

TRANSPORTATION RESEARCH BOARD

Where Are We Now with Performance-Based Pavement Warranties?

October 19, 2020

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#TRBwebinar



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- Questions? Contact Reggie Gillum at RGillum@nas.edu

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#TRBwebinar

Learning Objective

Discuss highway agency use of performance-based pavement warranties

#TRBwebinar



Transportation Research Board Webinar
October 19, 2020

Where Are We Now with Performance-Based Pavement Warranties?

***NCHRP Project 20-05, Topic 50-09
NCHRP Synthesis 553***

**Linda Pierce
NCE
Spokane, Washington**

Synthesis Purpose

*Document agency practices
associated with performance-based
pavement warranties*

*Asphalt & concrete pavement preservation,
rehabilitation, & new/reconstruction*

Learning Objective

*Describe highway agency use of
performance-based pavement
warranties*

Synthesis Panel

Jo Allen Gause
Senior Program Manager
NCHRP

Linda Pierce
Principal Investigator

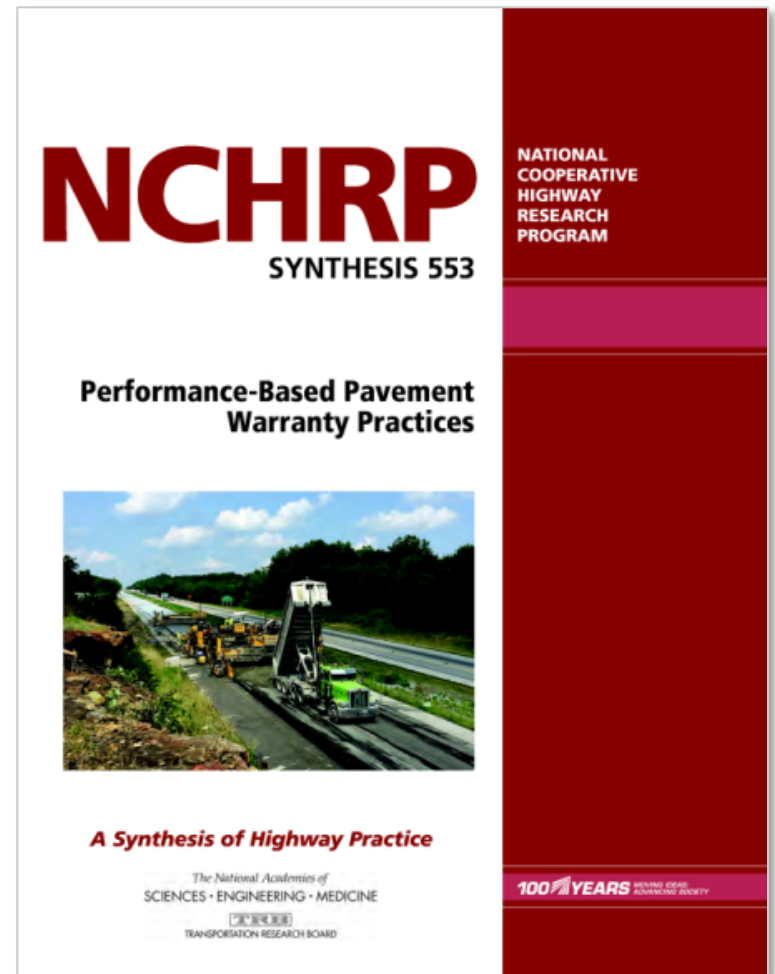
Jose Medina &
Sarah Stolte
Staff Engineer

Project Panel

- Anita Bush, NVDOT
- Xingwei Chen, LADOTD
- Gerald Huber, Heritage Research Group
- Thomas Kane, NYSDOT
- Munir Nazzal, Univ. of Cincinnati
- Cynthia Smith, MSDOT
- Charles Wienrank, ILDOT
- Katherine Petros, FHWA
- Nelson Gibson, TRB

Outline

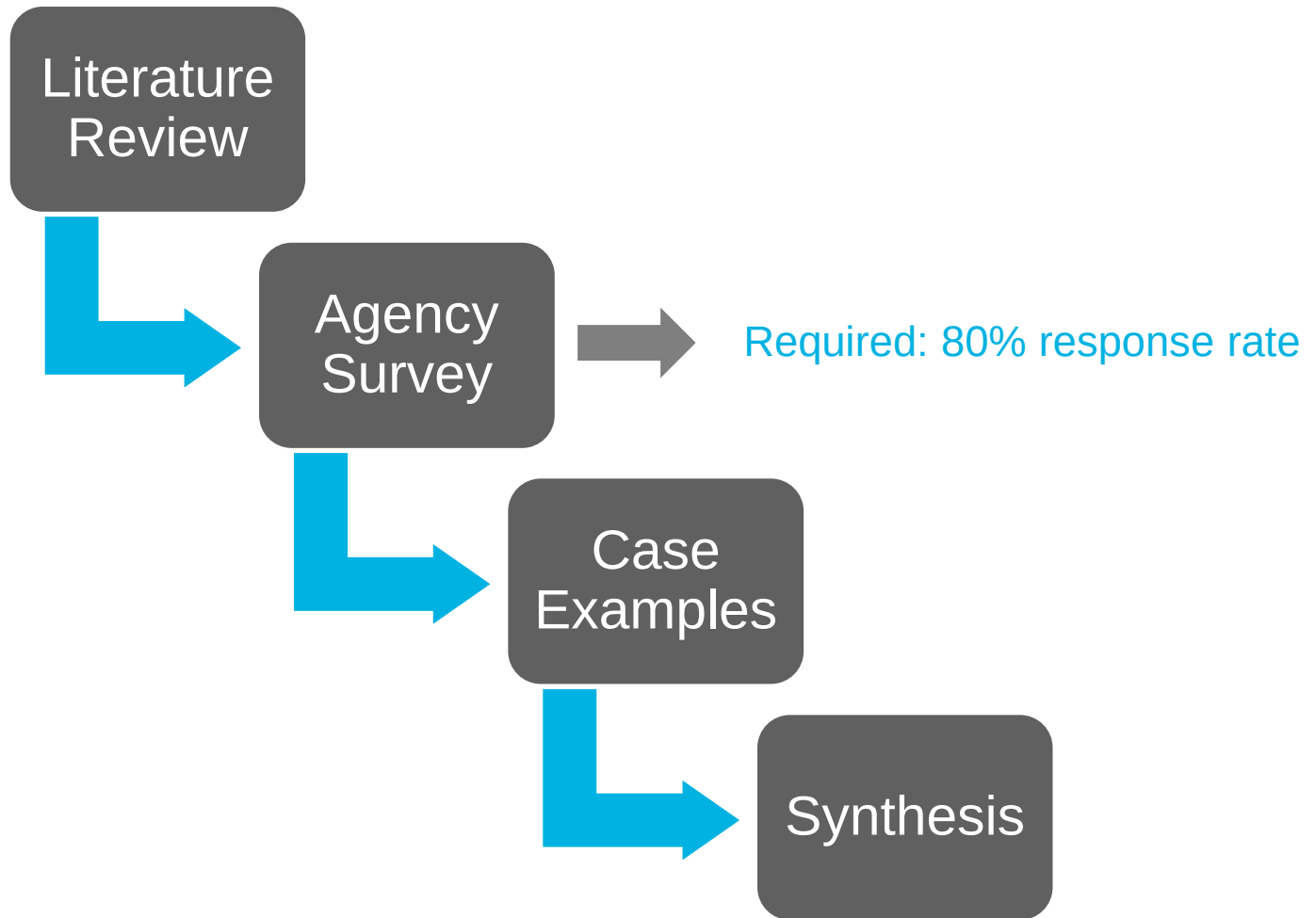
- Scope
- Highlight
 - Survey results
 - Case studies
- Concluding remarks
- Future research
- Questions



Scope

- Document agency practices:
 - Performance criteria & thresholds
 - Project selection criteria
 - Warranty periods
 - Warranty enforcement
 - Extent of use
 - Frequency of invoking warranties
 - Experience (performance improvement, cost, etc.)

Synthesis Process



Project Delivery

Design-Bid-Build

- Traditional
- Agency develops plans & specs
- Competitive bid (low bid)
- Contractor conducts work

Design-Build

- Agency selects design-builder
- Design-builder prepares plans & specs & conducts work

Private-Public Partnership

- Contract between public & private sector
- Takes on risk for design, construction, finance, long-term operation, & traffic revenue

Warranty Types

Materials & Workmanship

- Contractor responsible for correcting defects within contractor's control
- No responsibility for pavement design or resulting distress
- Some responsibility for material selection & workmanship

Performance

- Contractor fully responsible for product
- Short-term: mix design to thickness design
- Long-term: pavement performance

Warranty Period

- Duration of time from acceptance of work to end of the evaluation period
 - Pavement preservation: 1 to 3 years
 - Asphalt pavements: 3 to 5 years
 - Concrete pavements: 5 to 10 years
 - Long-term (P3): 20+ years

Performance Evaluation

- Manual & automated pavement condition surveys
 - Conducted by agency (or designee)
 - Prior to, every 6 to 12 months, & at end of warranty period
- Sample (300-500 ft) or 100% survey

