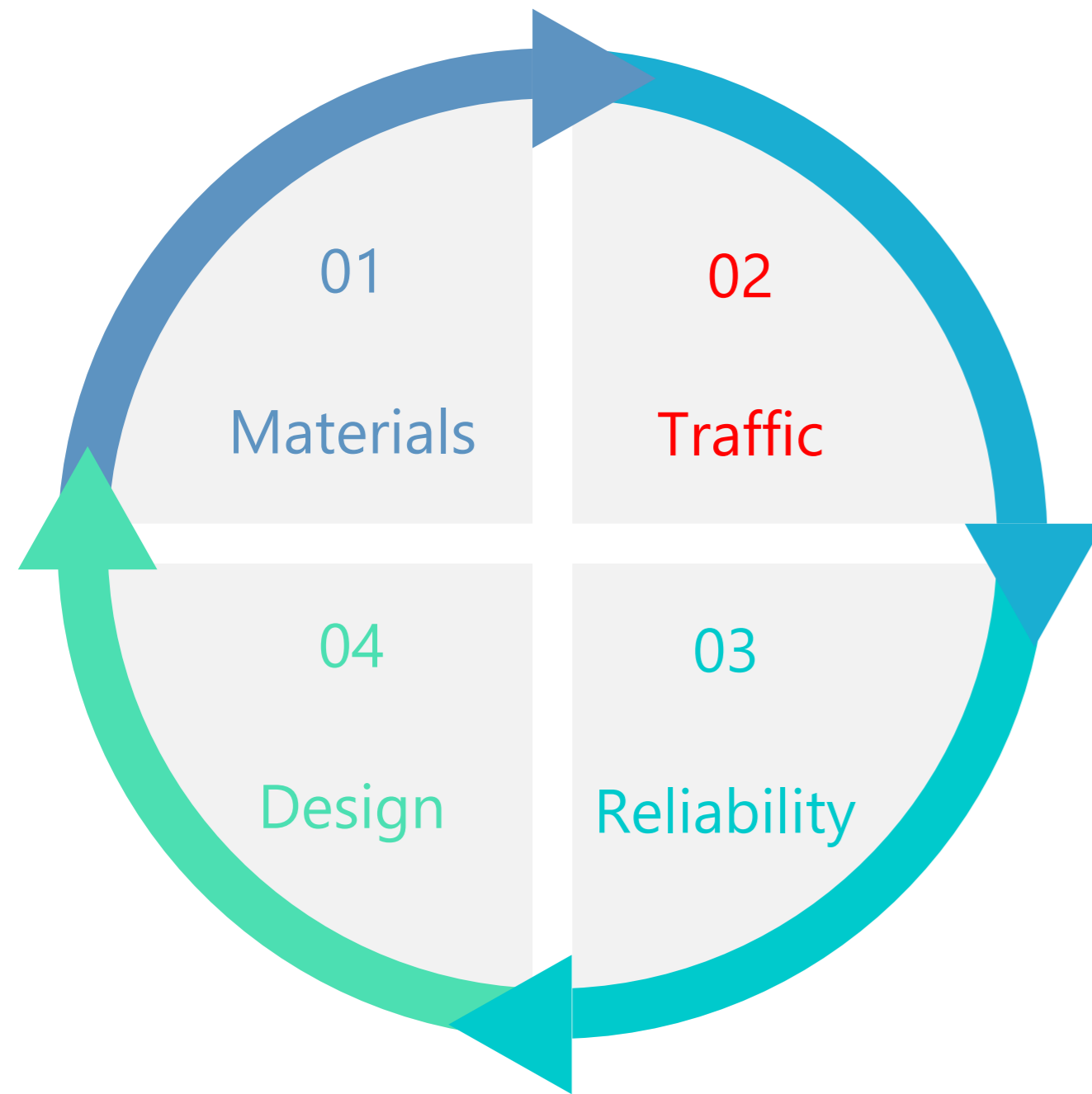
Support to the users are very important to achieve smooth deployment.



Input Name	Proposed Indiana Value				
	Asphalt	Asphalt	Asphalt	Asphalt	Asphalt
Material Type	Asphalt	Asphalt	Asphalt	Asphalt	Asphalt
Material	Asphalt concrete	Asphalt concrete	Asphalt concrete	Asphalt concrete	SMA
Nominal Maximum Aggregate Size (mm)	25	19	12.5	9.5	SMA 9.5
Reference temperature (F)	70	70	70	70	70
Effective binder content (%)	8.69	9.53	10.66	11.61	13.4
Air voids (%) as built	8	8	8	8	7
Total unit weight (pcf)	144.41	143.83	143.08	142.57	173.5
Thermal conductivity asphalt (BTU/hr-ft-F)	0.63	0.63	0.63	0.63	0.63
Heat capacity (BTU/lb-F)	0.31	0.31	0.31	0.31	0.31
Poisson's Ratio	0.35	0.35	0.35	0.35	0.35

Technical

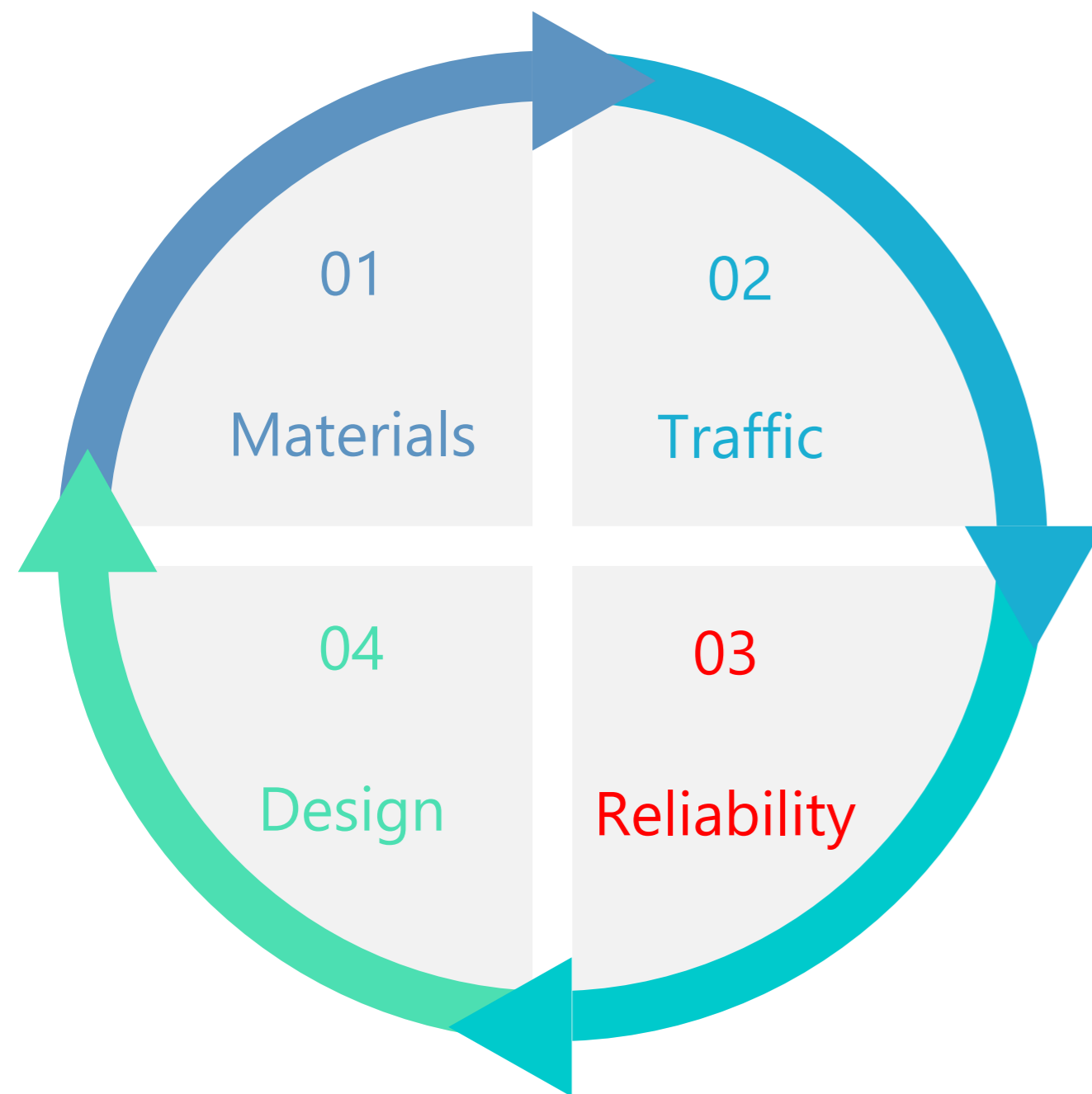
Support to the users are very important to achieve smooth deployment.



Group or Screen	Number	Input name	Typical Value	Proposed Indiana value	Status of input	Comments	
Traffic	1	Initial Two-Way AADTT	600 ~ 500000	Traffic Group A: 0 ~ 3,000	Critical & Important		
				Traffic Group B: 3,000 ~ 6,000			
				Traffic Group C: 6,000 ~ 20,000			
			Percent of Heavy Truck	7.0 ~ 45.0	Based on design project Based on design project	Critical & Important	
	2	Number of Lanes in Design Direction	1 ~ 6	Based on design project	Critical & Important		
	3	Percent of Trucks in Design Direction	52 ~ 75	2 Lanes: 52	Critical & Important		
				4 Lanes: 55			
				6 Lanes: 55			
				8 Lanes: 57			
				10 Lanes: 55			
				12 Lanes: 54			
	4	Percent of Trucks in Design Lane	28 ~ 100	2 Lanes: 100	Critical, Important & Sensitive		
				4 Lanes: 90			
				6 Lanes: 60			
				8 Lanes: 45			
10 Lanes: 40							
			12 Lanes: 40				
5	Operation Speed	20 ~ 65	Posted Speed Limit	Critical & Important	Traffic Group A=55 MPH; Traffic Group B=50 MPH; Traffic Group C=60 MPH; and Traffic Group D=65 MPH		

Technical

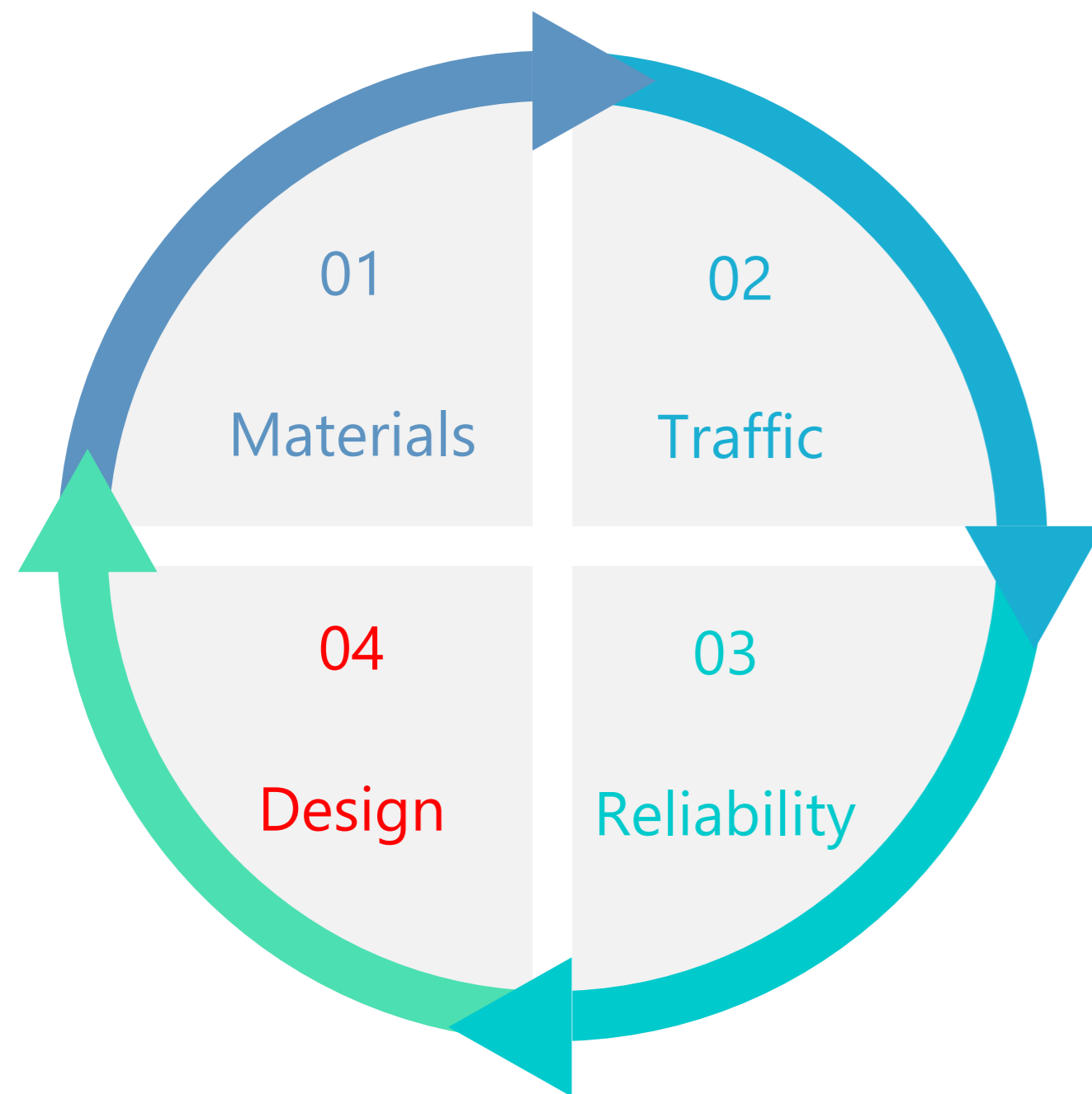
Support to the users are very important to achieve smooth deployment.



