Outline

1. Introduction – Why local validation/calibration?
2. Local Validation/Calibration Tools
3. PMIS Data and Validation/Calibration
4. Summary Comments
MEPDDG Global Calibration

LTPP GPS Test Sections Used in Calibration of Distress Prediction Models;

NCHRP Projects 1-37A & 1-40D

- Many assumptions used.
- Many inputs estimated.
MEPDG Global Calibration

- Global Calibration coefficients & exponents independent of local conditions?
- Changes in material/layer properties explain occurrence of distresses?

Local calibration factors provide flexibility, considers distress not explained by properties & other factors.
MEPDG Unique Feature

- Response Parameter & Calibration Factors
- Transfer Function & Calibration Factors
- Standard Deviation

Agency/User has options readily available for design!
Why Local Calibration?

- Expansive Soils
- Maintenance/Preservation Strategies
- Other Policies
- New Technology & Material Differences

Consideration of factors NOT included in MEPDG.
Why Local Calibration?

- Montana SPS-1 Sections
- Line of Equality
- Montana SPS-9 Sections

Remove bias & determine why are these so different?
Decision Factors

1. Cost of validation/calibration.
2. Value of potential improvement in prediction accuracy.

Decision: Yes, validate & calibrate MEPDG to our local conditions!
Expanding the Realm of Possibility

MEPDG – Local Validation/Calibration Tools

Manual of Recommended Practice for Calibration of M-E Based Models

1. Confirming or adjusting the global calibration factors.
2. Detailed and practical guide to complete local calibration.

MEPDG Software Itself

NCHRP Project 1-40B

Expanding the Realm of Possibility
Local Validation/Calibration

Hypotheses

- Mathematical models – assumed to be correct.
  - Pavement response models
  - Climatic model – ICM
  - HMA aging/PCC strength time dependent model

- Statistical or empirical models (transfer functions) may result in bias.
  - Revision of model coefficients to remove bias.
General Approach to Validation & Calibration of M-E Based Models

1. Traditional Split-Sample Approach
2. Jack-Knife Testing Approach
Validate/Calibrate MEPDG

What data do we use?
LTPP/PMIS & other databases!!

- How many sites?
- Length of roadway segments?
- How many distress observations?
  - Multiple points within segment at any one point in time?
  - Multiple points over time?
Validate/Calibrate MEPDG with PMIS Data

1. Data integration between different databases
   - Traffic
   - Materials
   - Construction
   - Performance

2. Data quality review

3. Analyses of precision & bias

Which button do I push?
Distress Definition & Measures

MEPDG

- Fatigue – Area Cracking
- Fatigue – LCWP
- Thermal – Transverse Cracking
- Rut Depths
- IRI

PMIS

- Fatigue Cracking
- Transverse Cracking
- Rutting
- Profile

Are Definitions & Measurements Compatible?

ARA

Expanding the Realm of Possibility
Data Integration: Effective use of available but limited resources.

Data integration: an automated process? Probably NOT!
Data Quality Review

What caused this increase in measured rutting?

Data measurement issues!
Data Quality Review

Pavement preservation issues!

Why are transverse cracking values so diverse?
Distress Data, Example:

Variability; A key data issue.

Example; Fatigue Cracking

Neat Mixes

Modified Mixes

PMA Mixes
Distress Data, Example:

Variability; A key data issue.

Example; Rut Depth
Distress Data Analyses:
Within Project Variation: **Outliers**

- **PMA Mix, Region 6, Route 6G, Both Directions, 2005**

Limited area with significant different distress value within PMIS segment.

Outliers, removed from calibration set.
Distress Data Analyses: *Within Project Variation: Abrupt Change*

Identify reasons for abrupt changes.

Sudden increase or decrease in distress value within PMIS segment.
Distress Data Analyses: Within Project Variation; **Drift**

Use segments w/consistent averages.

Consistent change in distress over project length, within PMIS segment.
Data Analyses: Bias & Residual Error from Validation/Calibration

Suggestion: Determine bias and error for local conditions & materials.
How Close is Close Enough?

\[
\left(\sigma_{\text{Total}}\right)^2 = \left(\sigma_{\text{Measurement}}\right)^2 + \left(\sigma_{\text{Lack-of-Fit}}\right)^2 + \left(\sigma_{\text{Input}}\right)^2 + \left(\sigma_{\text{Pure}}\right)^2
\]

Quantify the total error to answer this question!
Distress Predictions Analysis: Residual Errors, Rutting.

No bias between neat & PMA mixes!
Uses of PMIS Data for Validation/Calibration

- Identify factors/site features deviations or anomalies between performance observations.
- Identify bias between observations & predicted distresses for different design features & strategies.

Determination of the standard error – Probably NOT!
Pavement Management Systems Data - A Resource:

- Large time-series database on distress & pavement performance.
- Many dollars expended to develop PMIS and collect data.

Use of PMIS data for validation/calibration not a simple & quick process!!!!!
Key Topic: Feedback for Integrated Process

- Project Selection
- Planning
- Structural Design
- Bid Letting
- HMA Mixture Design
- Construction
- As-Built Plans & Performance Confirmation

Time Line, yr.

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Expanding the Realm of Possibility
In Summary

Local validation/calibration:
It’s an important decision but it’s your to make.

🌟 Accuracy
🌟 Costs

Manual of Recommended Practice for Calibrating M-E Based Models.
Thank you.
Any Questions?