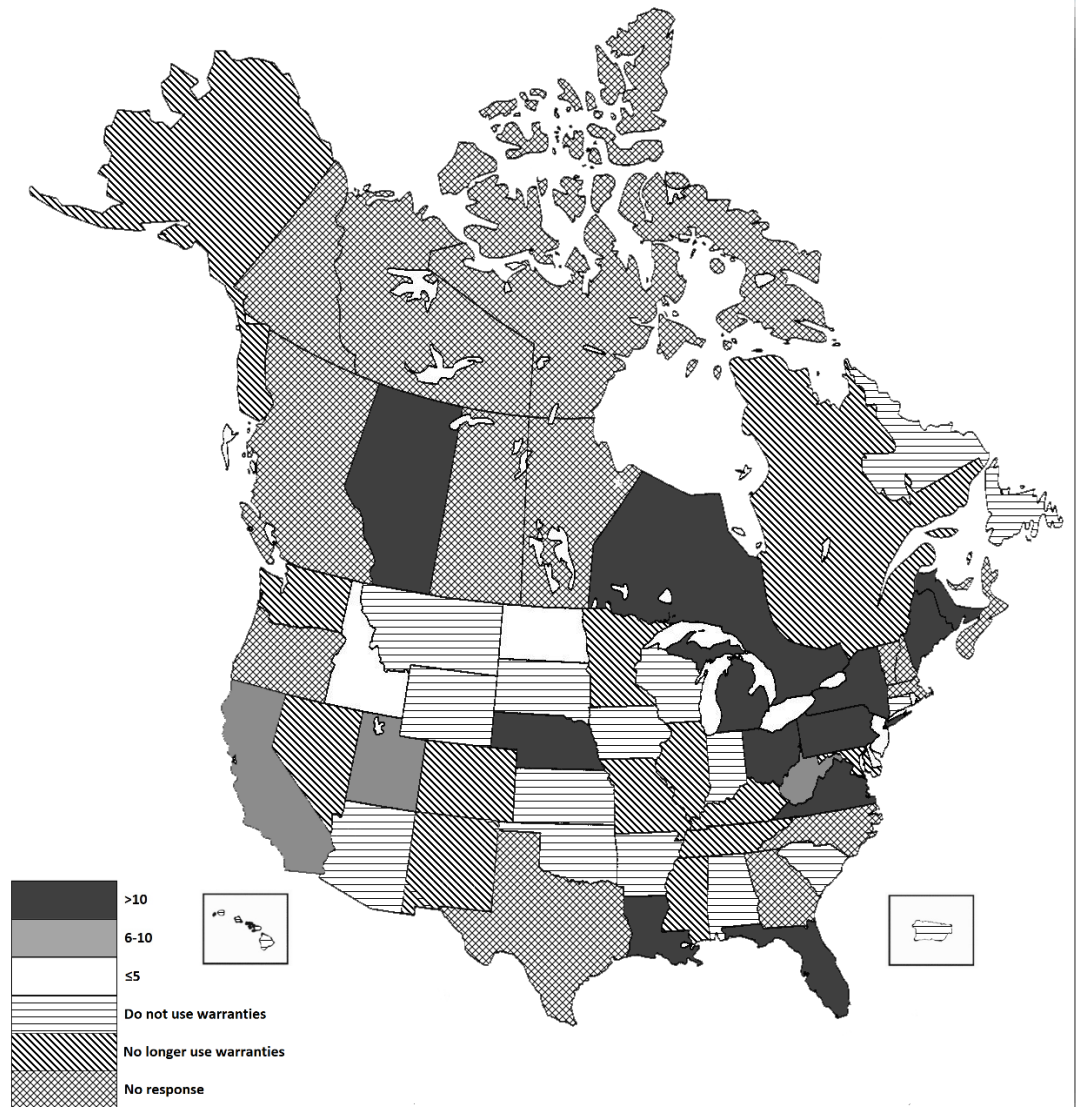


Agency Survey Results

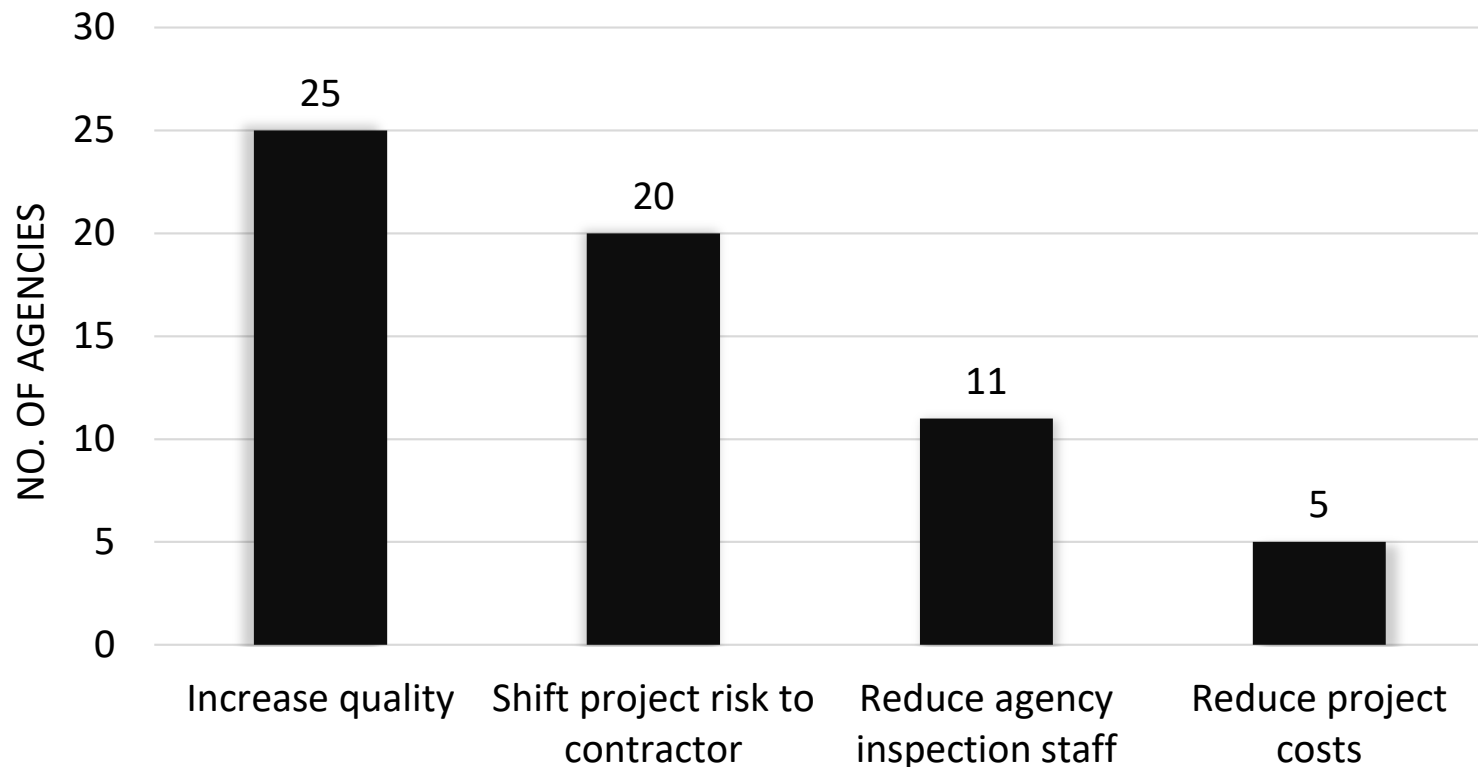
*44 U.S. & Puerto Rico highway agencies &
6 Canadian provincial & territorial agencies*

Years of Experience

- ≤ 5 years
 - 3 agencies
- 6 to 10 years
 - 3 agencies
- ≥ 10 years
 - 12 agencies