Group or Screen	Number	Input name	Typical Value	Proposed Indiana value	Status of input	Comments
Analysis Parameters	17	Project Name	From previous screen	From previous screen	Option	
	18	Initial IRI (in/mile)	65 - 75	70	Sensitive and Important	
	19	Terminal IRI Limit (in/mile)	150-240	Interstate=160, Arterial-Urban=190,	Sensitive and Important	
	20	Transverse Cracking Limit (%)	10%-50%	Interstate=10, Arterial-Urban=10, Arterial-	Sensitive and Important	
	21	Mean Joint Faulting Limit (inch)	0.10-0.16	Interstate=0.10, Arterial-Urban=0.10,	Sensitive and Important	Ignore the output, not a decision
	22	Terminal IRI Reliability (%)	70 - 95	Interstate=95, Arterial-Urban=90, Arterial-	Sensitive and Important	
	23	Transverse Cracking Reliability (%)	70 - 95	Interstate=95, Arterial-Urban=90, Arterial-	Sensitive and Important	
	24	Mean Joint Faulting Reliability (%)	70 - 95	Interstate=95, Arterial-Urban=90, Arterial-	Sensitive and Important	Ignore the output, not a decision

Technical

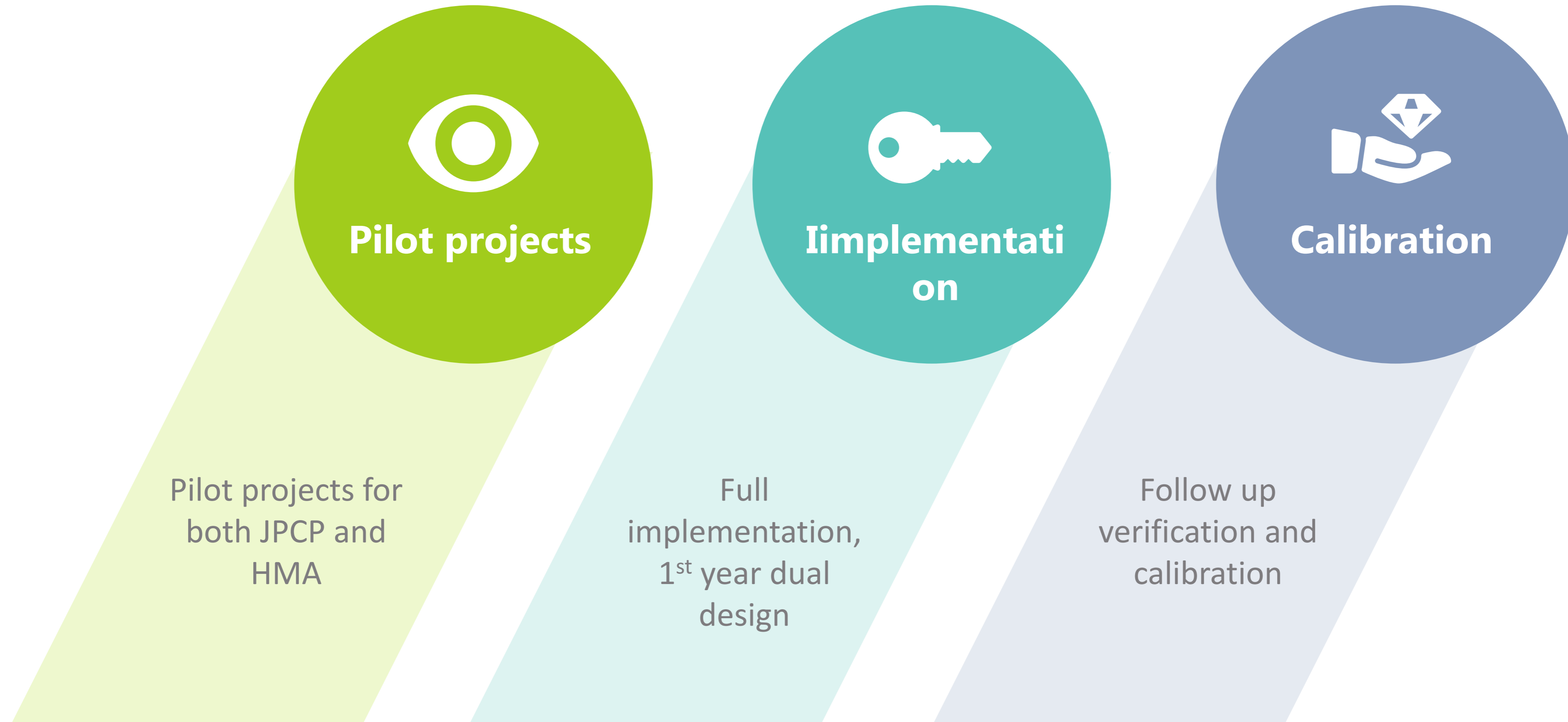
Support to the users are very important to achieve smooth deployment.



Group or Screen	Field Number	Input name	Typical Value	Proposed Indiana value	Status of input	Comments
Design Features	34	Slab thickness (inch)	This field is not an input, it comes from Layer #1 input	Input in parameter #66	Option	
	35	Permanent Curl/Warp Effective Temperature difference (degrees)	-10	-10	Sensitive and Critical	Do not change this value until further research
	36	Joint Spacing (feet)	15-30	9" to 12" = 20 feet, 13" to 16" = 18 feet	Sensitive and Critical	Can be changed to optimize the curling stress
	37	Sealant Type	None, Liquid, Silicone, and Performed	Silicone or preformed	Important	INDOT Manual Chapter 52
	38	Dowel Transverse Joint	Check item	Check this item	Sensitive and Critical	
	39	Dowel Diameter (inches)	1" to 1.5"	Thickness <9" = 1", between 9" to 12" = 1.25", >12" = 1.5"	Sensitive and Critical	INDOT Standard Drawing E-503-CCPJ-01
	40	Dowel Spacing (inches)	12"	12"	Important	INDOT Standard Drawing E-503-CCPJ-01
	41	Edge support: Tied Shoulder	Based on design	Based on design	Sensitive and Critical	INDOT Standard Drawing E-503-CCPJ-07
	42	Edge Support: Long Term LTE (%)	50% to 70% for sawed longitudinal joint with tie bar, 30% to 50% for construction longitudinal with tie bar, 0% for no tie bar	60%	Important	Not critical to Indiana
	43	Edge support: Widened Slab	Check item	Check this item if the slab width is wider than 12 feet	Sensitive and Critical	
	44	Edge Support: Slab width (feet)	12 to 14 feet	Slab width	Sensitive and Critical	Lane + widen edge

Implementation Strategy

Implementation can be achieved if the initial projects can go smoothly. Buy-in from the Department and the FHWA is very crucial for final adoption. Verification and local calibration will follow using the current practices.

