UNDERSTANDING PMIS: RIDE, PATCHING, AND OTHER FACTORS

Darlene C. Goehl, P.E.
TxDOT - BRY
<table>
<thead>
<tr>
<th></th>
<th>What is PMIS</th>
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<tbody>
<tr>
<td>2</td>
<td>Data Collection</td>
<td></td>
<td>4-6</td>
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<tr>
<td>3</td>
<td>Distresses</td>
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<td>7-9</td>
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<tr>
<td>4</td>
<td>How Scores are calculated</td>
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<td>10-26</td>
</tr>
<tr>
<td>5</td>
<td>How PMIS information is Used</td>
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<td>27-36</td>
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</table>
PMIS is “an automated system for storing, retrieving, analyzing and reporting information to help with pavement-related decision-making processes.”

**History**

- PMIS development began in May 1990 in response to a Federal mandate that every State have a Pavement Management System in place by February 1993.
- PMIS was an expansion of the existing Pavement Evaluation System (PES), which began in September 1982. PES used 2-mile rating sections instead of the 0.5-mile sections now used in PMIS.
- The PMIS database serves as a statewide memory bank for TxDOT, containing information dating back to fiscal year 1985 (FY 1985, September 1984) for all TxDOT-maintained mileage.
Data Collection

Visual Distress Ratings

Ride/Rut Measurements

Skid Measurements (ASTM-type)

Deflection Measurements (Falling Weight Deflectometer, FWD)
**Typical PMIS Schedule**

<table>
<thead>
<tr>
<th>Months</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
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<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
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<tbody>
<tr>
<td><strong>Statewide</strong></td>
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<tr>
<td>Build PMIS database for new FY</td>
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<td>Measure Ride and Rut Data</td>
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<tr>
<td>Finish Ride/Rut and Begin Analysis and Reporting (MNT)</td>
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<tr>
<td>Skid Measurements</td>
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<td>Train raters for new FY</td>
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<td>District Analysis – Visual &amp; Ride</td>
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<td>District Analysis – Skid</td>
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</table>
## Data Collection

<table>
<thead>
<tr>
<th>Data</th>
<th>% of System</th>
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</thead>
<tbody>
<tr>
<td>Pavement Visual Distress</td>
<td>100%</td>
</tr>
<tr>
<td>Ride Quality and Rutting</td>
<td>100%</td>
</tr>
<tr>
<td>Skid Measurements</td>
<td>50% IH and 25% non-IH</td>
</tr>
<tr>
<td>FWD</td>
<td>Project Level</td>
</tr>
</tbody>
</table>

### MNT:
- Certify contract and TxDOT visual raters
- Process invoices for distress ratings
- Repair and calibrate ride/rut equipment
- Certify ride/rut equipment operators
- Analyze and report data

### Districts:
- Audit distress ratings
- Approve invoices for distress ratings
- Operate ride/rut equipment (some districts)
Pavement Distress Types – Flexible

- Shallow Rutting (0.25 to 0.49 inches deep)
- Deep Rutting (0.50 to 0.99 inches deep)
- Alligator Cracking
- Raveling
- Patching
- Block Cracking
- Transverse Cracking
- Longitudinal Cracking
- Flushing
Pavement Distress Types — CRCP and JCP

- Spalled Cracks
- Punchouts
- Asphalt Patches
- Concrete Patches
- Failed Joints and Cracks
- Shattered Slabs
- Average Crack Spacing
- Concrete Patches
- Slabs with Longitudinal Cracks
- Apparent Joint Spacing
Evaluating and Scoring – Automated Data

Rut Data:

- Shallow Rutting (0.25 – 0.49 inches deep)
- Deep Rutting (0.50 – 0.99 inches deep)
- Both Wheelpaths
- 0.1-Mile Interval
- Measured at Highway Speed

Ride Data:

- International Roughness Index (inches per mile)
- Both Wheelpaths
- Converted to Serviceability Index (SI) for PMIS
- 0.1-Mile Interval
- Measured at Highway Speed
Pavement Scores

- **Condition Score**
  - Scale of 1-100
    - 100 is best
    - 1 is worst
  - Combination of Ride and Distress
Distress Score

- Scale of 1-100
  - 100 is best
  - 1 is worst
- Developed from Visual Distresses
- Use PMIS utility value concept to “normalize” the distress ratings
  - over a ½ mile section
All occurrences counted:

- Failed Joints and Cracks
- Failures
- Shattered Slabs
- Slabs with Longitudinal Cracking
- Concrete Patches
All occurrences counted:

- Spalled Cracks
- Punchouts
- Asphalt Patches
- Concrete Patches
ACP Pavement Distress

- % of Wheelpath Length
  - Shallow Rutting
  - Deep Rutting
  - Alligator Cracking

- All occurrences counted:
  - Failures

- per 100'station
  - Feet of Longitudinal Cracking
  - Number of Transverse Cracks

- % of lane area
  - Patching
  - Block Cracking
Distress Score Calculations for Flexible Pavements (ACP)

Distress Score = $100 \prod_{i=1}^{n} U_i$

$100 \times U_{SRut} \times U_{DRut} \times U_{Patch} \times U_{Fail} \times U_{Allig} \times U_{Blk} \times U_{Lng} \times U_{Trn}$

- Shallow Rutting (SRut)
- Deep Rutting (DRut)
- Patching (Patch)
- Failures (Fail)
- Alligator Cracking (Allig)
- Block Cracking (Blk)
- Longitudinal Cracking (Lng)
- Transverse Cracking (Trn)
ACP Distress Utility Values – Not Composite

(PMIS Pavement Types 4, 5, 6, 9, and 10)

Note: Assumes 0.5-Mile Data Collection Section

04 - Thick Asphalt Concrete Pavement (greater than 5.5" thick; 14.0 cm)
05 - Intermediate Asphalt Concrete Pavement (2.5-5.5" thick; 6.4-14.0 cm)
06 - Thin Asphalt Concrete Pavement (less than 2.5" thick; 6.4 cm)
09 - Overlaid or Widened Old Flexible Pavement
10 - Thin-surfaced Flexible Base Pavement (surface treatment or seal coat)
Distress Score Calculations for Continuously-Reinforced Concrete Pavements (CRCP)

\[
Distress\ Score = 100 \prod_{i=1}^{n} U_i
\]

\[
100 \times U_{Spall} \times U_{Punch} \times U_{ACPatch} \times U_{PCPatch}
\]

- Spalled Cracks (Spall)
- Punchouts (Punch)
- Asphalt Patches (ACPatch)
- Concrete Patches (PCPatch)
CRCP Distress Utility Values

(PMIS Pavement Type 1)

Note: Assumes 0.5-Mile Data Collection Section
Distress Score Calculations

for Jointed Concrete Pavements (JCP)

\[ \text{Distress Score} = 100 \prod_{i=1}^{n} U_i \]

\[ 100 \times U_{\text{FailInt}} \times U_{\text{Fail}} \times U_{\text{SSlab}} \times U_{\text{Lng}} \times U_{\text{PCPatch}} \]
JCP Distress Utility Values

(PMIS Pavement Types 2 and 3)

Note: Assumes 0.5-Mile Data Collection Section
Different Distress Types

ACP Shallow Rutting, 20 percent = 0.8843
ACP Longitudinal Cracking, 150 feet per station (100 ft) = 0.7749

ACP Patching, 10 percent = 0.8369
ACP Alligator Cracking, 5 percent = 0.8932

Multiple Distress Types

ACP Shallow Rutting, 20 percent &
ACP Longitudinal Cracking, 150 feet per station = 0.8843 * 0.7749 = 0.6800

ACP Alligator Cracking, 5 percent &
ACP Patching, 10 percent = 0.8932 * 0.8369 = 0.7230
## Ride Scores

### Ride Score
- **Scale of 0 - 5**
  - 5 is best
  - 0 is worst
- **IRI Scale 0 to 950+**
  - 0 is best
  - 950+ is worst

### IRI and Ride Score

<table>
<thead>
<tr>
<th>PSR</th>
<th>IRI (in/mi)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5</td>
<td>169</td>
<td>FPS MINIMUM for seal coat</td>
</tr>
<tr>
<td>2.6</td>
<td>159</td>
<td></td>
</tr>
<tr>
<td>2.7</td>
<td>150</td>
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<tr>
<td>2.8</td>
<td>141</td>
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<tr>
<td>2.9</td>
<td>133</td>
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<td>3</td>
<td>125</td>
<td>FPS MINIMUM for overlay</td>
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<td>3.1</td>
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<td>3.2</td>
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<td>3.3</td>
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<td>3.4</td>
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<td>3.8</td>
<td>67</td>
<td>Hot Mix Ride Penalty &gt;65 (sch 1)</td>
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<td>3.9</td>
<td>61</td>
<td>FPS INITIAL for seal coat</td>
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<td>Hot Mix Ride Bonus &lt;60</td>
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<td>4.5</td>
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<td>FPS INITIAL for overlay</td>
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</table>
Automated Data Collection