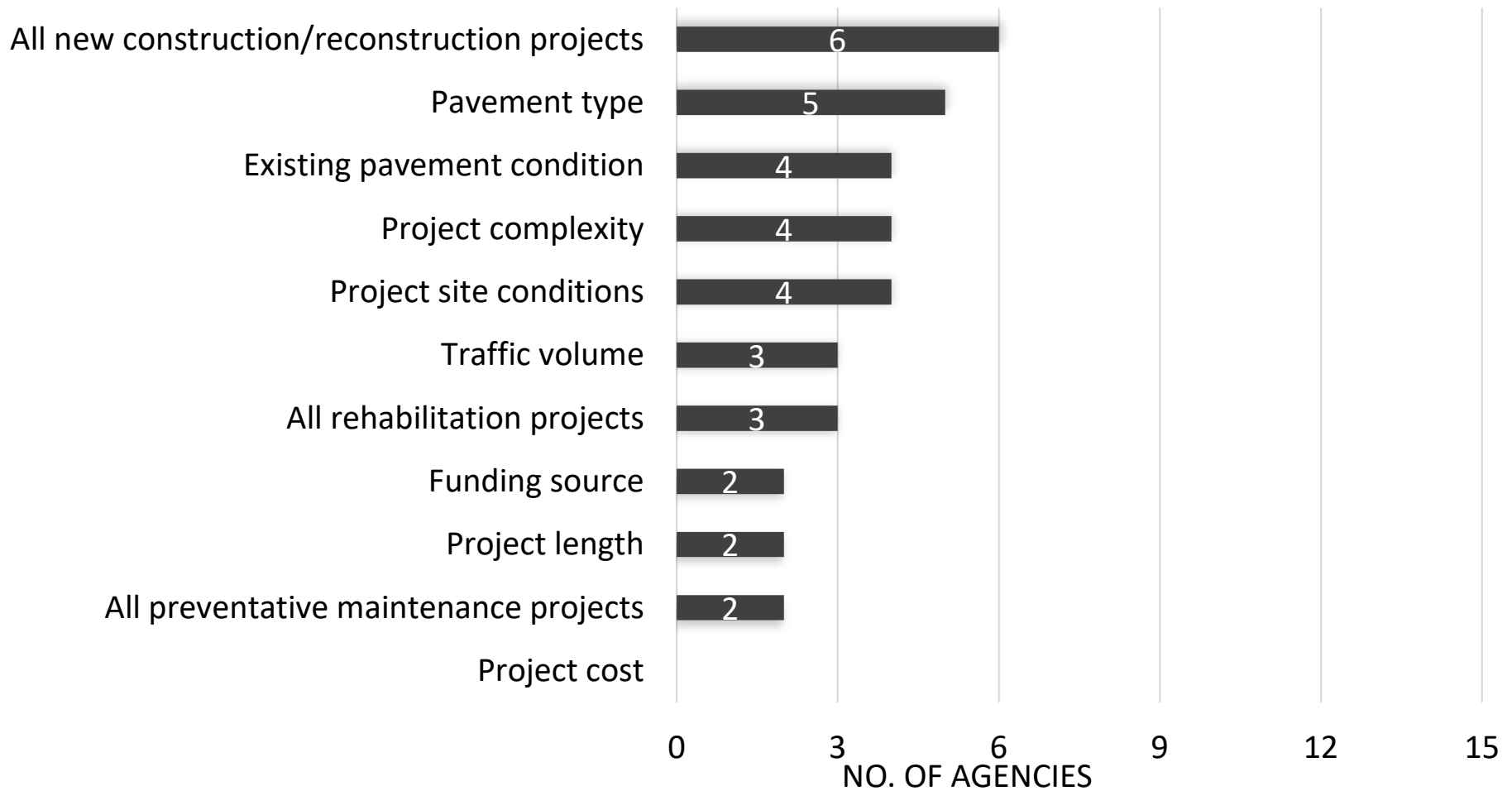


Warranty Objectives



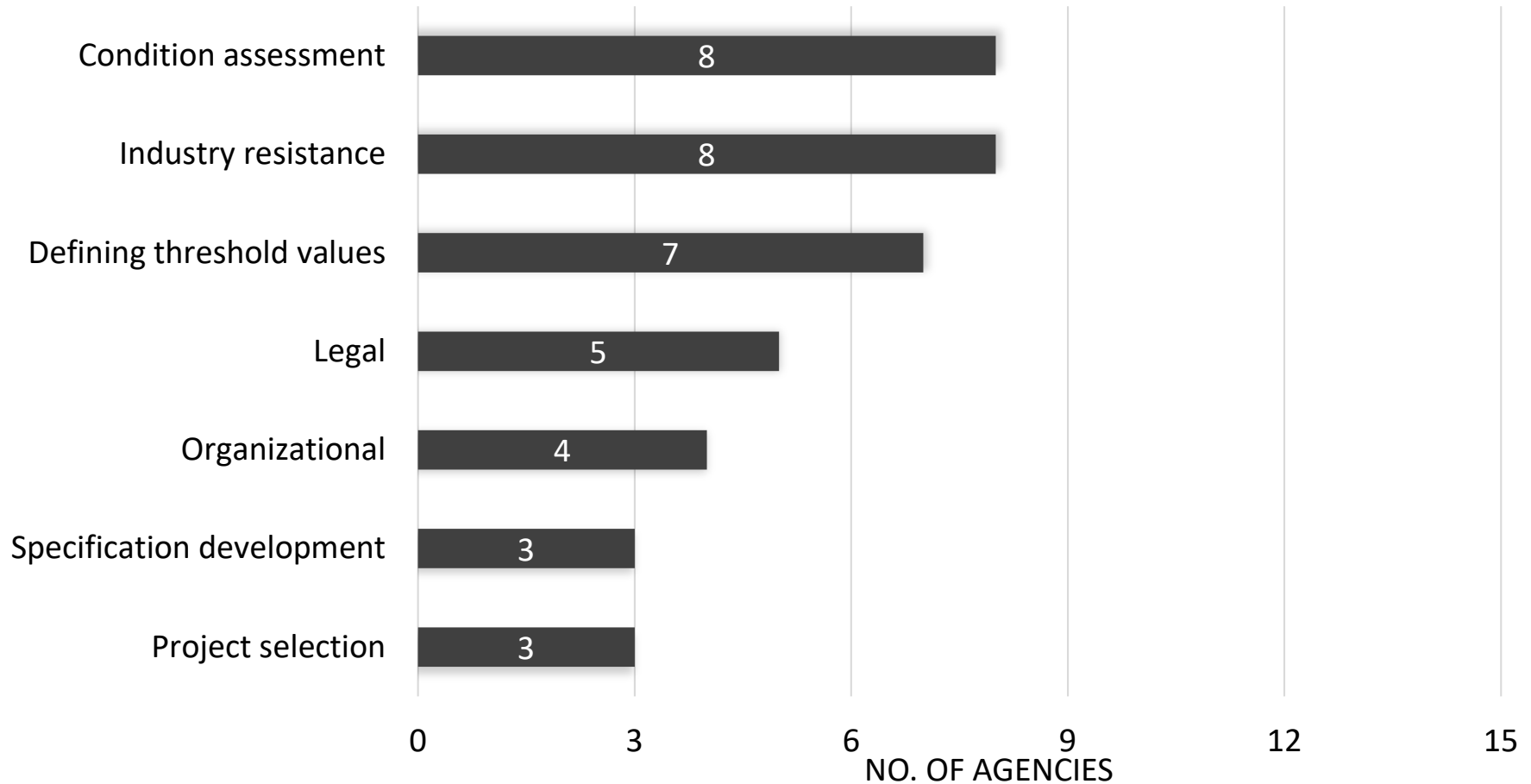
Number of responding agencies: 32

Project Selection



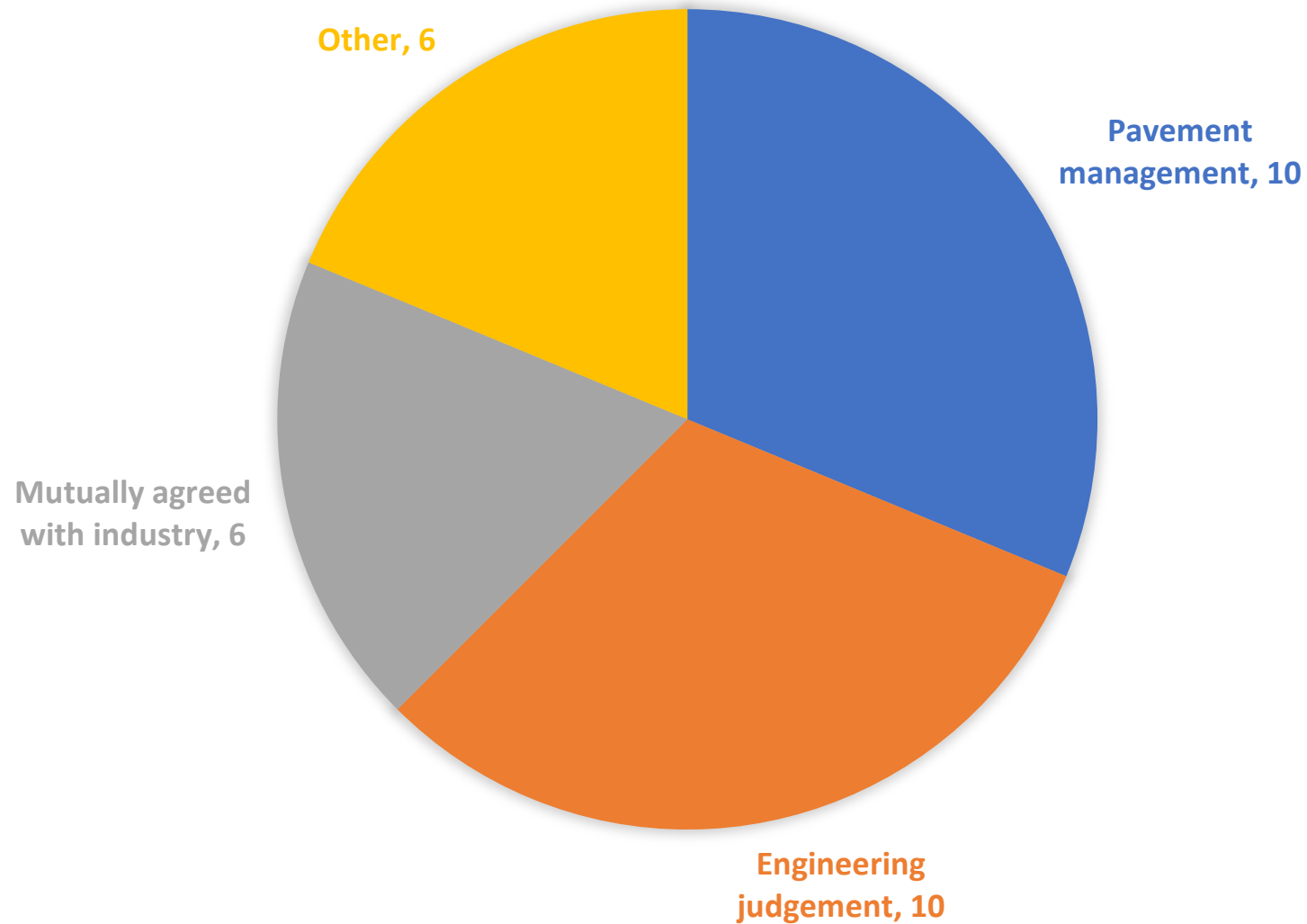
Number of responding agencies: 14

Warranty Challenges



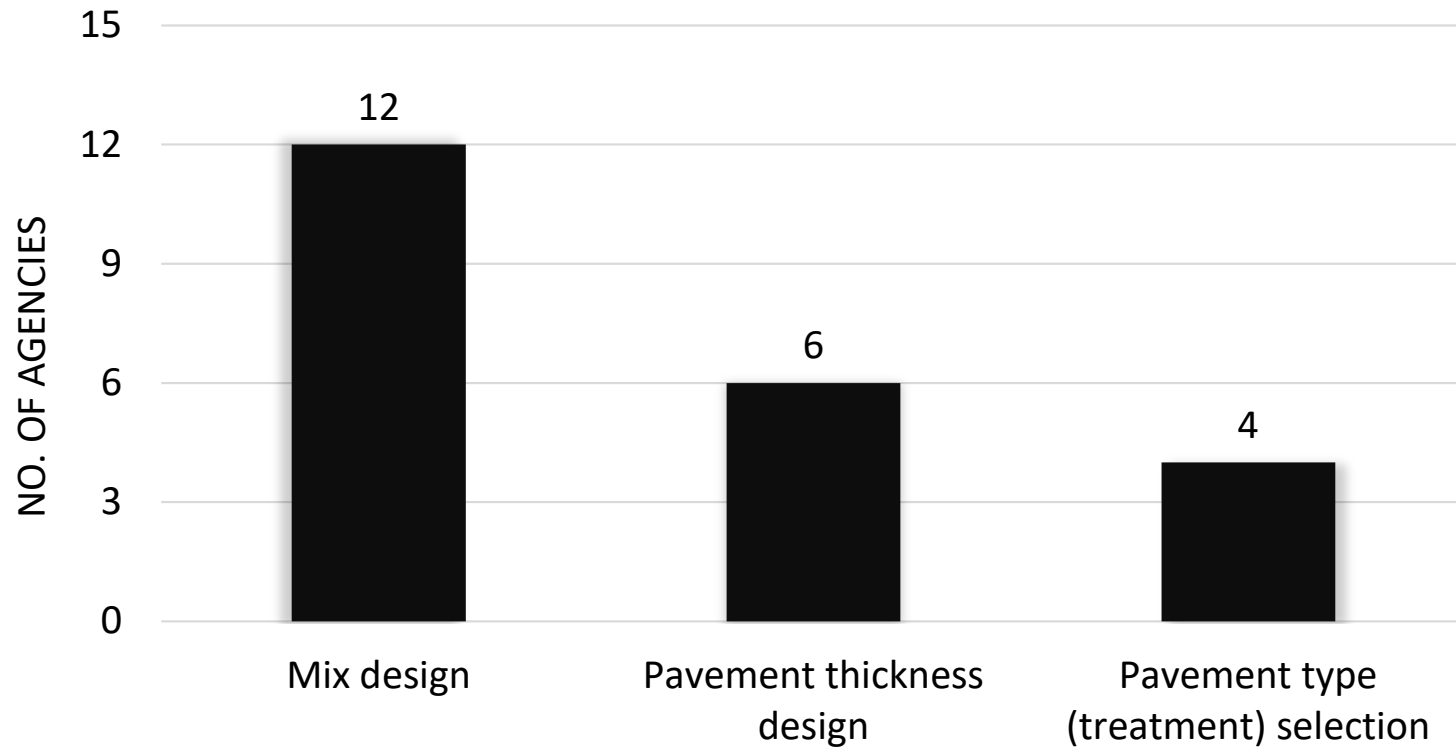
Number of responding agencies: 16

Performance Criteria



No. responding agencies = 16

Contractor's Responsibility



Number of responding agencies: 13



Case Examples

Alberta

Florida

Michigan

Pennsylvania

West Virginia

Alberta Transportation

- Design-build-finance-operate
 - 30-year performance warranty
 - Penalties for delays in opening to traffic
 - No tolls
 - Compensate contractor monthly
- New asphalt or concrete pavements