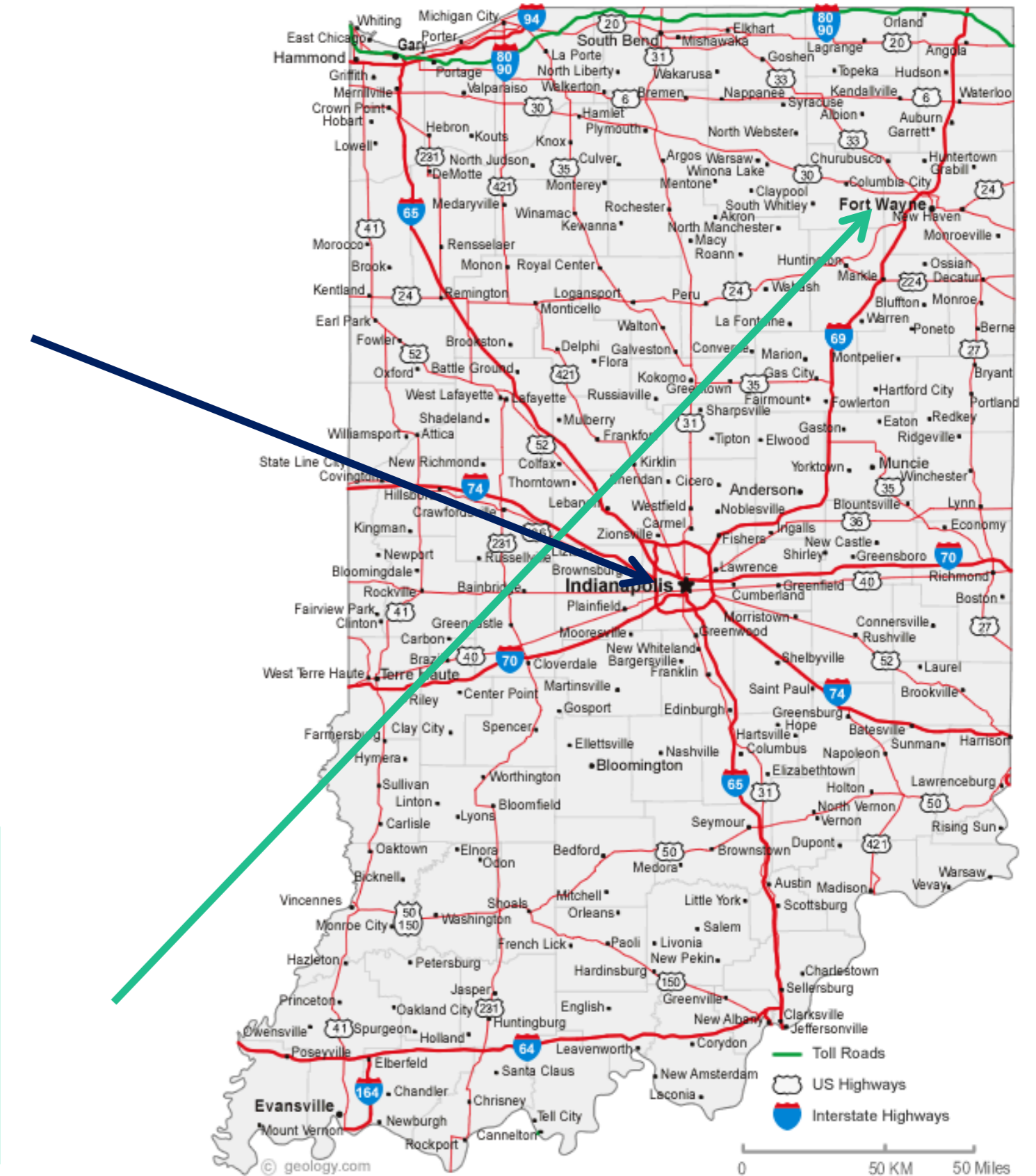


Pilot Projects

The first JPCP and HMA in the nation using the MEPDG version 0.9

I-465 in Indianapolis
JPCP – MEPDG 14 inches
JPCP – AASHTO 1998 16 inches

SR-14 in Allen County
HMA – MEPDG 13.5 inches
HMA – AASHTO 1993 15 inches

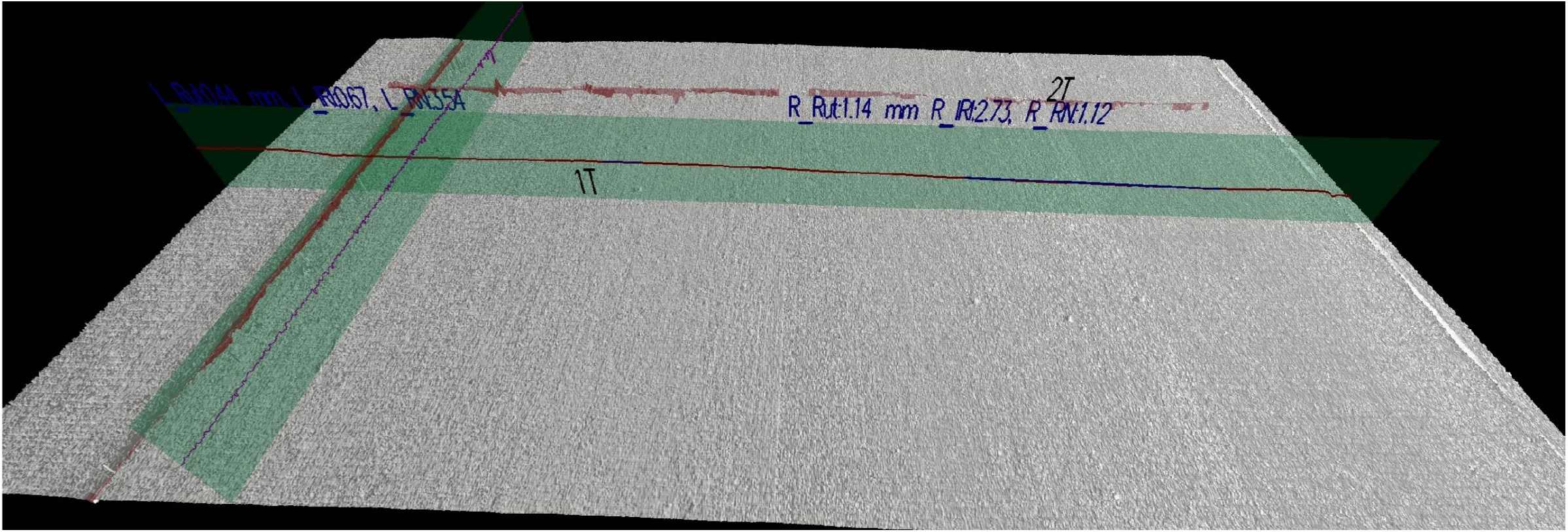
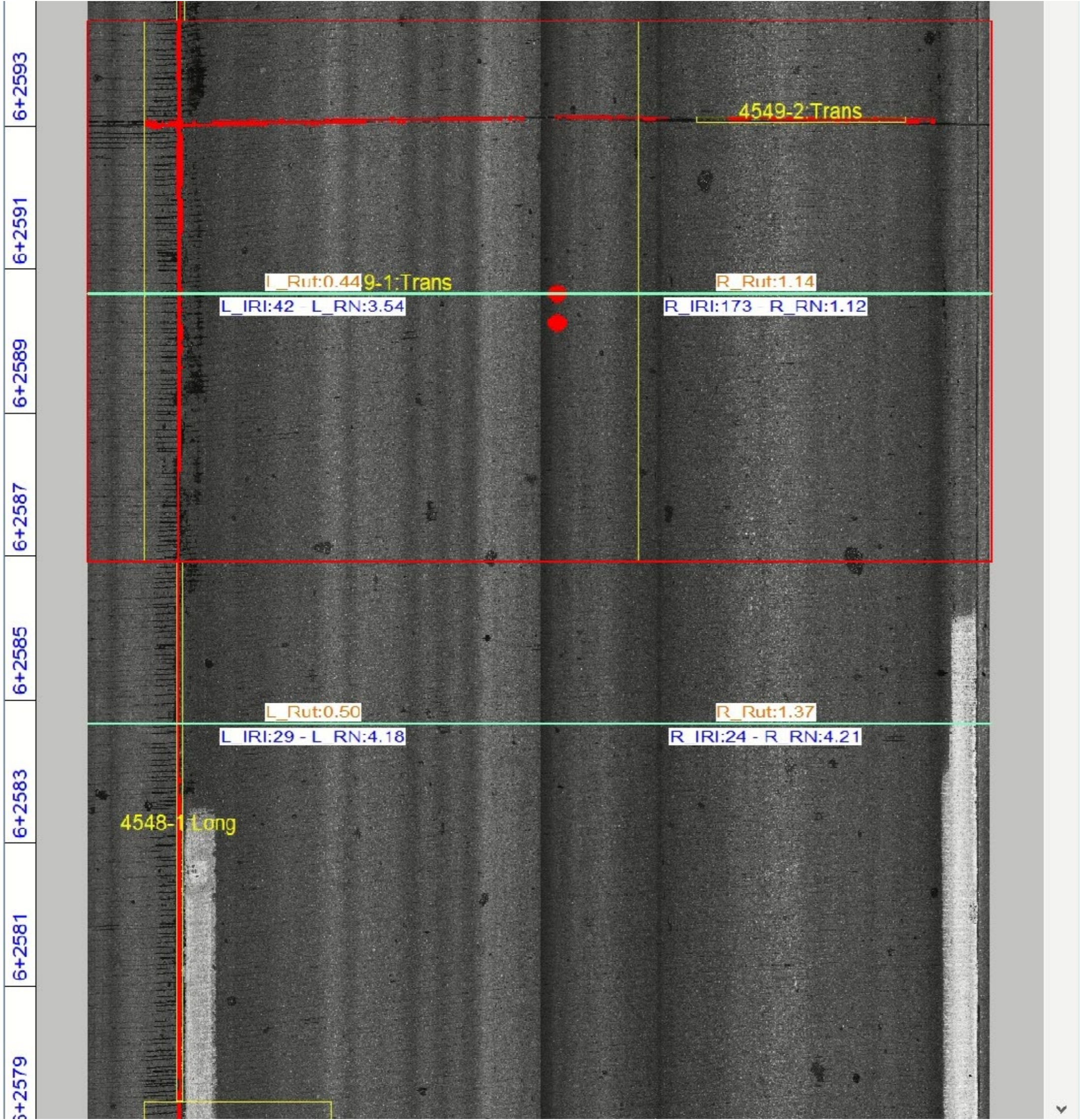


Interstate I-465, Indianapolis



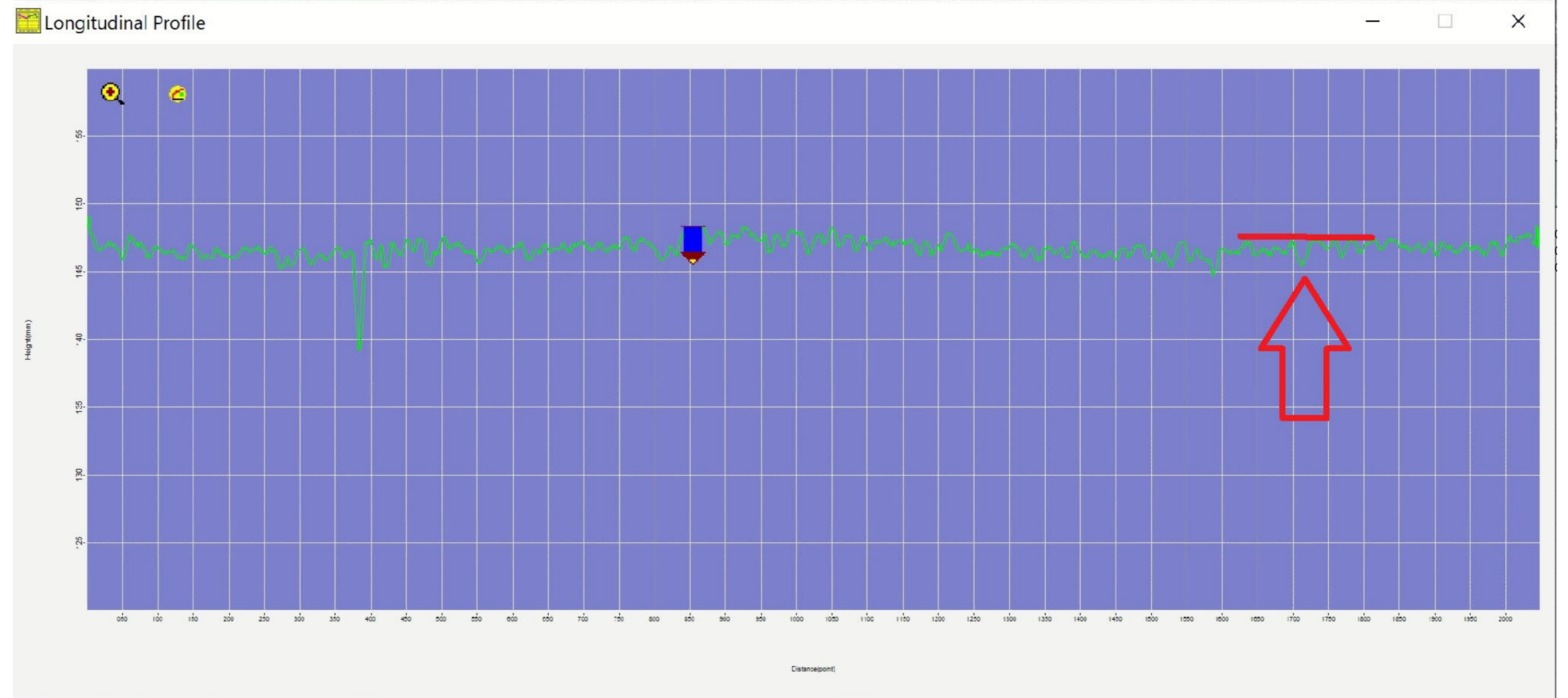
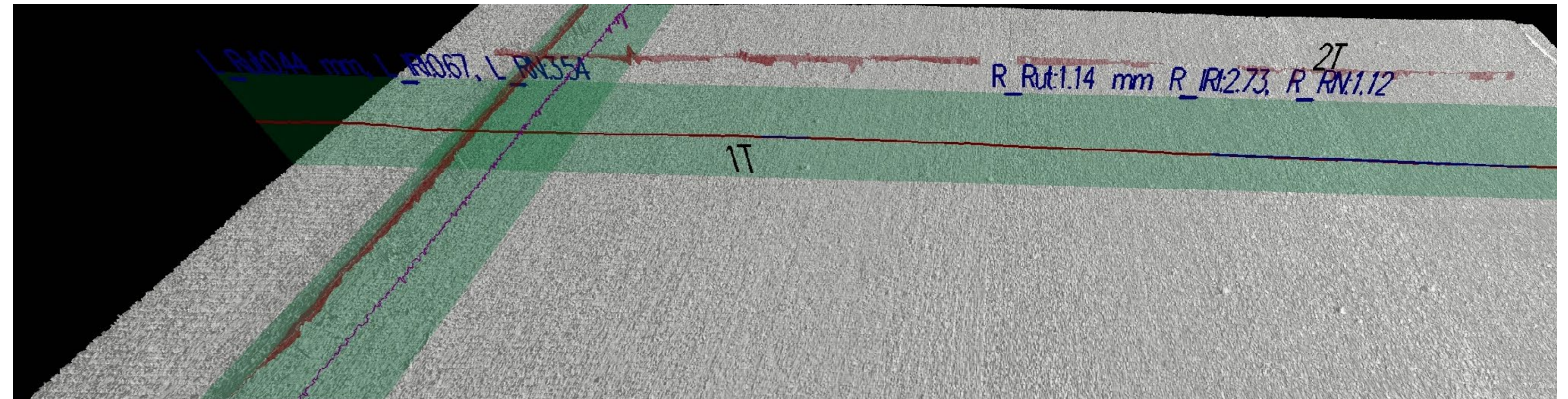
- Designed with AASHTO 1998 Supplemental for 18 foot joint spacing and the thickness was 16 inches
- Designed with MEPDG version 1.0 for 16 foot joint spacing and 14 inches, tied shoulder, not widened slab

I-465 Performance after 10 years



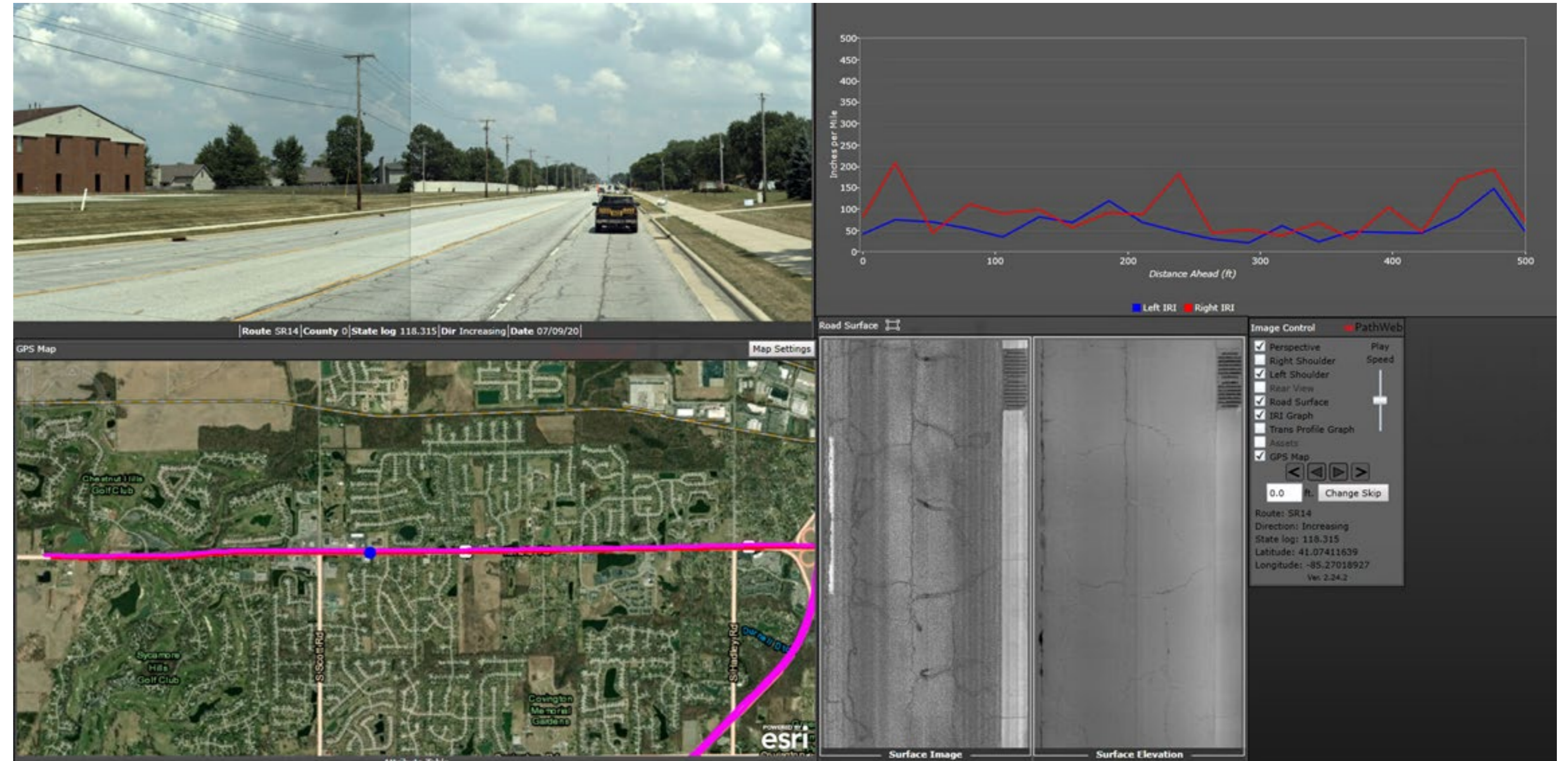
I-465 Performance after 10 years

- Zero crack at all lanes, none in the heavy truck lane (3 &4)
- Some cracks in bridge approaches on embankments
- Joint faulting less than 1 millimeter
- Current Lane 4 IRI is 42"/mile
 - Left wheel path 41"/mile
 - Right wheel path 43"/mile
- Current Lane 3 IRI is 45"/mile
 - Left wheel path 43"/mile
 - Right wheel path 48"/mile
- Truck lanes are Lane 3 and 4