- International Roughness Index (inches per mile)
- Both Wheelpaths
- Converted to Serviceability Index (SI) for PMIS
- 0.1-Mile Interval
- Measured at Highway Speed

$U_{\text{Ride}}$ is the Utility Factor for Ride Quality...
Ride Quality Utility Values – All Pavement Types

Based on Ride Score

PMIS Ride Quality Utility Values

Utility Value vs. Ride Score

- "Low" Traffic
- "Medium" Traffic
- "High" Traffic

Graph showing the utility values for different traffic conditions based on ride score.
Ride Quality Utility Values – All Pavement Types

Based on International Roughness Index (IRI)

Average IRI (inches/mile)

Utility Value

-0.30
-0.20
-0.10
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00

ADT = 10,000 & Speed limit 55 mph (High Traffic Group)

ADT = 5,000 & Speed limit 70 mph (High Traffic Group)

Substandard ≥ 165
Substandard ≥ 206
Substandard ≥ 253

IRI = 120 in/mile

"Low" Traffic
"Medium" Traffic
"High" Traffic
Condition Score Equation

\[ \text{Condition Score} = \text{Distress Score} \times U_{\text{Ride}} \]

Combines Distress and Ride Quality for Section
How is PMIS used?

- **Track Condition of Texas Pavements Over Time**
  - Performance Measure for Districts
    - Statewide Pavement Condition Goal of 90% “good or better” by FY12
  - Map-21 performance measures

- **PMIS supports network-level pavement decisions at the Division, District, Area Office, and Maintenance Section level.**
  - Allocation formulas of annual Unified Transportation Program (UTP)
  - Used for 4yr plan project selection and review
    - Both Construction and Maintenance
  - Help Districts Evaluate Effectiveness of Designs, Treatments, Materials, and Specifications
What are Current Capabilities of PMIS?

- Describes current pavement condition and trends
- Locates areas with problems
- Identifies types of problems
  - distress, ride, rut, etc.
- Estimates general Preventive Maintenance (PM) and Rehab needs (lane miles and dollars)
- PMIS has models for predicting future condition, but they are based on very general assumptions of how long treatments last...
Predicted Scores

Bryan District – Individual Distresses FY02 to FY13

Districtwide Miles with CS<70

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>ACP Failures</th>
<th>ACP Alligator Cracking</th>
<th>CRCP Punchouts</th>
<th>JCP Failures</th>
<th>ACP Ride</th>
<th>FLEX PATCHING</th>
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<tr>
<td>FY02</td>
<td>496.8</td>
<td>41.0</td>
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<td>278.4</td>
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Miles vs. Fiscal Year
Districts – Project Selection with PMIS data

- **Safety Projects**
  - Skid Data
  - Flushing

- **PM projects**
  - Seal Coat
    - Distress Score
    - Flushing
    - Raveling
  - Overlays
    - Ride Score
    - Distress Score
    - Flushing

- **Rehabilitation**
  - Condition Score
  - Distress Score
  - Ride Score
  - Individual Distresses
    - Failures
    - Patching
    - Ride
    - Cracking
Funding Formulas

Table VIII-2 2014 UTP Programming Information by Category

Each district shall receive an allocation based on this funding target formula:

- **Preventive Maintenance**
  - 3 basic criteria are weighted by %. A total allocation % is calculated by district with 98% directed toward roadway maintenance & 2% directed toward bridge maintenance.
    - 65% On system lane miles
    - 33% *Pavement distress* score pace factor
    - 2% Square footage of on system bridge deck area

- **Rehabilitation**
  - 32.5% 3-Year Average Lane - Miles of pavement distress scores < 70
  - 20% Vehicle miles traveled per lane mile (On system)
  - 32.5% Equivalent Single Axle Load Miles (On & Off system & Interstate)
  - 15% *Pavement distress* score pace factor
The pace factor is used to assure that funding is reactive to increases and decreases in district needs. If a district’s distress score begins to decrease for reasons not captured in the above factors, the “Pace” factor will increase funding to the district to address these additional needs. The factor is calculated as follows:

- Determine district with highest distress score
- (Equation: “= Max (District Distress Score Range)”).
- Determine deviation of district’s distress score from the highest score.
- Total all deviations for all districts from the maximum score.
Improve the overall condition of Texas pavements within given funding by using longer-lasting treatments applied at the right place and at the right time...
Questions