 - Type & thickness determined by contractor

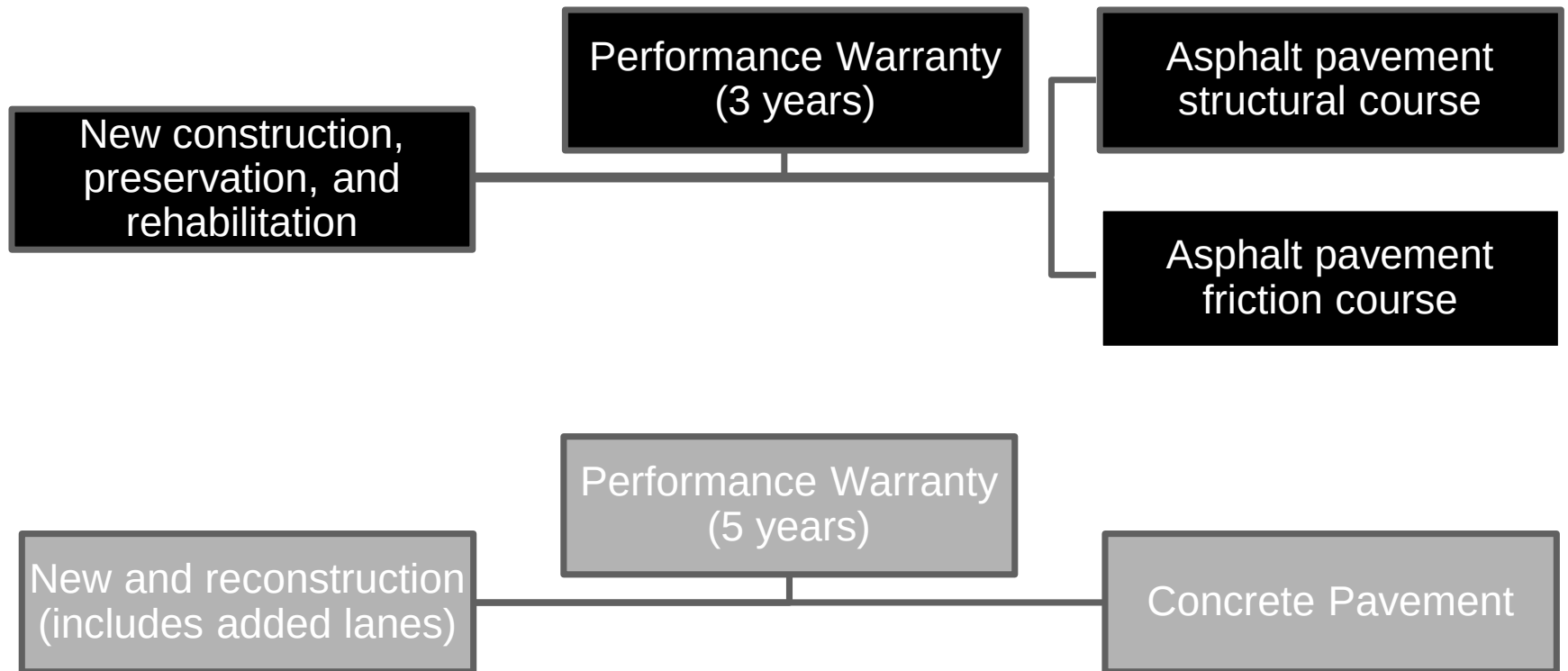
Requirements

- Contractor responsible for all aspects
- Pavement design life: 50 years
 - Future rehab: mill & overlay
- Pavement condition:
 - Conducted by contractor (prior to opening, at least once every 3 years)
 - IRI, rut, skid, surface defects
 - Maintain during operating period

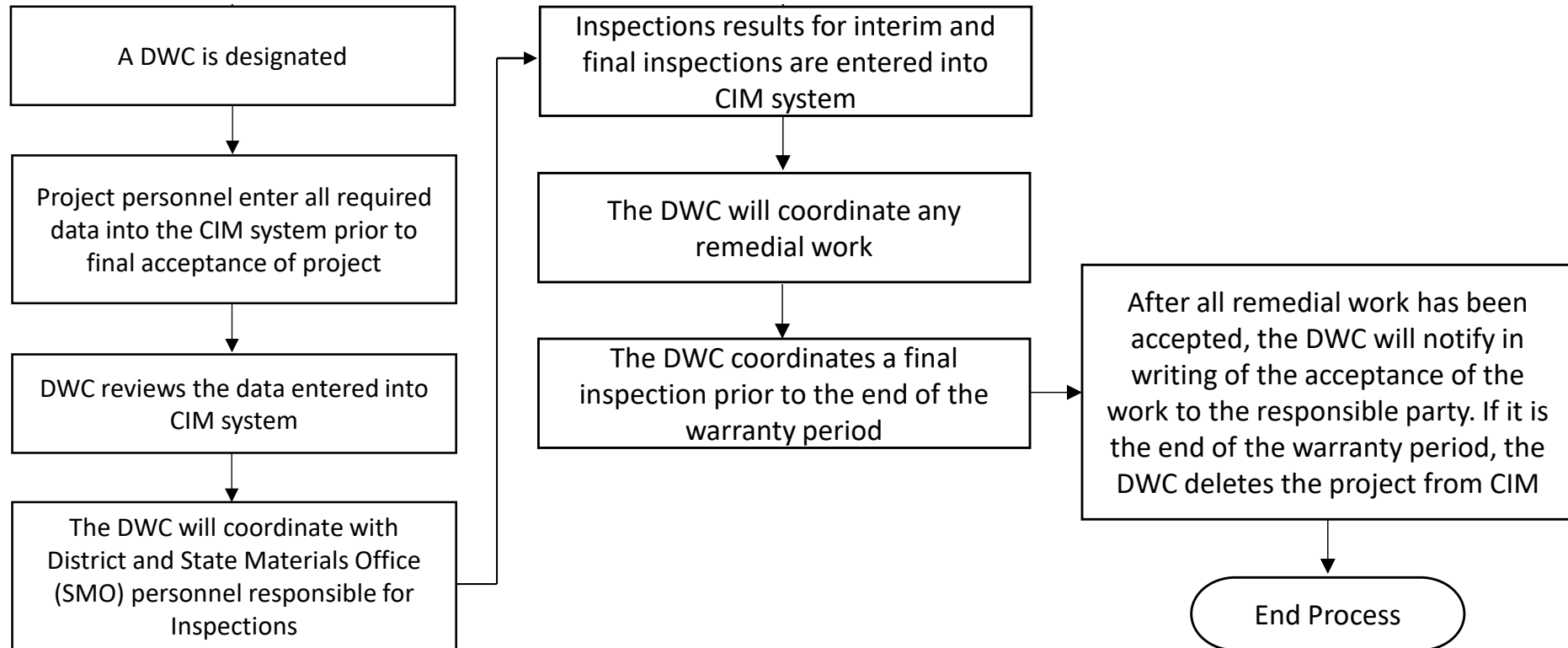
Turn-Back

- Cross-slope & superelevation
- Pavement width
- IRI, rut, skid, surface defects
- Long-life pavements:
 - No strengthening or structural overlay for 10 years
- All others:
 - Require < 2-inch asphalt overlay (or equivalent) for 10 years
- 10-year ESALs determined by mutually agreed independent consultant