SR-14 Performance after 10 years

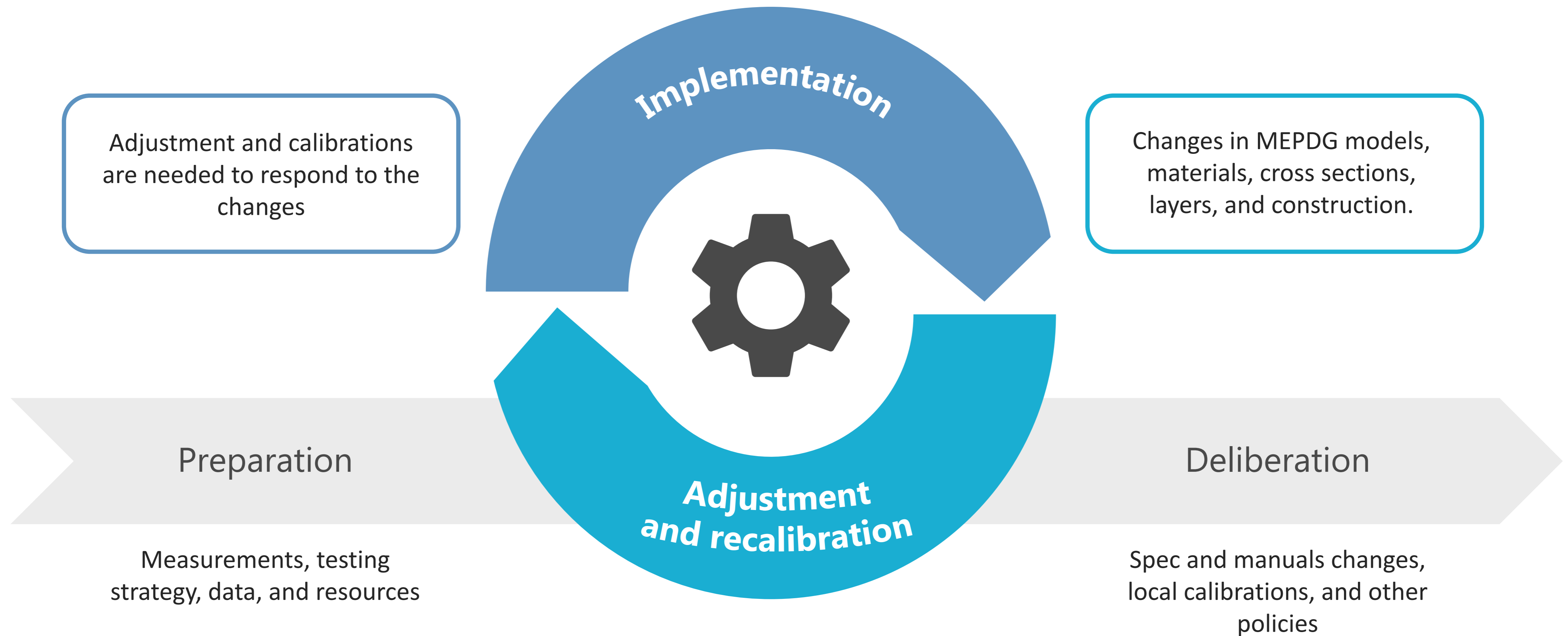
- Numerous construction issues during construction of the HMA layers
- There is top-down cracks due to the sandwiched drainage layer
- Thermal cracks are excessive due to the binder issue
- Scheduled for mill and fill of 1.5" in FY 2021



Circle of

Implementation

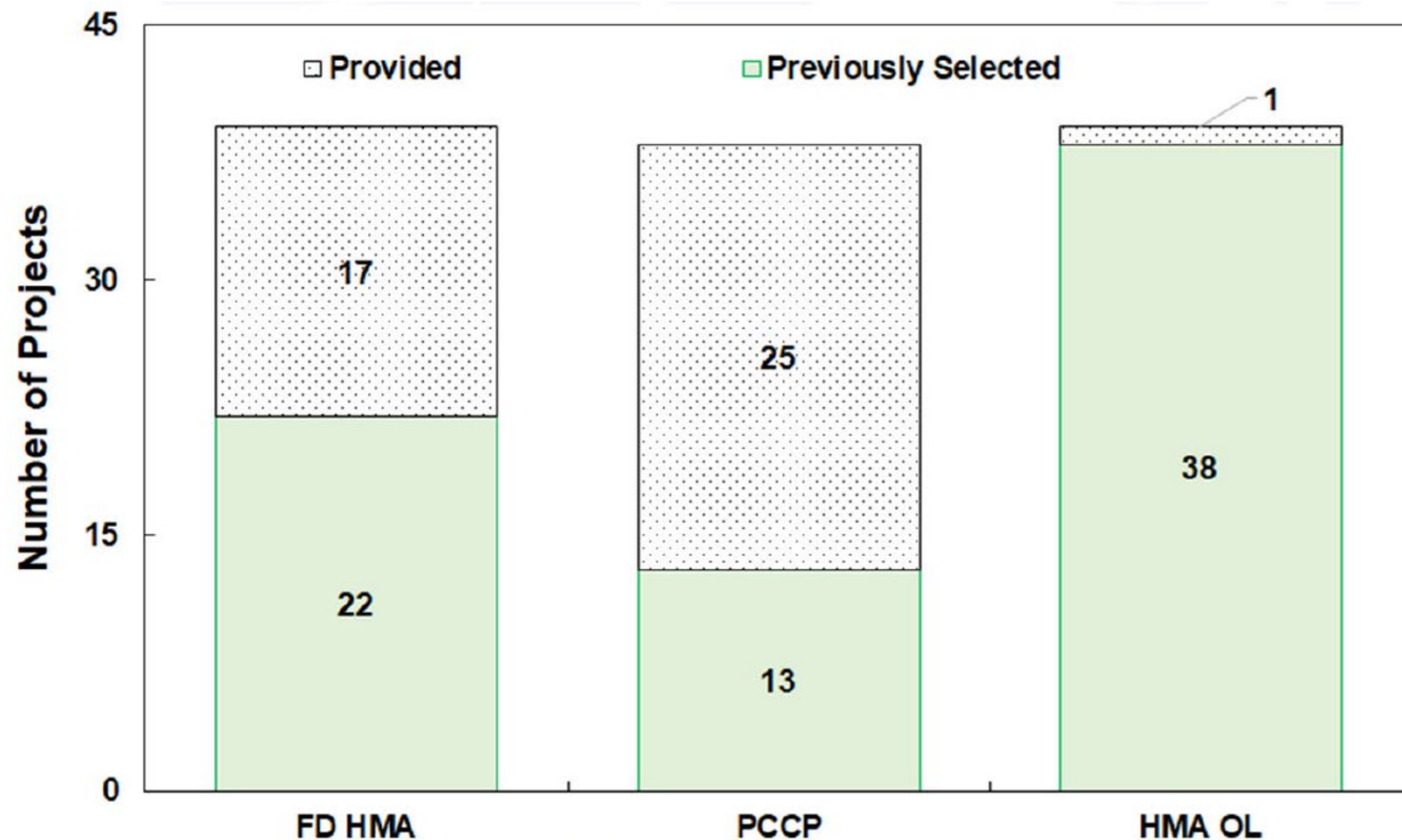
Design and construction are not static. Changes are made all the time, everyday.



Re-adjustment and Local Calibration

Requirements for re-adjustment of other input parameters are easy to achieve. Requirements for local calibration is difficult to achieve due to the number of sections that are old enough for analysis.

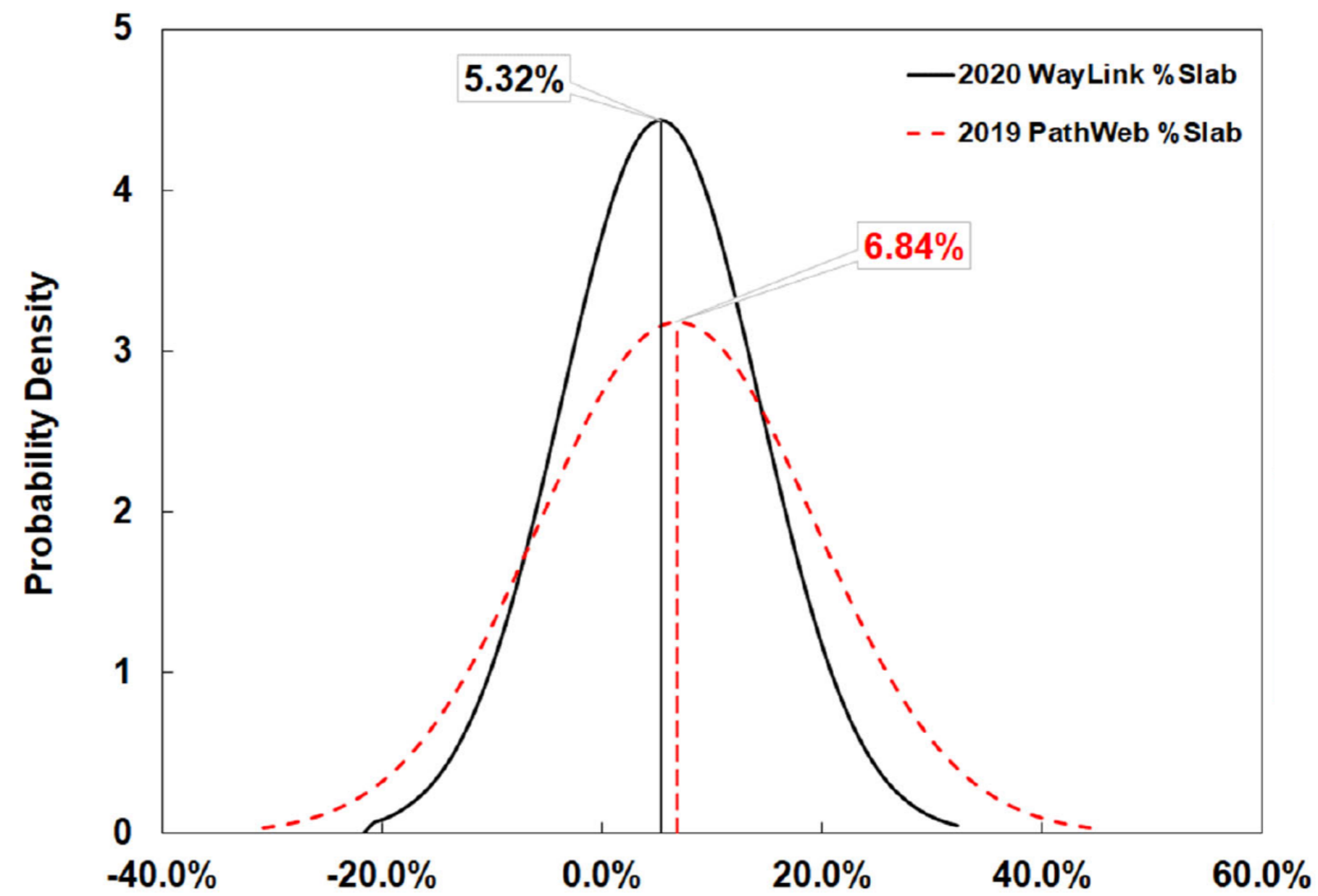
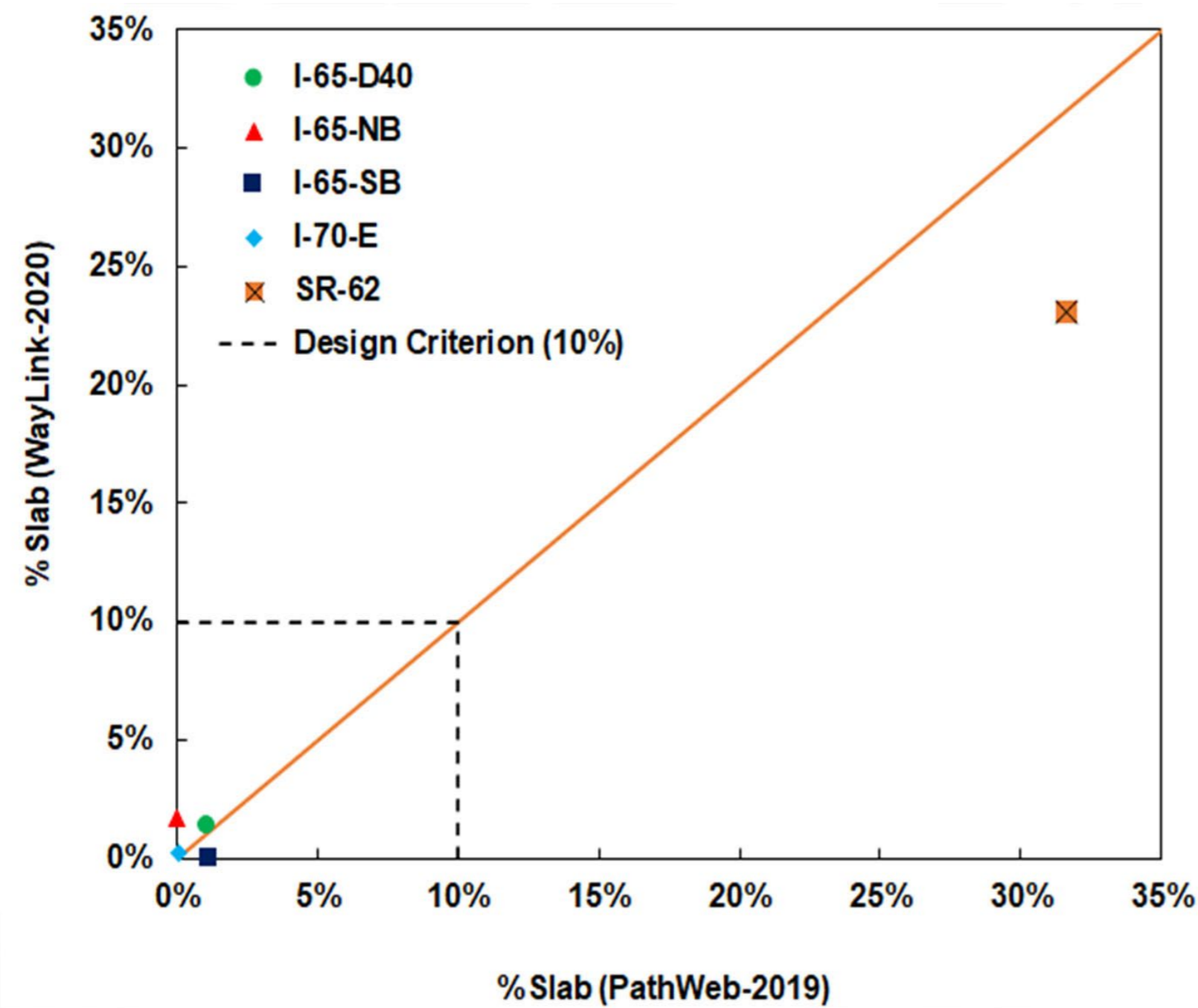
	Minimum Number of Projects	Available Number of Projects
HMA Full-Depth	31	39
HMA Overlay	31	39
PCCP	39	38



#	Route	Design ID	Contract #	Road	2019 PathWeb From Measure	4-30-2019 - Pathweb TO measure	PaveType	Latitude From	Latitude To	Longitude From	Longitude To
1	SR-3	100753	B-28735	SR3	43.375	43.613	FDHMA	39.005521	39.00805	-85.62879	-85.6318
2	SR-19	8351220	R-26291	SR19	100.641	100.752	FDHMA	41.505885	41.507454	-86.001942	-86.001636
3	SR-119	8351220	R-26291	SR119	13.69	13.83	FDHMA	41.50777	41.508702	-86.001146	-85.998737
4	I-65-1	1383354	R-37075	I65	99.608	99.994	FDHMA	39.630601	39.636182	-86.074025	-86.074045
5	I-65-2	1383354	R-37075	I65	98.844	99.608	FDHMA	39.619521	39.630601	-86.073989	-86.074025
6	US-231	9608820	B-26727	US231	161.2	161.609	FDHMA	39.983134	39.989049	-86.903282	-86.903486
7	SR-130	8351540	R-24643	SR130	1.161	1.445	FDHMA	41.526663	41.524972	-87.224103	-87.219094
8	SR-124	800265	R-31896	SR124	0	0.541	FDHMA	40.749781	40.752569	-86.06594	-86.056532
9	US-31-S	600432	PLC-34823	US31	108.46	109.059	FDHMA	39.947495	39.956165	-86.15755	-86.157583
10	US-31-N	600432	PLC-34823	US31	109.059	109.797	FDHMA	39.956165	39.966867	-86.157583	-86.157594
11	SR-105	200231	B-29503	SR105	15.621	15.821	FDHMA	40.867971	40.87079	-85.60169	-85.602512
12	I-69-1	500438	IR-31120	I69	28.553	34.171	FDHMA	38.259439	38.333526	-87.426973	-87.396435
13	I-69-2	500440	IR-33038	I69	34.212	38.466	FDHMA	38.334102	38.377289	-87.396429	-87.343773
14	I-69-4-R	1006075	IR-33742	I69	113.649	114.685	FDHMA	39.094006	39.107684	-86.56574	-86.558974
15	I-69-4-U	1006075	IR-33742	I69	114.685	114.992	FDHMA	39.107684	39.111842	-86.558974	-86.560849
16	I-69-5	902175	IR-33049	I69	69.237	73.5	FDHMA	38.744576	38.800427	-87.094105	-87.069921
17	I-469-NB	400603	R-30314	I469	8.649	12.421	FDHMA	40.961885	40.987343	-85.131566	-85.071234
18	US-31	710760	IR-30132	US31	230.176	230.93	FDHMA	41.605835	41.615642	-86.258546	-86.252295
19	I-69-6	902201	IR-33040	I69	39.313	40.413	FDHMA	38.387973	38.402826	-87.336129	-87.32882
20	I-69-9	902205	IR-33045	I69	58.139	58.522	FDHMA	38.608332	38.613021	-87.169439	-87.165674
21	I-69-10	500446	IR-33734	I69	90.432	90.601	FDHMA	38.932115	38.934049	-86.878988	-86.877078
22	SR-445	1173067	IR-33737	SR445	0.927	1.325	FDHMA	39.038831	39.040356	-86.722177	-86.715317
23	I-69-11	1006074	R-33735	I69	95.405	95.535	FDHMA	38.963319	38.963545	-86.802363	-86.799966
24	I-69-11	1006074	R-33735	I69	95.718	96.266	FDHMA	38.963868	38.964829	-86.796588	-86.786493
25	I-69-11	1006074	R-33735	I69	96.42	96.639	FDHMA	38.965099	38.965481	-86.783649	-86.779615

Sources of Data

The issue is related to the availability of the data. PMS versus project level data, yearly data locations, QC/QA of the data.



t-test

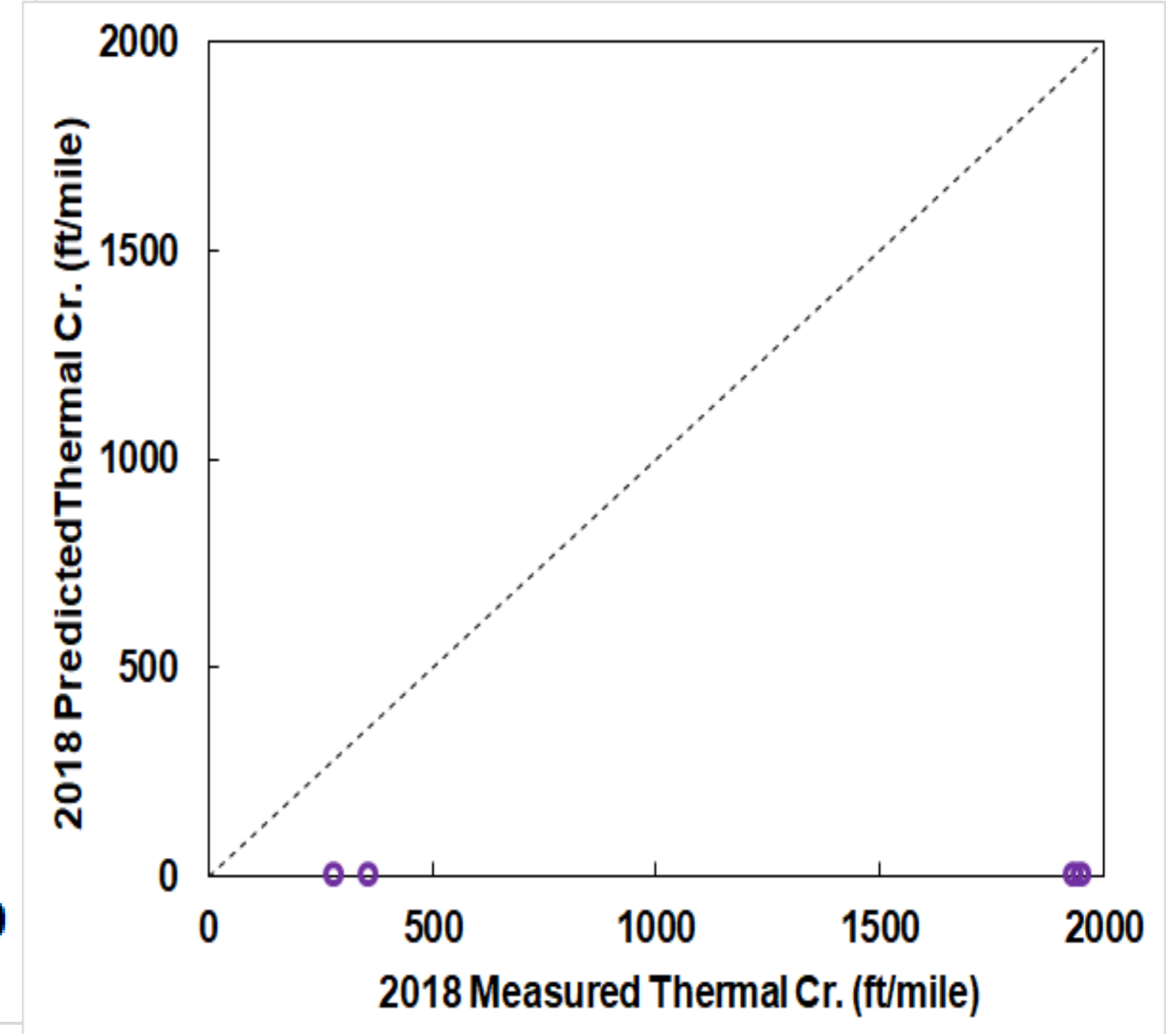
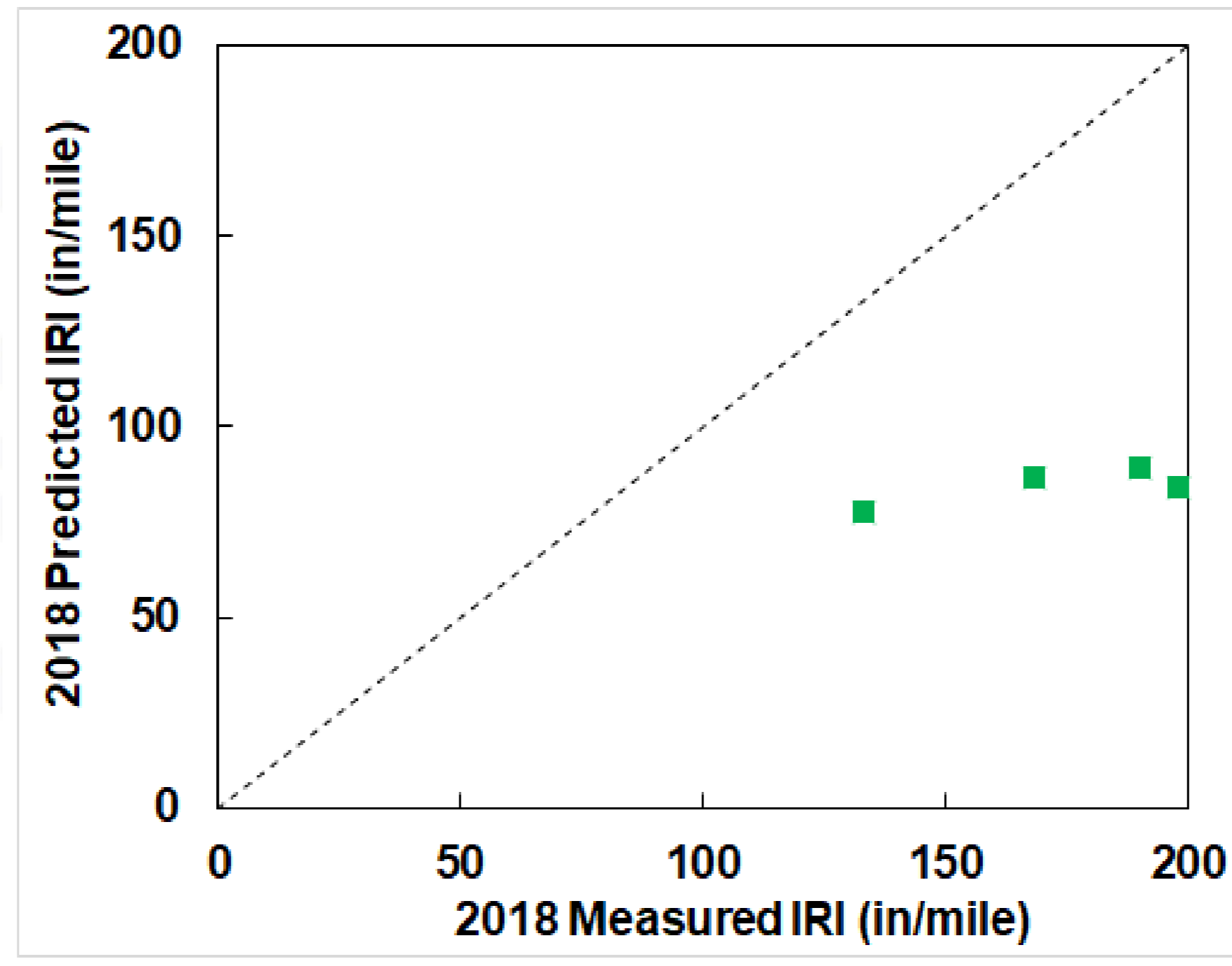
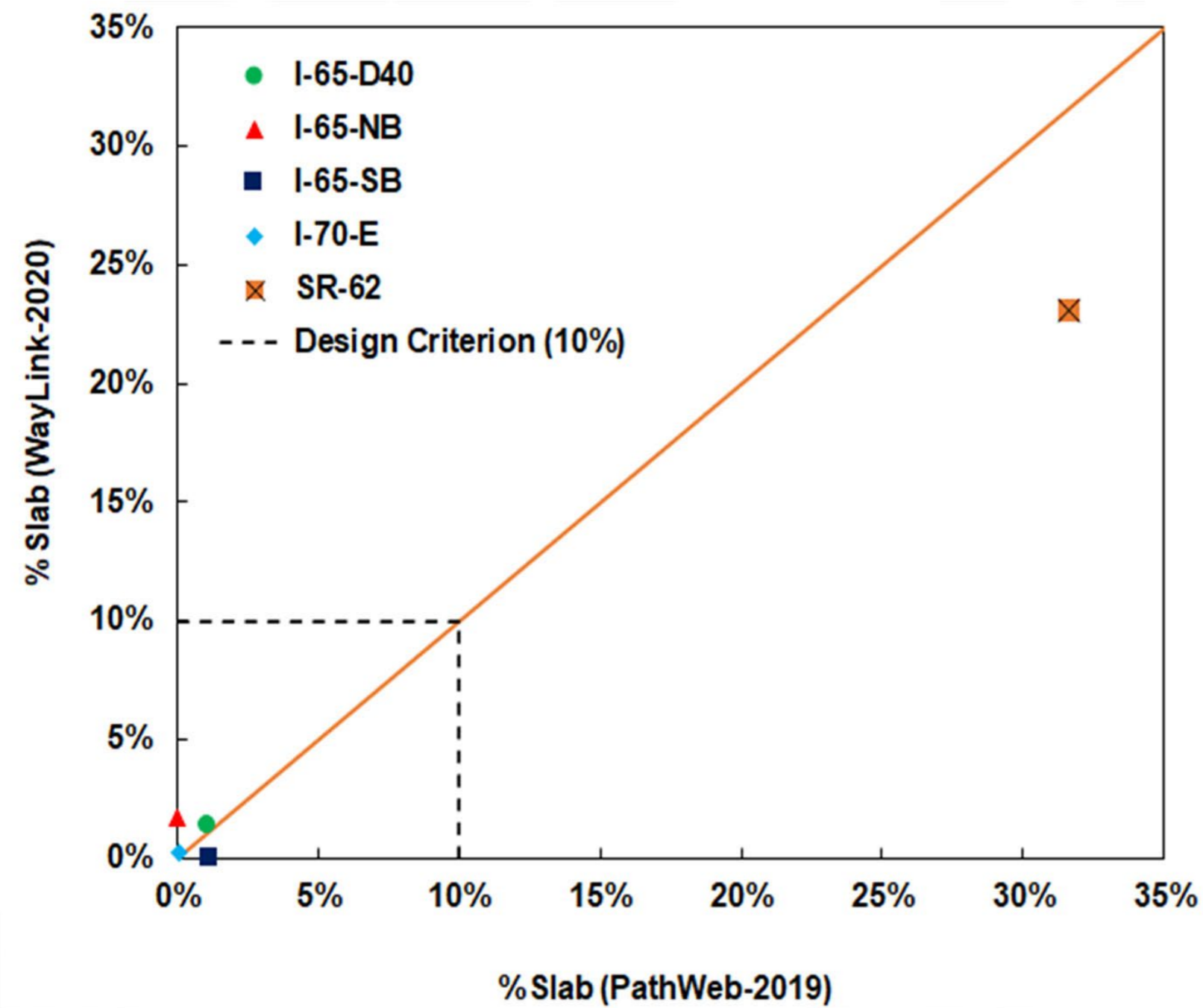
p-value: 0.453