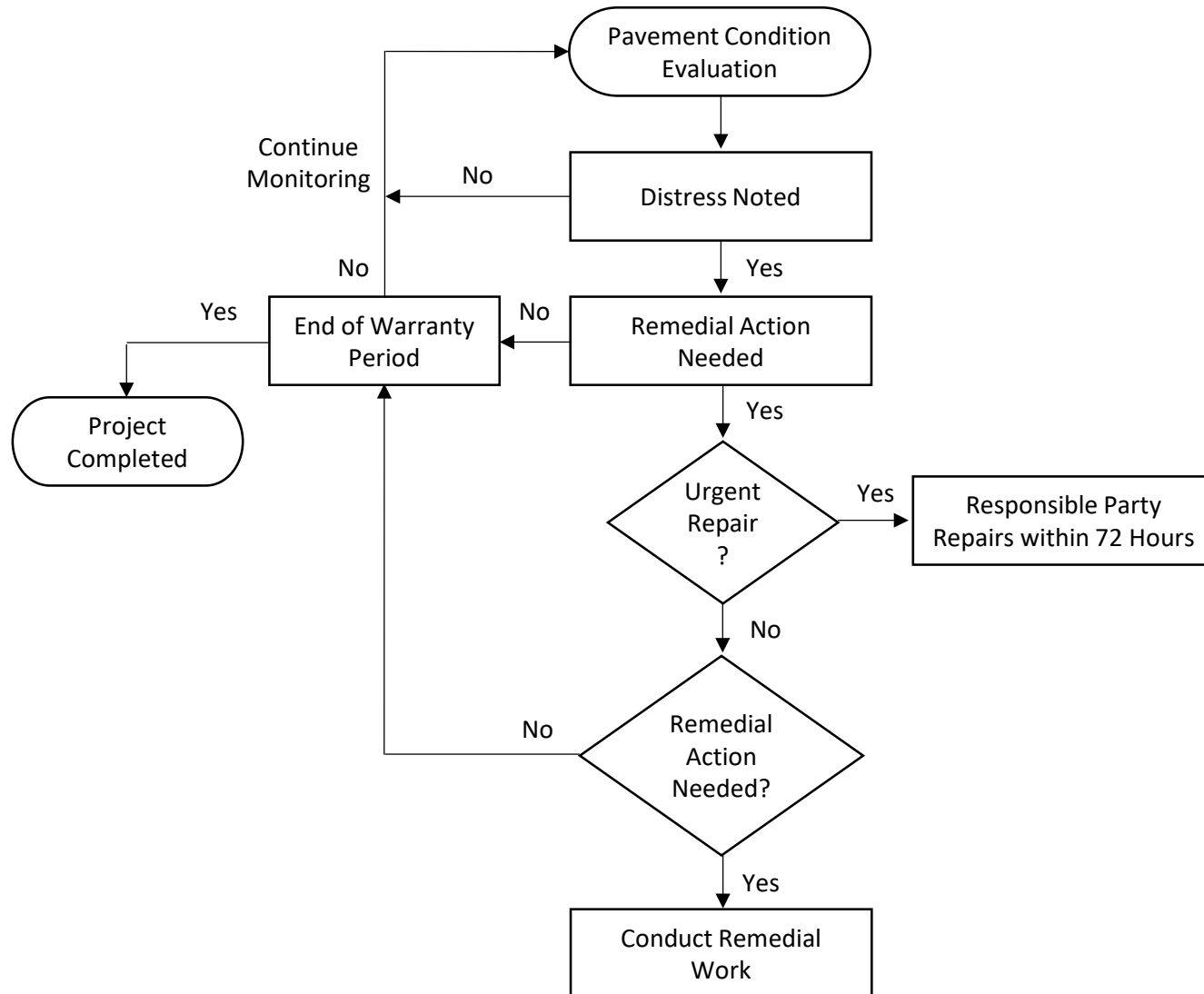
Florida DOT



Warranty Process



Pavement Evaluation



Performance Criteria–Asphalt

Distress Type	Threshold Value	Remedial Work
Bleeding	$\geq 10 \text{ ft}^2$ (0.9 m ²)	Remove & replace full depth, full lane width, & length plus 50 ft (15 m) on each end
Cracking	$\geq 30 \text{ ft}$ (9 m) long & $\geq 0.125 \text{ in.}$ (3 mm) wide	Remove & replace full depth & width of all layers
Potholes & slippage areas	As observed by Engineer	Remove & replace full depth, full lane width, & length plus 50 ft (15 m) on each end
Raveling, friction course delamination	Any length	Remove & replace full depth, full lane width, & length plus 50 ft (15 m) on each end
Ride Number	< 3.5	Remove & replace friction course layer full length & width; less extent may be proposed if DOT approved
Rutting	$> 0.25 \text{ in.}$ (6 mm)	Remove & replace full depth & lane width of all layers; or contractor proposed, & DOT approved
Settlement/depression	$\geq 0.5 \text{ in.}$ (13 mm)	Propose the correction method, approved by DOT

Category 1 – mainline, access roads, frontage roads $\geq 55 \text{ mph}$ (89 kph)

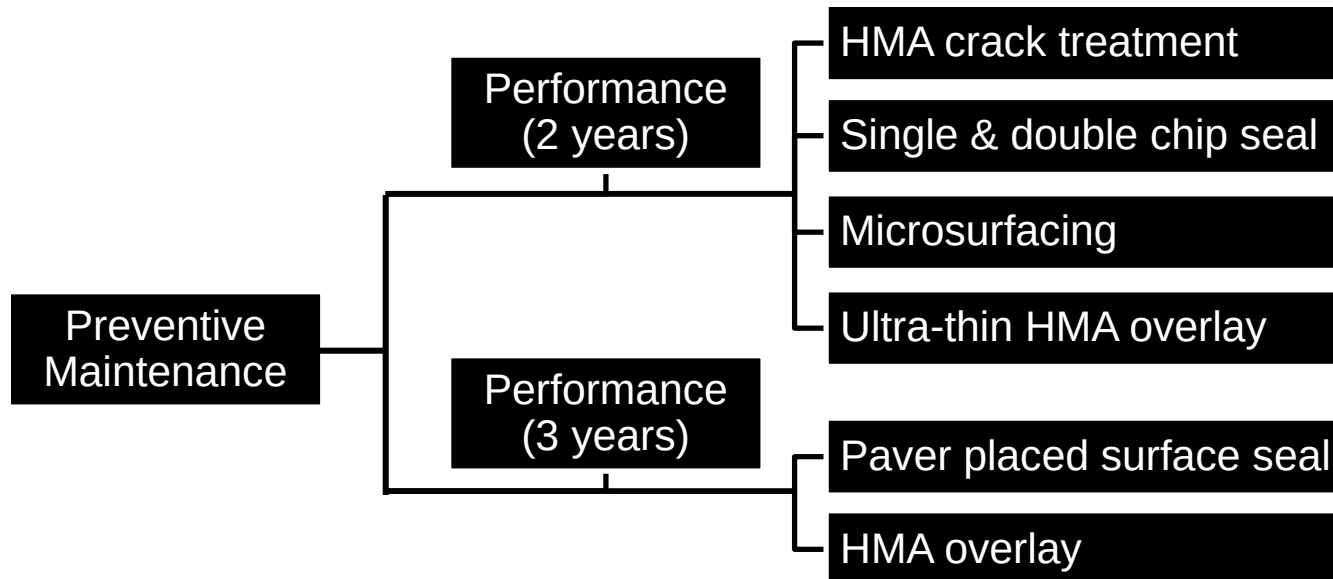
Performance Criteria – Concrete

Distress Type	Threshold Value	Remedial Work
Cracking	4 per ln-mi > 0.125 in. wide OR any crack > 0.1875 in. (3 per ln-km > 3 mm wide OR any crack > 5 mm)	Full depth replacement minimum 6 ft (1.8 m) long & full slab width
Ride Number	< 3.5	Grind all deficient & partial lots
Shattered Slab	Divide slab into 3+ segments	Full slab replacement
Spalling in wheel path	4 per ln-mi > 1 in. wide & > 6 in. long OR any single area > 3 in. wide (2 per ln-km > 25 mm wide & > 152 mm long OR any single area > 76 mm wide)	Full depth replacement minimum 6 ft (1.8 m) long & full slab width

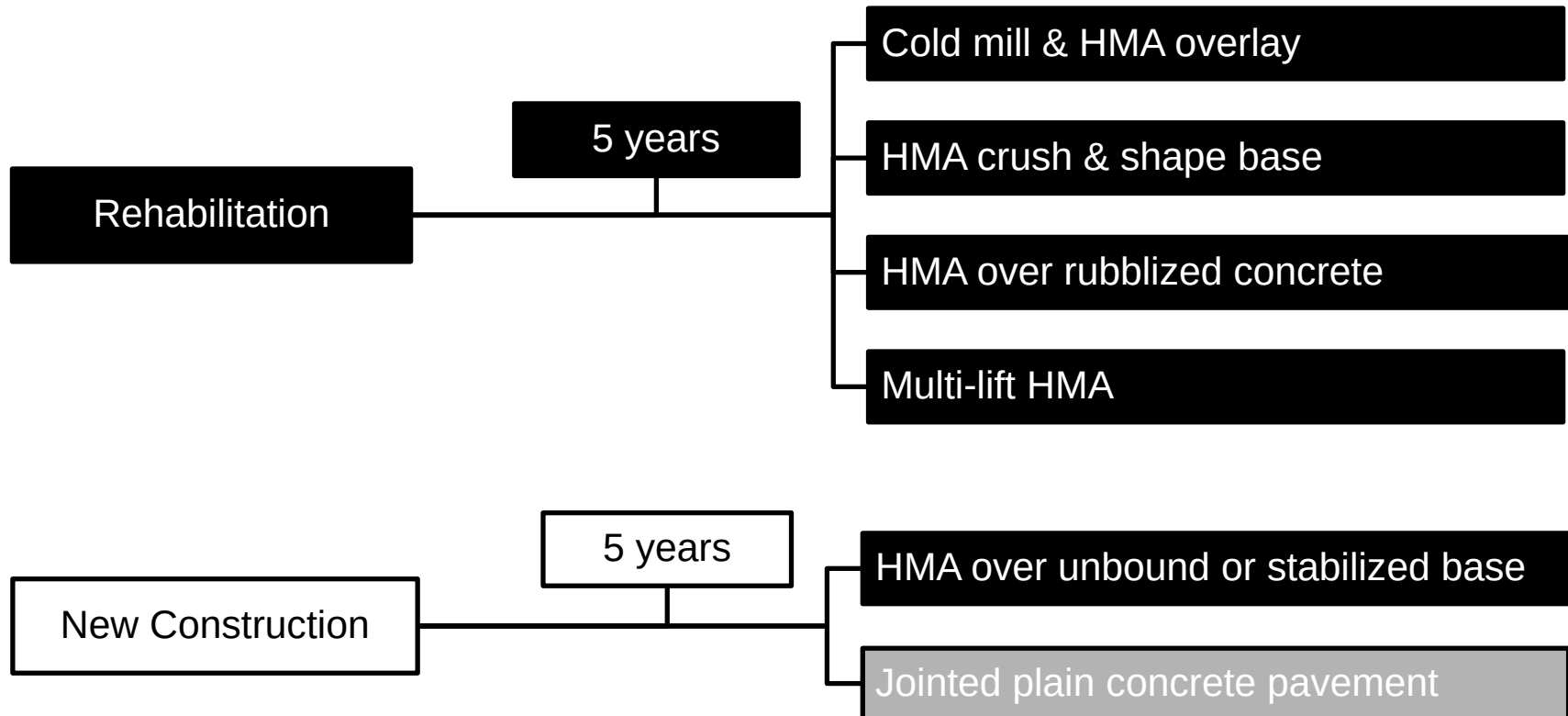
Statewide Dispute Review Board

- 3 members
 - Agency, contractor, & mutually agreed
- Decisions are binding with no appeal
- Remedial work not required when:
 - Agency thickness design is deficient
 - ESALs > 25% design ESALs
 - Underlying layer failure not part of contract
 - Deficiency due to third party
 - Raveling OGFC due to turning movements