Null hypothesis is Accepted.
The difference between means are NOT statistically Significant

Predicted vs Measured

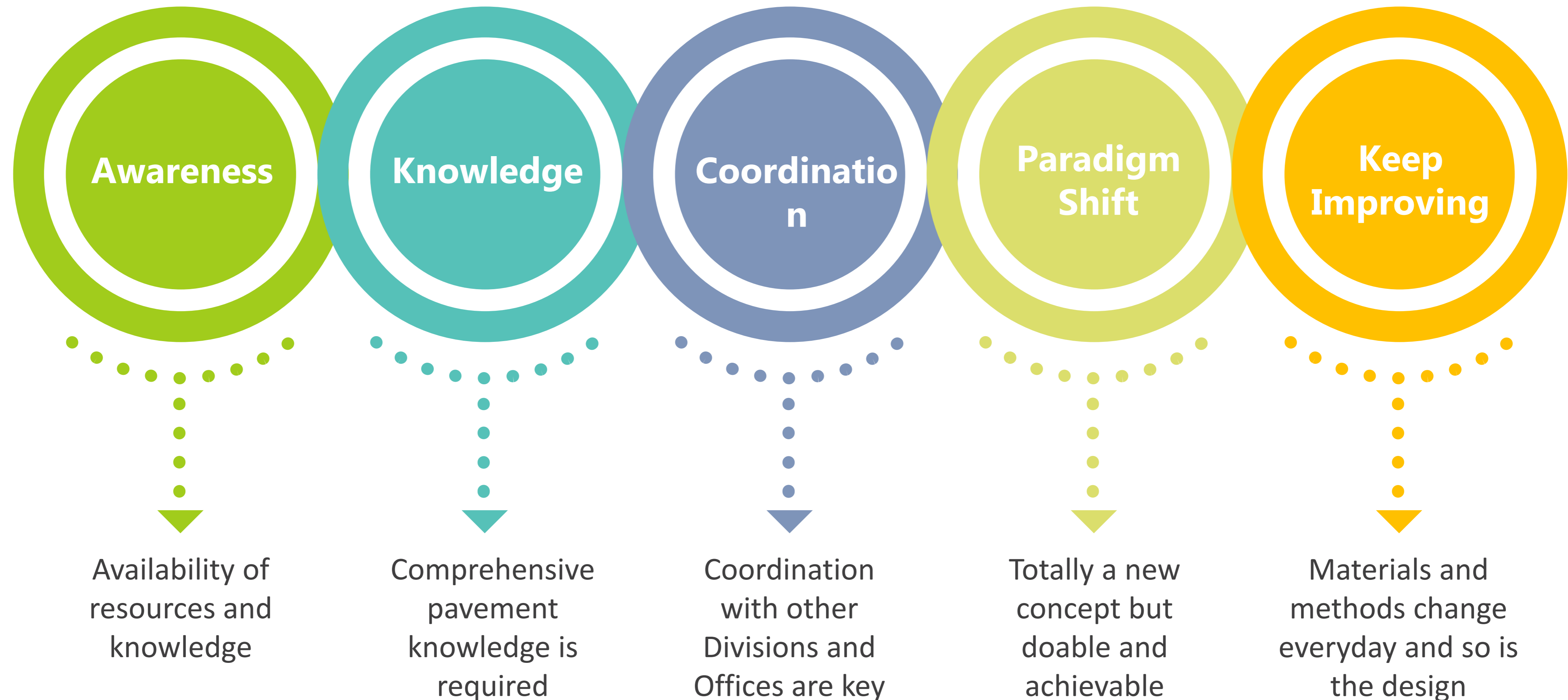
Performance

Early local calibration results indicated a few pavement predicted performance parameters are over-predicted while a few others are under-predicted. Concentrate on the dominant parameters.



Conclusions

Overall conclusions from initiatives to implementation



Successful MEPDG implementation: Virginia's experience

Affan Habib, P.E.,
Virginia Department of Transportation

Objective

- Share our lessons learned
- Share some retrospective thoughts
- Help others in their implementation effort
- Help ourselves (we are all in our learning curve)

Successful MEPDG implementation in VA: What is the measure of success?

- Short term

- ✓ DOT designers can handle the design
- ✓ Consultants can handle the design
- ✓ Designs meet field experience/expectation
- ✓ No major surprises to anyone with the design

- Long term

- MEPDG sustains over time
- MEPDG realizes all the potentials of the system



“Why is it taking so long?”



- Is it too tough?
- Is it implementable?
- Is the juice worth the squeeze?
- Are we competent enough?

Not surprising compared to full development of AASHTO 1993 method

1958-1960: AASHTO Road test

- 836 test sections, 27M dollar (~0.25B in today's value)

1962: Interim Guide with design nomograph

1972: AASHTO Interim Guide for Design of Pavement Structures

1981: Guide for the Design of Rigid Pavement (revised Chapter III of the guide)

1986: Guide for Design of Pavement Structures

- First not labeled as 'interim'
- Significant revisions (almost 14 items)
- A chapter discussing the state of knowledge of M-E design was included

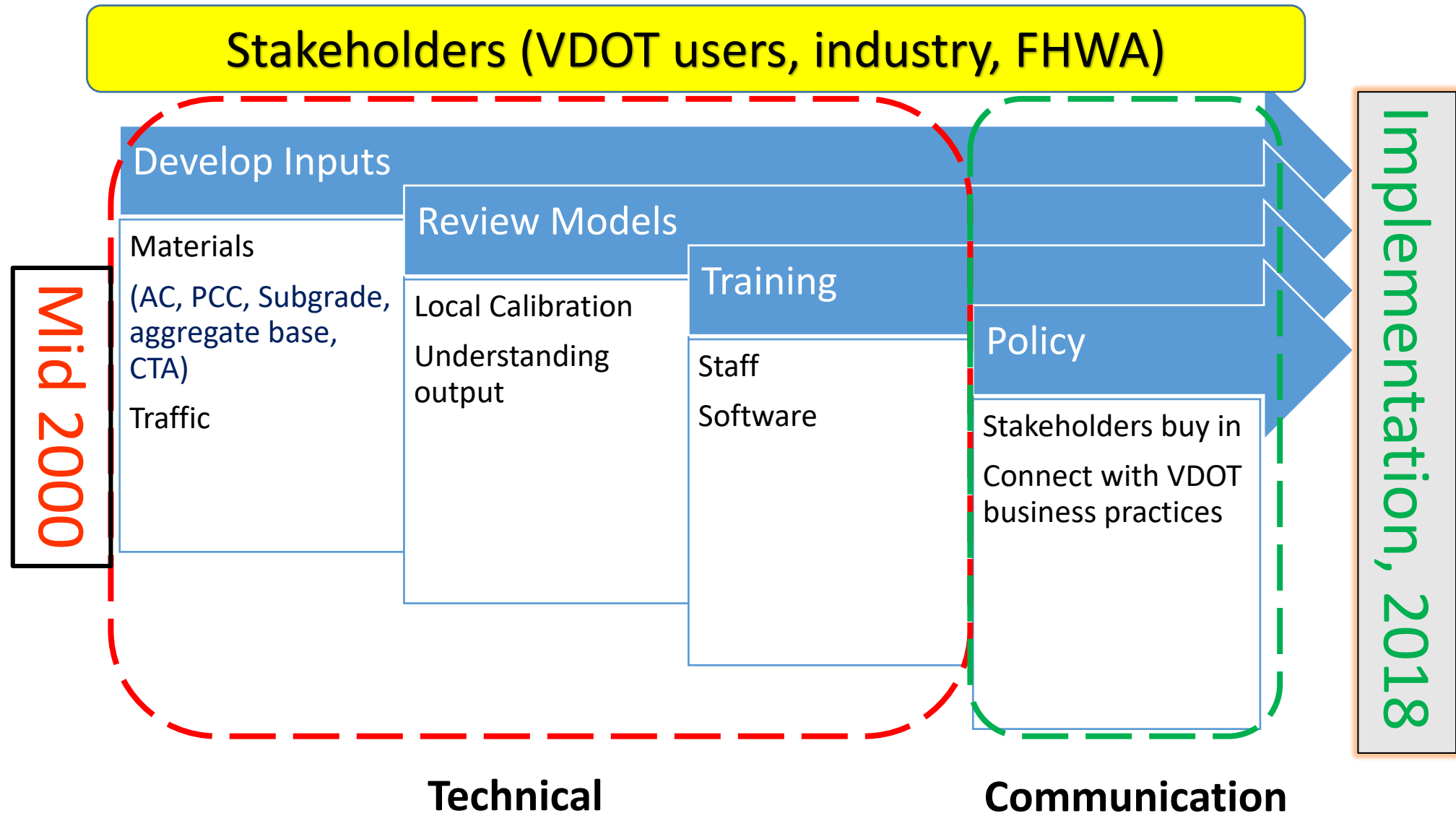
1991: Darwin software based on 1986 guide

1993: Revised 1986 guide containing modification to the overlay design procedure

1998: A Supplement to the AASHTO Guide for Design of Pavement Structures

- Part II, Rigid Pavement Design and Rigid Joint Design
- Utilizes LTPP data analysis

VDOT's MEPDG implementation at a glance



Develop inputs

- The software comes with “default” input data (out of LTPP sections)
 - This can be used to run any design (level 3 input)
 - Option to use local data (a.k.a. level 1 or 2)
 - Mix and match inputs permissible
- Should we use level 3 or level 2 or 1?
 - How much improvement to expect from using level 2 or level 1?
- Which inputs are important?
- NCHRP study on sensitivity (NCHRP 01-47) provides guidance
 - It ranks sensitivity for various input parameters

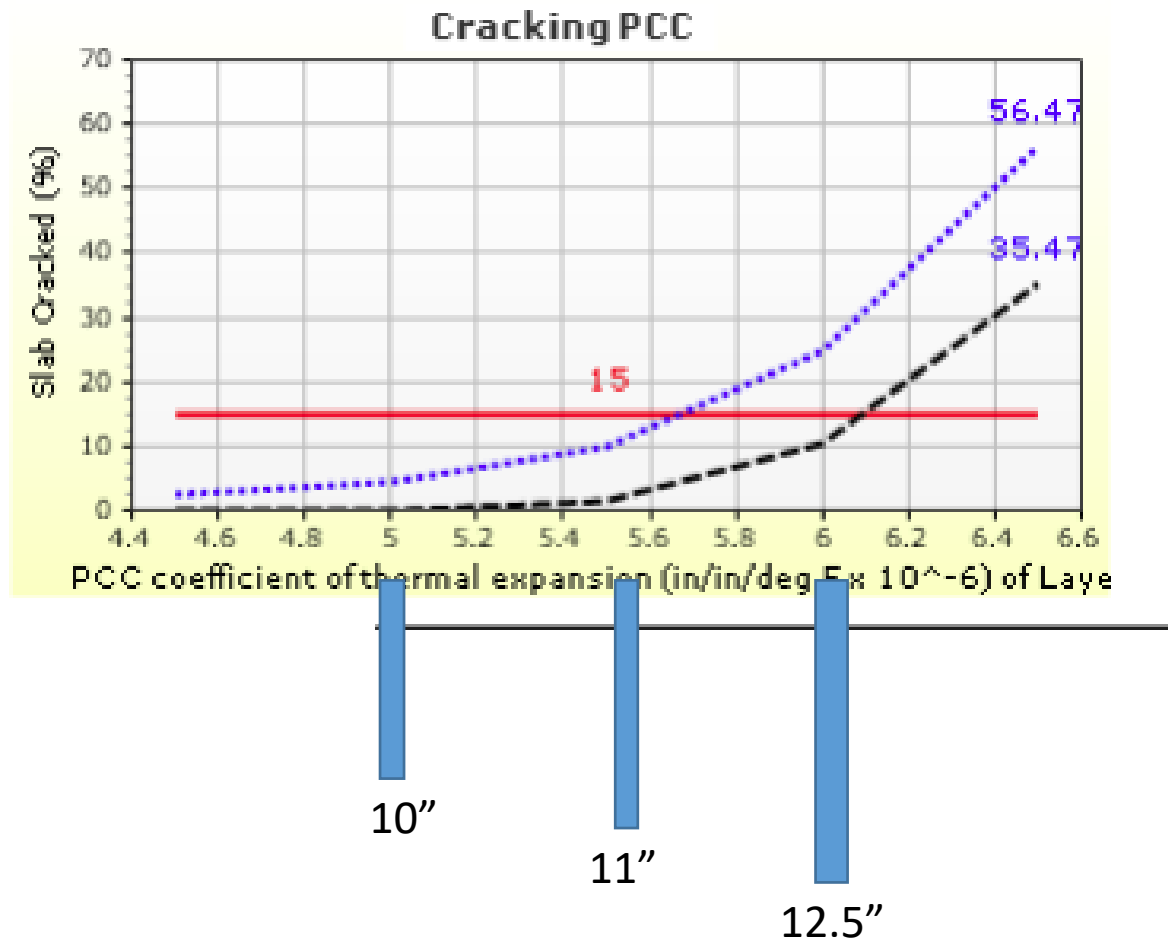
Develop inputs, contd.

- Use level 3 for less insensitive parameters
- Dilema: sensitivity vs. reality
 - Some sensitive parameters are not used in mix design and acceptance
 - Example: Dynamic modulus for AC, Coefficient of thermal expansion for PCC
 - Uncertainty of actual values of these properties during construction
 - How significant is to characterize all the sensitive properties?

How did we address these questions?

PCC sensitive parameter: CTE

11" JPCP, 15' joint spacing, 6000 truck, Richmond VA



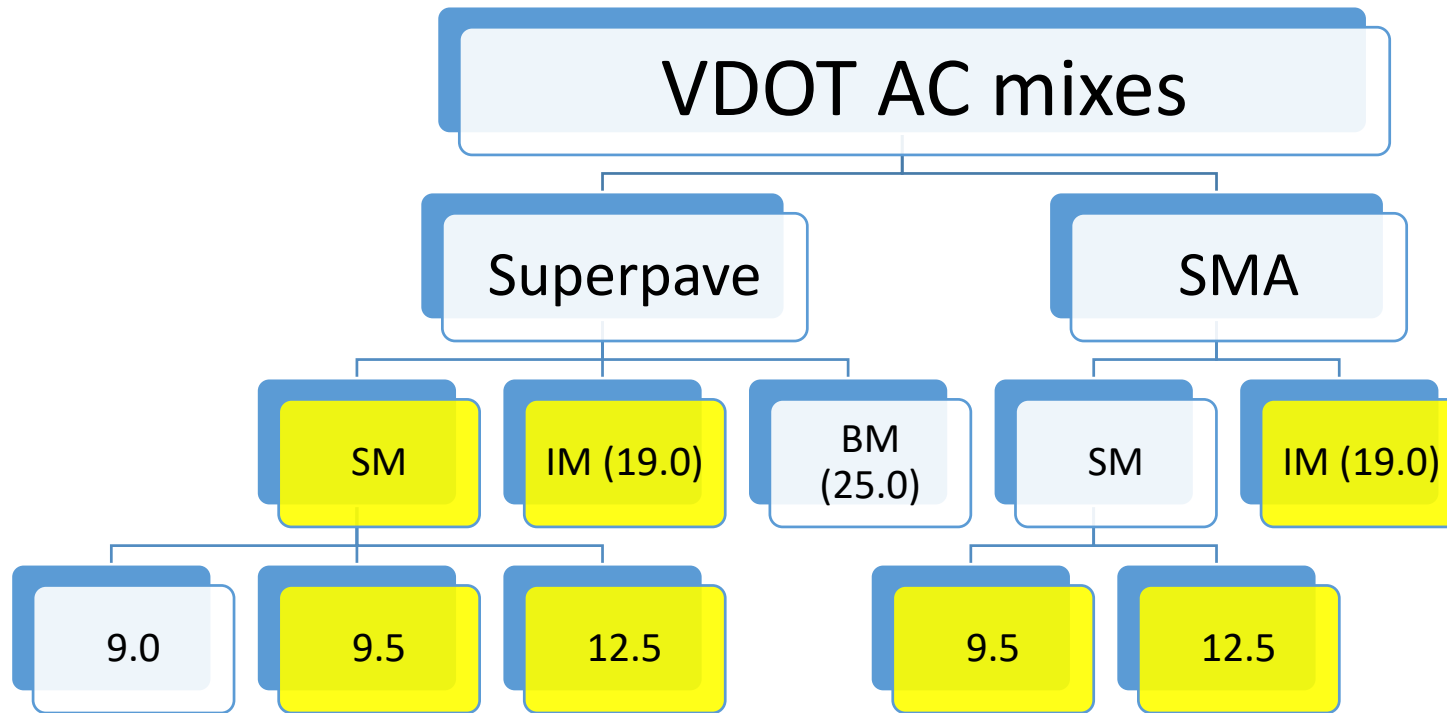
Issues faced

- Only few projects in Virginia
- Variable test results
- Difficulty to establish cluster values based on geography or materials
- Uncertainty of what materials to be used in construction

VDOT decided to use the MOP recommended value

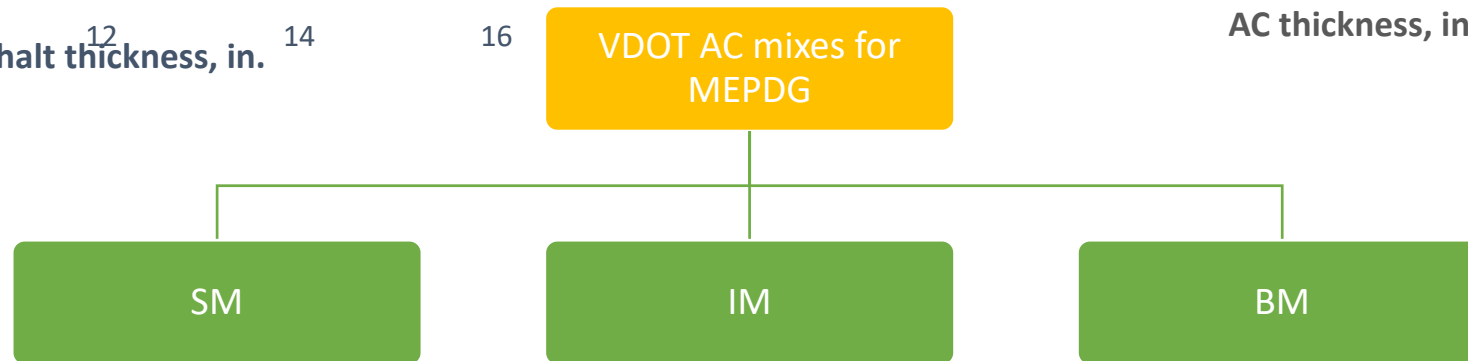
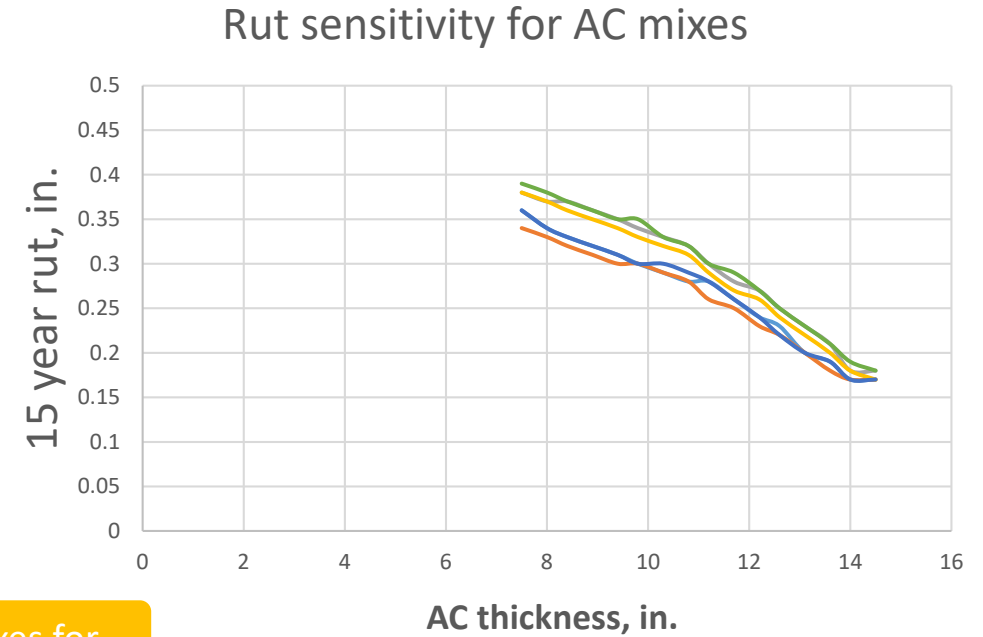
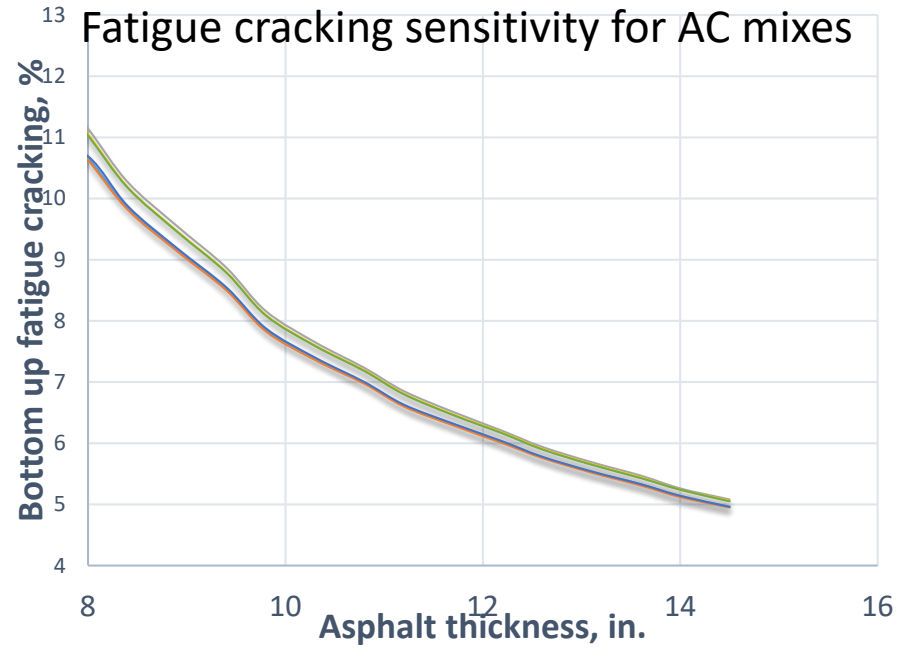
Better to focus on the geometric features