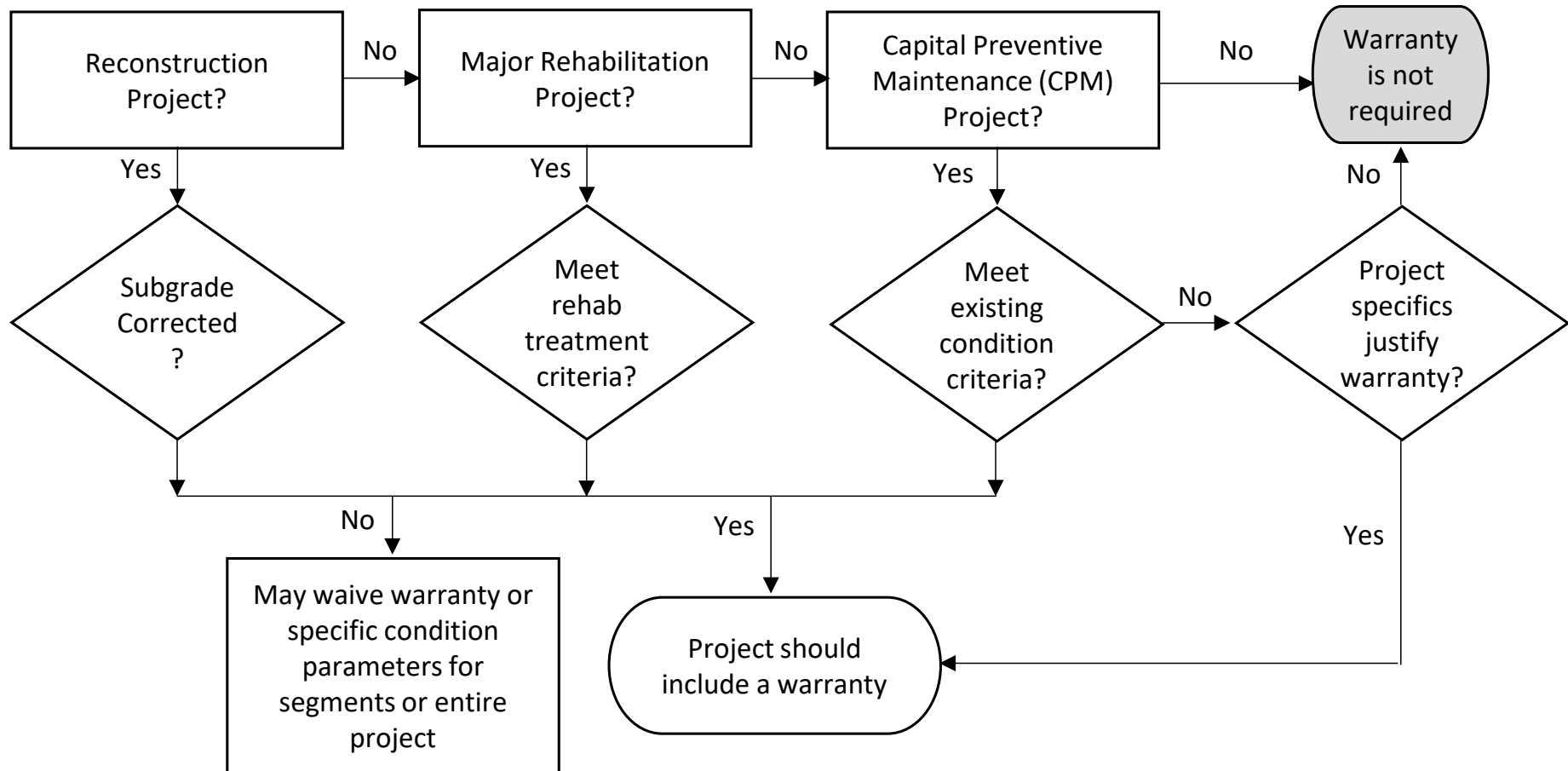
Michigan DOT



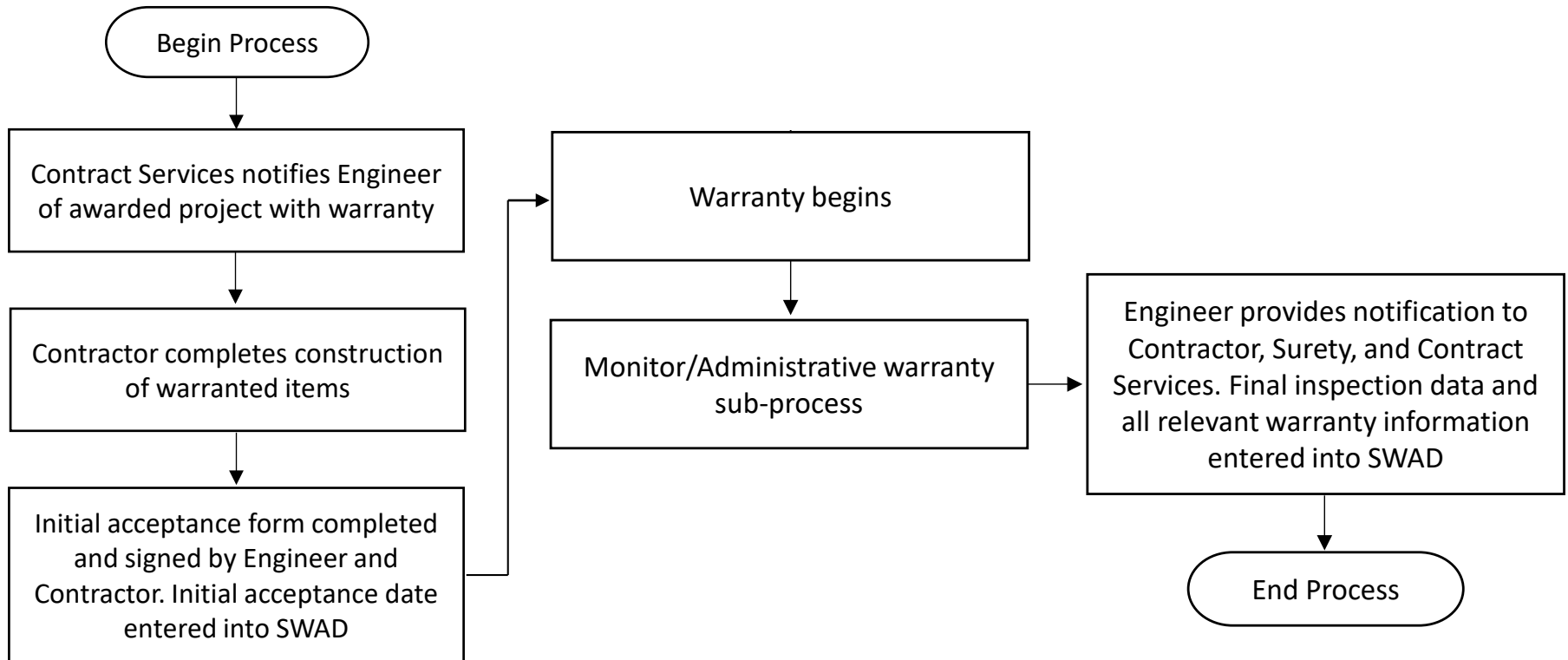
Materials & Workmanship



Decision Tree



Warranty Process



Pavement Evaluation

- Agency conducts cursory (windshield) survey
 - Warranty work identified
 - Contractor disagrees & initiates conflict resolution
 - Agency conducts detailed inspection

Performance Criteria

Treatment Type	Inspection Period Begins	Cursory Evaluation	Detailed Evaluation
HMA crack treatment	20 months	Minimum 1 segment per mile	Total length from cursory inspection
Single & double chip seals	20 months	N/A	Distress in worst segment every 2 mi (3.2 km)
Paver placed surface seal	32 months	Approximate quantities for the worst segment(s) by distress type	Distress in worst segments (exceed threshold limits) for each distress type
Microsurfacing	20 months	Approximate quantities for the worst segment(s) by distress type	Distress in worst segments (exceed threshold limits) for each distress type
Ultra-thin HMA overlay	20 months	Approximate quantities for the worst segment(s) by distress type	Distress in worst segments (exceed threshold limits) for each distress type
HMA overlay or cold mill & HMA overlay	32 months	Total distress in any given segment	Distress in worst segments (exceed threshold limits) for each distress type

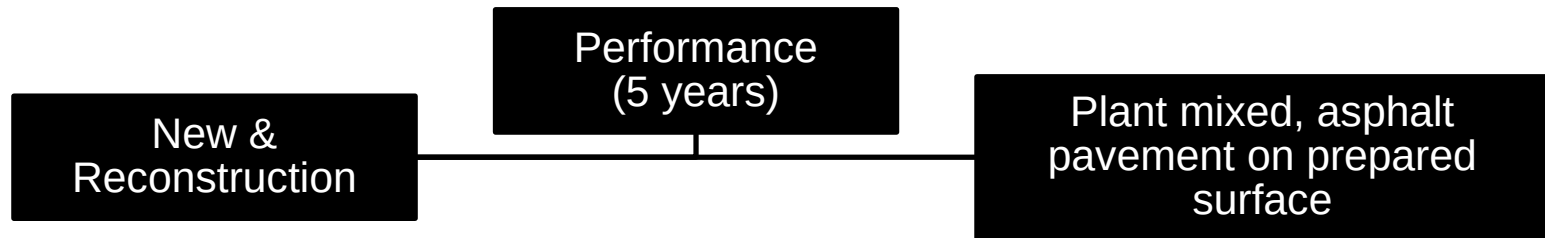
Performance Criteria *(continued)*

Treatment Type	Inspection Period Begins	Cursory Evaluation	Detailed Evaluation
HMA crush & shape base or HMA over unbound or stabilized base	30 months	Estimated quantity of worst segments of each distress type	N/A
HMA over rubblized concrete, multi-lift HMA, or HMA new construction	54 months	Estimated quantity of worst segments of each distress type	Measured quantity of each distress in each segment. Tally segments exceeding threshold limit
JPCP new construction	30 months	Quantity of worst segments of each distress type	N/A
	54 months	Quantity of worst segments of each distress type	Segments $\geq$ 1 distresses exceeding threshold limit