AC sensitive parameter: Dynamic modulus

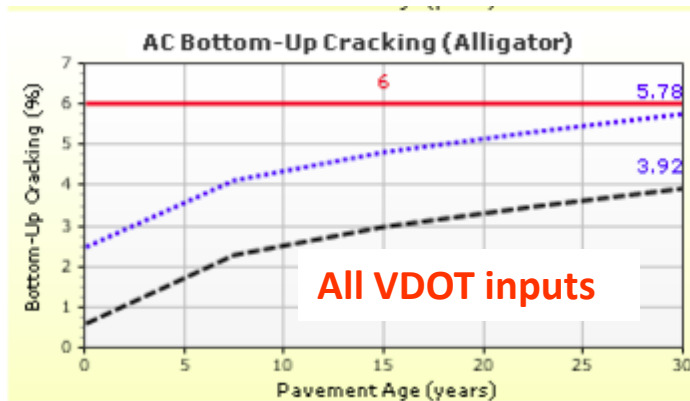


- Layer coefficient: 0.44
- We characterized 29 mixes
- Use individual mixes in design?
- Difference between VDOT & default mixes?

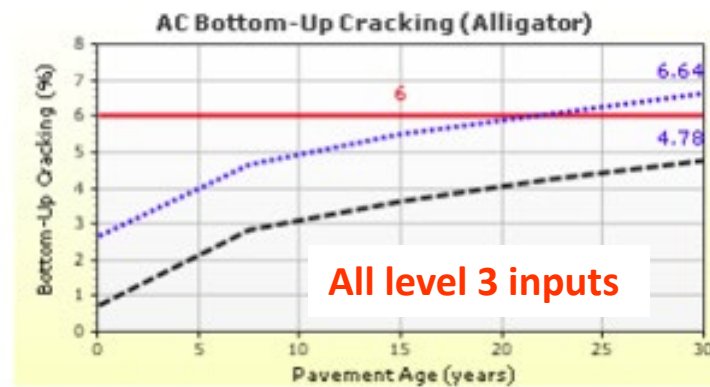
Performance of various VDOT AC mixes



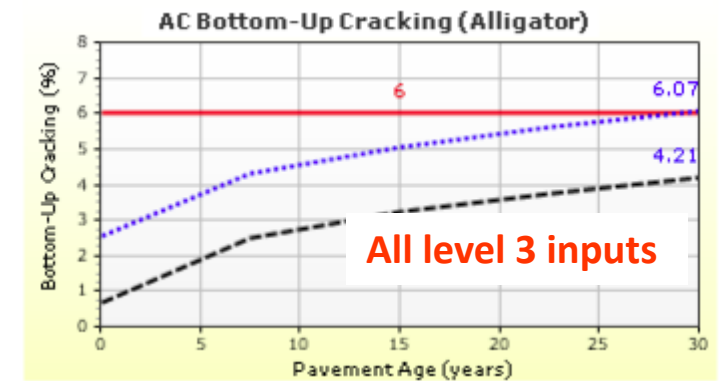
Performance comparison between VDOT and default (level 3) inputs



12.5" AC



12.5" AC



13.5" AC

- Local calibration using level 3 data may minimize some of these gaps
- This is just a “snap” shot, not a comprehensive comparison
- Other states may have different results

Should states go for Input parameters characterization for MEPDG implementation?

- if I could go back....(a potentially better approach?)
 - Local calibration using level 3 data
 - Implement MEPDG
 - Test local materials
 - Verify/refine local calibration
- Characterization of local materials can be critical, if
 - Distinctly known different properties among various materials, locations
 - AND
 - Distinctly different field performance
 - Good degree of confidence the contractor will use similar materials

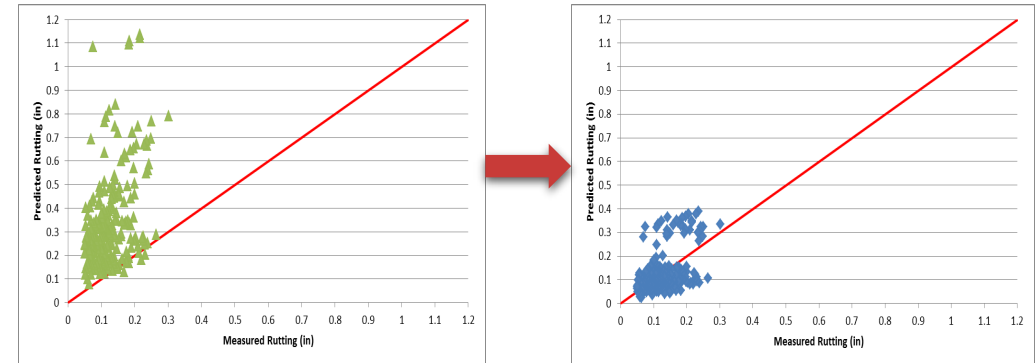
Quicker implementation

Model review: Local calibration

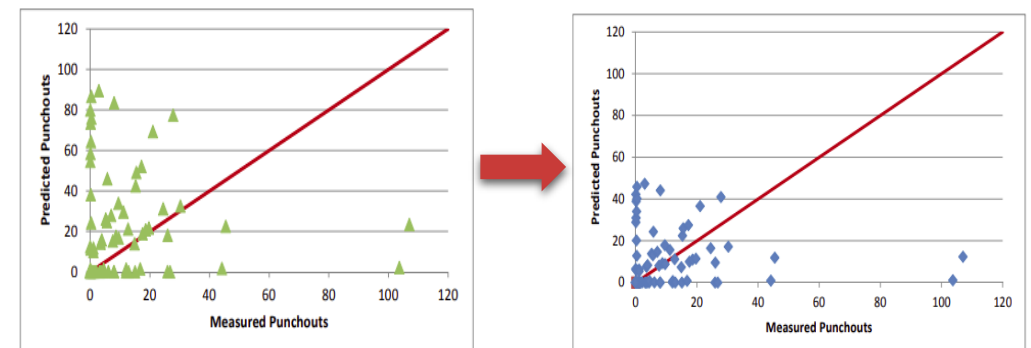
- Done in house (VTRC/Materials)
 - Used PMS data
 - AC: Fat. cracking & total rutting
 - CRCP: Punhnout
 - JPCP: Using global calibration
- Used version 2.2

Similar calibration not feasible in 1993 method
Calibration not perfect but a step forward
May need future refinement

Rutting calibration



Punchout calibration



Model review: Understanding output (passing the “smell” test)

- Ran sensitivity analysis for various parameters covering wide range of
 - Traffic
 - Subgrade
 - Environment
 - Materials
- The objective was to ‘catch’ anything ‘unusual’ so we can -
 - Address it (if there is a solution)
 - Come up with work around
 - Make concerned aware of it (at a minimum)
- Enhanced our level of confidence

Technical challenges

- Issues with characterizing/modeling all materials
 - We currently do not distinguish SMA, polymer mixes from superpave mixes
 - Cannot model recycled materials (CCPR/CIR)
 - These issues are common with 1993 method
 - MEPDG provides options for better solution
- Version 2.2.6 does not have semi rigid design option
 - Design semi rigid pavements as flexible pavement
 - Modeling stabilized materials as 80ksi agg. base disabling EICM

Technical challenges, contd.

- Apparent insensitivity to aggregate base
 - Would wait to see NCHRP 1-53 study
 - Mandated the use of 6" aggregate base or stabilized materials for pavement designed with MEPDG
- MEPDG is not a “silver bullet”
 - Need to manage expectation
 - It is the right step towards improvement

Training

- Had series of trainings
 - Used both ARA and in-house trainers
 - Internal users, external consultants
- Trainings help to minimize some fear of “complications”
 - We made it simple
 - Used the library function
 - Designers mostly need to pick thickness of the materials
 - Calibration coefficient part of our installation
- Do not expect to identical results of 1993 method

How did we manage all these?

- We missed few target dates
- Project planning approach (scope, schedule, budget)

Goal: Implementing MEPDG by January 1, 2018

Revision 6/28/2017

Objective(s):

- Create MEPDG Stakeholders and Technical Working Group (TWG) and conduct meetings during the implementation stage of MEPDG.
- Finalize outstanding material characterization, modeling, and performance target issues.
- Finalize MEPDG user manual and upload on VDOT consultant site.

Timeframe: December 2016 – September 2017

Activities	Lead/Partners	Target Date for Completion	Status of Progress/Issues	Actual Completion Date	Scope of Activities	Impact of Activities on Implementation Timeline
Activity 1: Establishing Stakeholders and Technical Working Committee						
Activity 1A: Establish stakeholders group (VDOT, Industry, and FHWA)	PD&E	December 2016/January 2017		December 2016	Stakeholder group will include representatives of VDOT, FHWA, and Industry. The group will be provided period update on status and progress of the implementation.	Critical*
Activity 1B: Establish Technical Working Group (TWG)	PD&E	December 2016/January 2017		January 2017	The TWG will include VDOT (Maintenance, CO Material, Districts, and VCTR), and Industry representatives. The team will address technical issues encountered during the implementation.	Critical*
Activity 2: Addressing MEPDG material characterization issues						
Activity 2 A: Consolidate existing asphalt mixes characteristics to one mix property per mix type (Surface, Intermediate, Base, and SMA)	Girum/ Ben	January 30, 2017		January 30, 2017	This activity will consolidate the existing test results from previous VCTR study to one unique value per mix type (Surface, Intermediate, Base, and SMA).	Important*
Activity 2 B: Reviewing Material Characterization input for CTA Layers and assess the impact of stiff layers on rigid pavements.	Girum /PD&E/TWG	May 1, 2017		April 15, 2017	This activity will incorporate the findings of VCTR research study on characterization of CTA for MEPDG Design in the user manual. This activity will also look the impact of CTA under flexible and rigid pavement.	Important*
Activity 2 C: Capping Subgrade Resilient Modulus (RM) value	Girum/PD&E/TWG	March 15, 2017		March 15, 2017	This activity will assess the need to provide capping on the resilient modulus value of subgrade soil. (Current VDOT MOI limits the maximum RM value of subgrade soils to 15,000 psi)	Important*
Activity 2 D: Providing Level 1 low temperature input values for Surface Mixes	Girum	March 3, 2017		March 3, 2017	This activity includes creating Level 1 low temperature input values (creep compliance and indirect tensile strength at 14 degree) for Surface Mixes. The task involves creating input values in a tabular and xml format from VTRC research study.	Important*
Activity 2 E: Finalizing the Development of Virginia Test Method on test to determine resilient modulus from Unconfined Compression (UC) test.	Girum/PD&E/Soil Lab /Quality Assurance	June 1, 2017		April 27, 2017	PD&E will facilitate the implementation of the proposed VTM. The VTM will be finalized & readily available as an alternative testing method to determine RM.	Important*

Policy: Getting stakeholders' buy in

- Kept industry in the loop
- Provided a year out notice to industry before “flipping” switch
- Established Technical Working Group (TWG) and stakeholders group
 - VDOT, industry, FHWA
- TWG addressed the technical issues/concerns
 - Provided plan, solicited feedback
 - Addressed everyone's comments, concerns
 - Transparent & open
 - Discussed all limitations, assumptions, potential workarounds
- Provided monthly update to the stakeholders group
- Obtained executive and industry buy in

Policy: Governance documents etc.

- Updated governance documents
- Finalized user manual
 - https://www.virginiadot.org/VDOT/Business/asset_upload_file108_3638.pdf
- Uploaded all xml files on the web for the consultants
 - <https://www.virginiadot.org/business/materials-download-docs.asp>
- Provided “training” to local consultants
 - <https://www.vtca.org/resources/other-resources/vtca-mepdg-seminar-video/>

Lessons learned

- Don't be perfectionist
- Ask if you are going forward
- Performing local calibration on level 3 data may be a significant time saver
- Run sensitivity and simulations to avoid any surprise
- Transparent communication with stakeholders is critical
- Have a long term plan to incorporate updates and revise protocols

Questions

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