Corrective Action

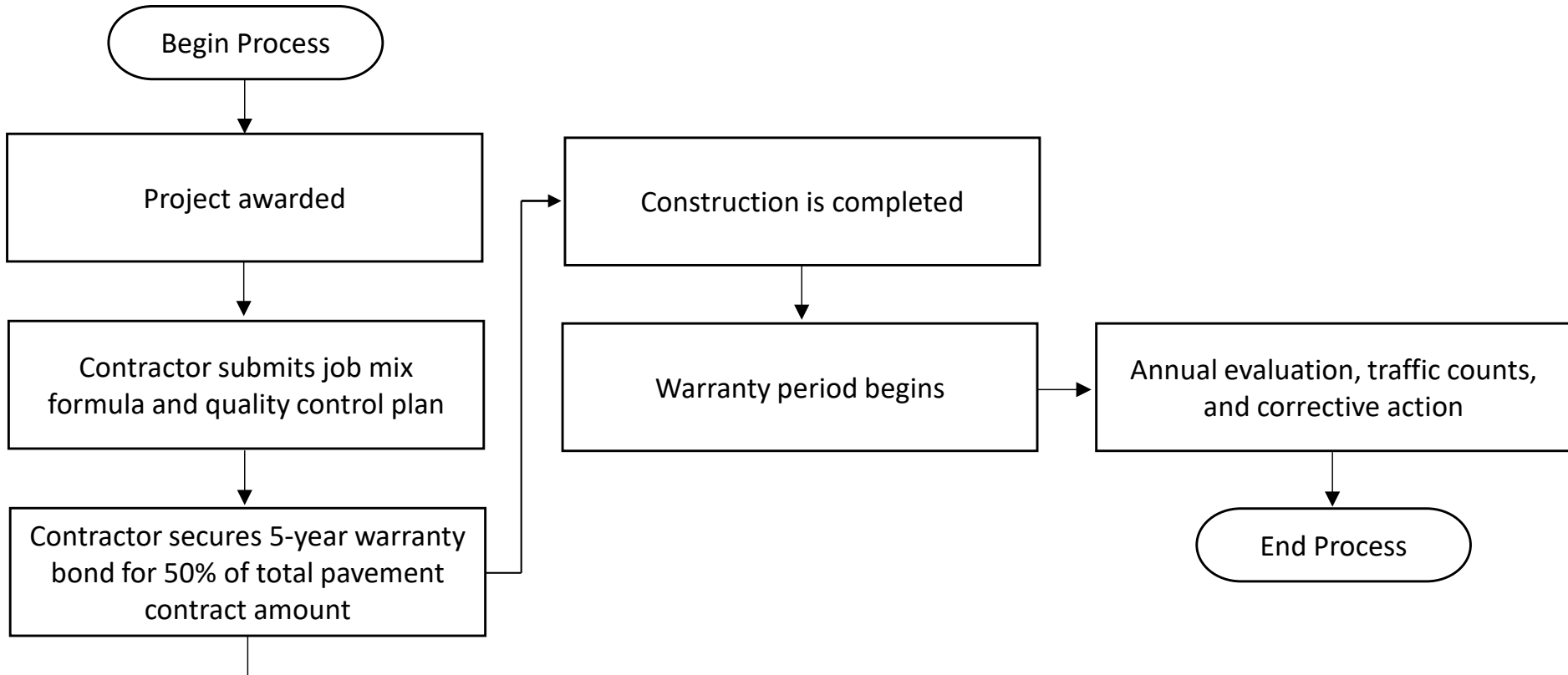
- 5 members
 - 2 agency, 2 contractor, & 1 mutually agreed
- Contractor not held responsible for:
 - Agency thickness design is deficient
- If contractor M&W & agency thickness design, cost for correcting shared (% responsibility)

Pennsylvania DOT



- Mainline pavements
 - Good base & drainage conditions
 - Eligible for ride quality specifications
 - 20-year design life

Warranty Process



Pavement Evaluation

- Agency (or designated appointee) conducts each year of warranty period
 - Automated or manual pavement condition surveys (Publication 336)
 - Flushing & potholes (manual)
 - Year 5: > 30% two or more low severity distress types
 - Microsurfacing or
 - Other agency approved treatment

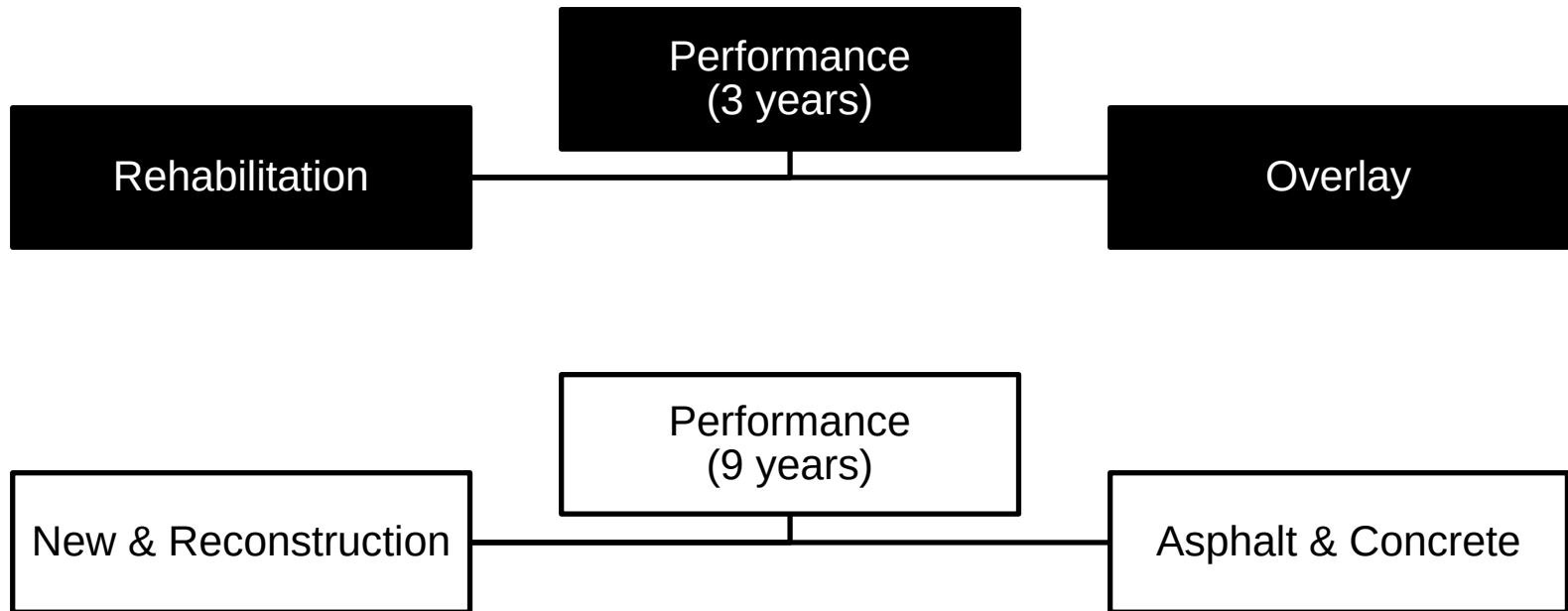
Performance Criteria

Distress Type	Threshold Value	Remedial Work
Cracking (transverse & miscellaneous)	All low to medium severity	Seal crack 0.25 to 1.0 in. (6 to 25 mm) & fill cracks > 1 in. (25 mm) with 4.75 mm bituminous wearing course
	All high severity	Remove & replace full lane width & depth necessary & length not less than 10 ft (3 m) beyond distressed area
Fatigue cracking	All medium or greater severity	Remove & replace full lane width & depth necessary & length not less than 10 ft (3 m) beyond distressed area
Flushing	All	Remove & replace layer full depth & full or half lane width & a minimum of 24 in. (0.6 m) beyond distressed area
Longitudinal, shoulder, & lane joints	All medium severity	Seal crack 0.25 to 1.0 in. (6 to 25 mm) & fill cracks > 1 in. (25 mm) with 4.75 mm bituminous wearing course
	All high severity	Remove & replace 12 in. (305 mm) either side of joint & a minimum of 24 in. (610 mm) beyond distressed area
Potholes (+ slippage areas)	All	Remove & replace full lane width to depth necessary & length not less than 10 ft (3 m) beyond distressed area
Raveling / Weathering	All medium or greater severity	Remove & replace full lane width to depth necessary & length not less than 10 ft (3 m) beyond distressed area
Rutting (verified by straightedge)	> 0.375 in. (9.5 mm)	Remove & replace full lane width to depth necessary & length not less than 10 ft (3 m) beyond distressed area

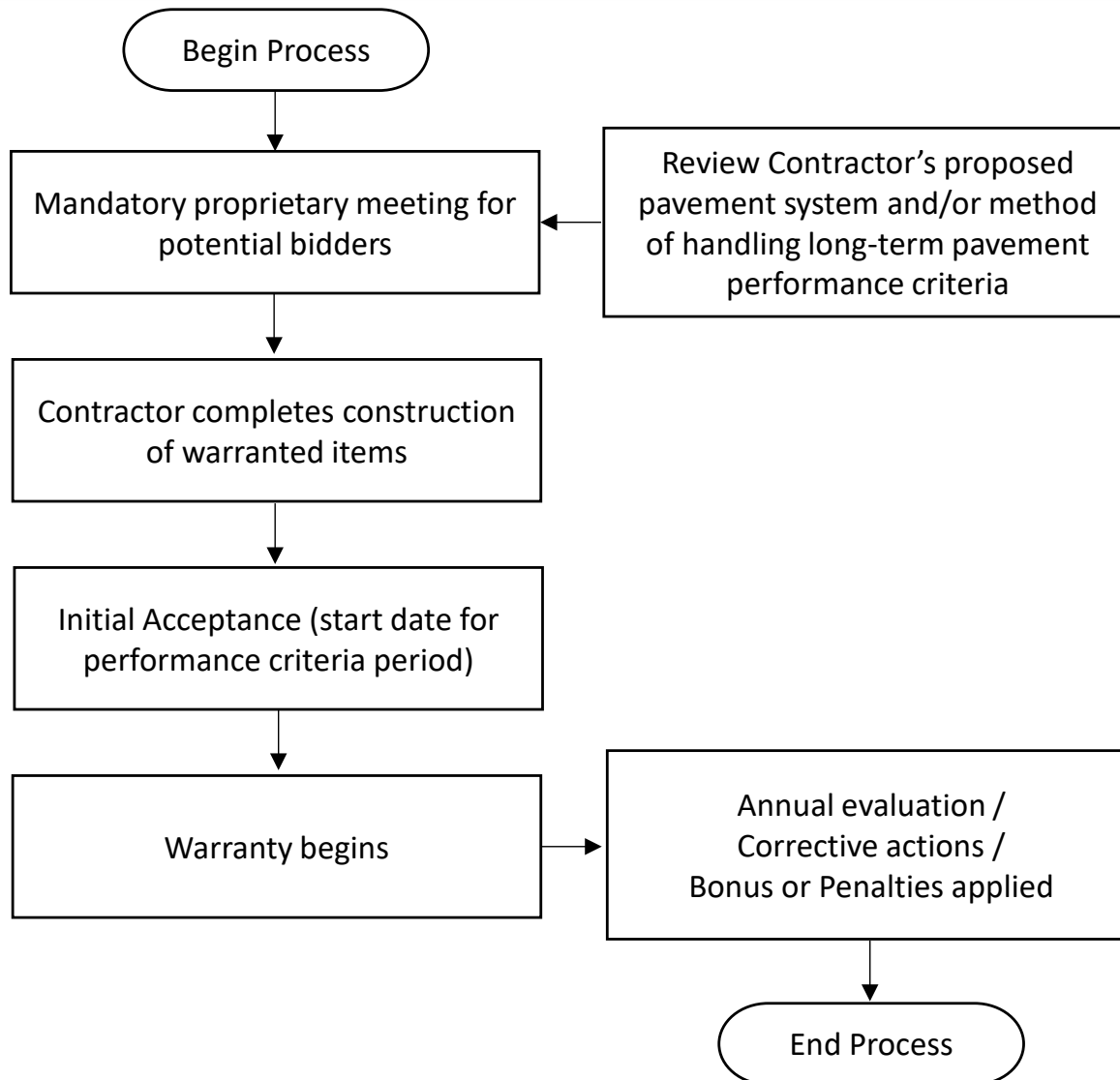
Conflict Resolution

- 5 members
 - 2 agency, 2 contractor, & mutually agreed
- Contractor not responsible for:
 - Base failure beyond contractor control
 - Rutting & base repair if ESALs exceed 100% of 20-year design
 - Agency caused distress (e.g., coring)
 - Forces of nature
 - Distress caused by traffic accidents

West Virginia DOT



Warranty Process



Proposal:

- Proposed pavement system
- Method to address long-term performance

Mandatory Meeting:

- Scope of work
- Maintaining traffic during work
- Proposed maintenance activities

Pavement Evaluation

- Agency-conducts annual manual pavement evaluation
- Determines corrective action
- Assess & applies bonus or penalty, when applicable



Performance Criteria–Asphalt

Distress Type	Limit
Alligator cracking	23 LF (7 LM)
Block cracking	76 LF (23 LM)
Lane edge cracking / deterioration	100 LF (31 LM)
Longitudinal cracking	76 LF (23 LM)
Longitudinal joint deterioration	50 LF (15 LM)
Patching	Repair if other distress is present
Potholes / surface delamination	0
Raveling / weathering	40 LF (12 LM)
Rutting	≥ 0.5 in. (13 mm)

Performance Criteria – Concrete

Distress Type	Limit
Blowups	0
D cracking(b)	0
Lane edge spalling	76 LF (23 LM)
Longitudinal cracking	76 LF (23 LM)
Longitudinal joint spalling	76 LF (23 LM)
Patching	Repair distressed partial depth repairs
Popouts	76 LF (23 LM)
Scaling(c)	39 LF (12 LM)
Transverse joint spalling	5 count

Corrective Action

- Required on all medium & high severity distress & skid number < 35
 - Address all distress along with the adjacent lane
- Areas of segregation, raveling, or bleeding are monitored, if continues, maintenance required
- All corrective action proposed by contractor during the mandatory meeting

Bonus / Penalty

Year	PSR Criteria		IRI Criteria, in/mi (m/km)		Bonus (%)	Penalty for no Corrective Action (%)
	Bonus	Corrective Action	Bonus	Corrective Action		
1	98	< 96	< 65 (1.03)	> 81 (1.28)	0.11	0.22
2	97	< 95	< 65 (1.03)	> 81 (1.28)	0.11	0.22
3	96	< 94	< 65 (1.03)	> 81 (1.28)	0.28	0.56
4	90	< 88	< 65 (1.03)	> 81 (1.28)	0.28	0.56
5	90	< 88	< 65 (1.03)	> 81 (1.28)	0.44	0.88
6	90	< 88	< 65 (1.03)	> 81 (1.28)	0.44	0.88
7	85	< 80	< 65 (1.03)	> 81 (1.28)	0.89	1.78
8	85	< 80	< 65 (1.03)	> 81 (1.28)	0.89	1.78
9	85	< 80	< 65 (1.03)	> 81 (1.28)	1.56	3.12

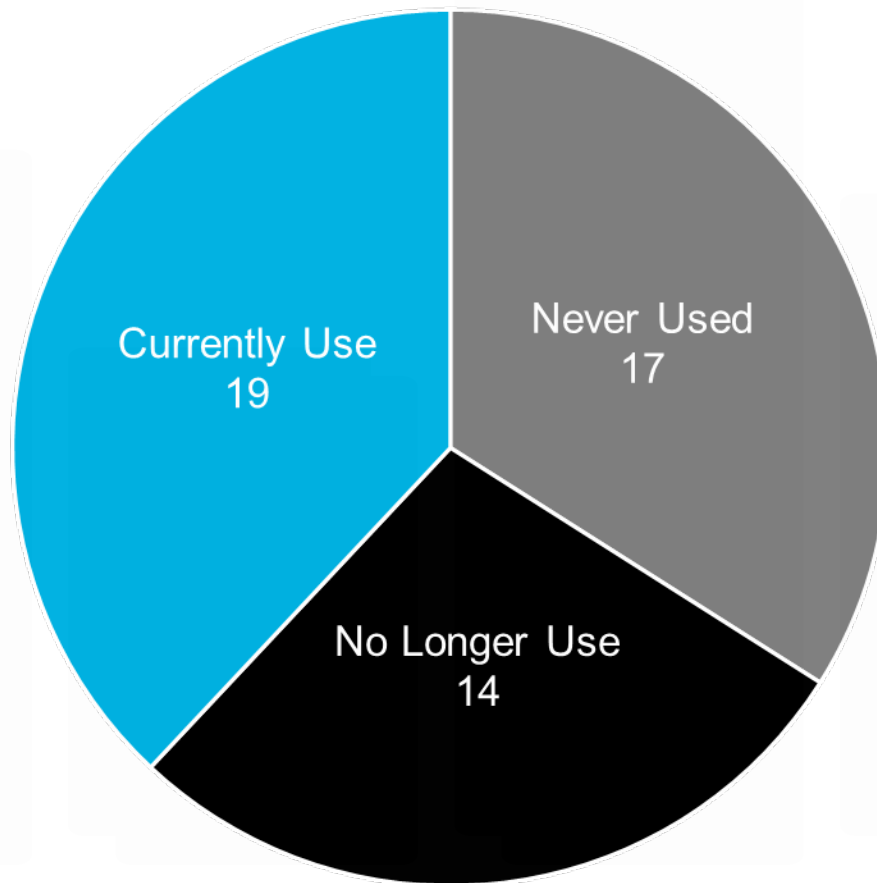
- Not cumulative or carried over year to year
- Applied separately for PSR & IRI (based on % of bid item)
- Applied only to mainline

Concluding Remarks

- Materials & workmanship
 - 1-2 years
 - Repair distress within contractors' control
- Performance
 - Preservation: 1-3 years
 - Asphalt: 3-5 years
 - Concrete: 5-10 years
 - P3: 20+ years
 - Contractor to maintain to specific performance indicators

Concluding Remarks *(continued)*

Pavement Warranty Use



Concluding Remarks *(continued)*

- Project selection primarily based on construction type
- Pavement management data used to determine performance indicators & threshold limits
- Agency-conducted condition assessment
- Functional and structural distress criteria

Concluding Remarks *(continued)*

Agency	Project Type	Pavement Type	Warranty Type	Warranty Period
Alberta Transportation	Case-by-case	Asphalt & concrete	Performance	30 years
Florida DOT	New & reconstruction	Concrete	Performance	5 years
	Preservation & rehabilitation	Asphalt structural & friction course	Performance	3 years
Michigan DOT	Preventive maintenance	Multiple	Performance	2 to 3 years
	Rehabilitation	Multiple	Materials & workmanship	5 years
Pennsylvania DOT	New & reconstruction	Asphalt	Performance	5 years
West Virginia DOH	New & reconstruction	Asphalt & concrete	Performance	9 years

Suggestions for Future Research

- U.S. Domestic Scan
- Application of Pavement Warranties Post Original Construction
- Framework for Defining Performance Thresholds & Warranty Periods
- Cost & Performance Impacts of Pavement Warranties
- Evaluation of Pavement Warranties

Q&A

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Today's Panelists

#TRBWebinar



Moderator: Charles Wienrank



Linda Pierce



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- Registration is open!
- Check our [website](#) for more information



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