Comparing Manual and Automated Distress Data

Scott George, P. E.
Pavement Management Engineer
2008 Southeastern States Pavement Management and Design Conference
North Little Rock, Arkansas
June 3, 2008
Research Project ST-1977

- “A Pavement Rating Procedure,” conducted by University of Alabama, published 1985
- Consisted of Delphi study using experienced District & Maintenance Engineers
- Correlated physical distress measurements with engineers’ opinions of road condition
- Established pavement condition rating (PCR) number
PCR Equation

\[
PCR = 95.5727 - 5.5085 (5.0 - PSI) - 1.5964 \\
(\ln (ALL1 + 1)) - 1.9629 (\ln (ALL2 + 1)) - 2.9795 (\ln (ALL3 + 1)) - .01630 \\
(PATF + PATP) - .07262 (BLK1 + BLK2 + BLK3 + BLK4) - .2220 \\
(ORUT) - 3.4948 (RVLL) - 7.5269 \\
(RVLW) - 11.2297 (RVLE) - .03032 \\
(LNG1 + LNG2) - .05484 (LNG3 + LNG4) - .53050 (TRN1 + TRN2) - .69736 (TRN3 + TRN4)
\]
Automated Data Collection

• Manual surveys took too long to complete
• Increased traffic on roads put raters in greater jeopardy.
• 1990—Several firms considered for pilot study
  - PCES/Roadman
  - PAVEDEX
  - IMS
  - PAVETECH
Survey completed for half of state
Results deemed unacceptable
Remainder of survey completed manually (last manual rating completed in 1992)
Roadware

- First contract for 1996-1997 cycle
- Video collected continuously, data reported for first 50M segment per km
- Data first used in 1998 PCR report
- Second cycle began in 1999, completed in 2001
- Data collected continuously, reported in 50M segments
Roadware

• Third cycle began April 2002

• Video collected continuously, data reported very 0.01 mi

• IM Review Committee questioned data accuracy from previous cycles

• Reviewed data from previous cycles

• No documented quality assurance plan
Historical Percentile Values

Level 1 Alligator Cracking

- 1988 DOT
- 1990 DOT
- 1996 Roadware
- 1999 Roadware
Historical Percentile Values

Level 2 Alligator Cracking

Alligator Cracking—Level 2 (ft²)

Percentile

1988 DOT
1990 DOT
1996 Roadware
1999 Roadware

Percentile

0 50 55 60 65 70 75 80 85 90 95

200 200 250 250
Historical Percentile Values

Level 3 Alligator Cracking

- 1988 DOT
- 1990 DOT
- 1996 Roadware
- 1999 Roadware
2002 ALDOT QA Process

200 ft manual ratings completed every 10 lane miles in rural areas by raters with 8+ years of experience
QA Sample Percentile Values

First Division 2002

Percentile

Alligator Cracking--Level 2 (ft²)

- DOT values
- Roadware values
A Study of Manual vs. Automated Pavement Condition Surveys

David H. Timm, Ph. D. & Jason M. McQueen

- A summary of distress collection history and state of the practice
- Survey of other States’ use of automated distress collection
- Review of ALDOT’s QA process and PCR equation
2002 ALDOT QA Process

Regression analysis – None of the variables showed good correlation

Best Correlation was IRI at $R^2 = 0.65$
2002 ALDOT QA Process

Weakness: Location
Recommended using GPS to locate QA sites

Weakness: Agreement between ALDOT raters

Phase II of QA Program
Used one rater; surveyed 200 ft every 20 miles
2002 ALDOT QA Process

No systematic error between vendor and ALDOT

Three general trends observed

• Vendor reported greater OWP rutting
• Vendor underreported alligator level 1
• Vendor over reported alligator level 3
ALDOT PCR Equation

Monte Carlo simulation to determine sensitivity of the PCR equation
Accurate cracking data has greatest impact on PCR
“Pavement Management System Review”

David P. Hale, Ph. D.
Daniel S. Turner, Ph. D., P. E.
Jay K. Lindly, Ph. D., P. E.
Shane Sharpe, Ph. D.
Research Project 930-598

- Notice-of-need document
- Pavement distress questionnaire
- New ALDOT pavement distress rating procedure ALDOT-414
Pavement Distress Questionnaire

What would you like to know from the PMS?
Do you perform significant amounts of maintenance on the driving lanes other than resurfacing?
What minimum crack width is significant to you?
What type of distresses trigger in your mind a need for maintenance?
If you have OGFC or SMA surfaces how do you determine the need for maintenance?
ALDOT 414 Severity Levels

Severity Level 1: Cracks having widths $> \frac{1}{25}''$ and $\leq \frac{1}{8}''$

Severity Level 2: Cracks having widths $> \frac{1}{8}''$ and $\leq \frac{1}{4}''$

Severity Level 3: Cracks having widths $> \frac{1}{4}''$
ALDOT 414 Data Quality Requirements

- IRI: ± 5% compared to Dipstick control section
- Cross slope and grade data: ±0.20%
- Load associated cracking: ± 10%
- Non-Load associated cracking: ± 10%
- Transverse cracking: ± 10%
- Rut depth: ±0.1 in.
- Transverse joint faulting: ±0.1 in.
ALDOT 414 QC/QA
Requirements

Senor verification bi-weekly

ALDOT sample 3% images and rate
More Field Verification

Chose twelve sites in northwest Alabama

October 2007 ALDOT rater rated 0.3 miles at each site in the office then rated in the field

March 2008 ALDOT performed field survey again
More Field Verification

University of Alabama research team asked Roadware to run the twelve sites.
Pathway re-ran the twelve sites earlier this year.
Each vendor was given the field ratings from 1/3 of the sites to calibrate their process.
Percent Within Limits—10%

zeros included
Percent Within Limits—10%  
zeros not included

- Percentages for different wheelpaths and trips are shown.
- The graph compares the performance of Wheelpath 1, Wheelpath 2, Wheelpath 3, and the Sum of all wheelpaths.

Legend:
- V1--first trip
- V1--second trip
- V2--first trip
- V2--second trip
- Target
Percent Within Limits—10 ft

zeros included

- Wheelpath 1
- Wheelpath 2
- Wheelpath 3
- Wheelpath Sum

- V1--first trip
- V1--second trip
- V2--first trip
- V2--second trip
- Target
Percent Within Limits—10 ft
zeros not included

- Wheelpath 1
- Wheelpath 2
- Wheelpath 3
- Wheelpath Sum

V1--first trip
V1--second trip
V2--first trip
V2--second trip
Target
Number Within Limits—10%

zeros included

- Wheelpath 1
- Wheelpath 2
- Wheelpath 3
- Wheelpath Sum

V1--first trip
V1--second trip
V2--first trip
V2--second trip
Number Within Limits—10%
zeros not included
Next

Research team will follow up with more detailed statistical analysis of the data

Dr. Bugao Xu, University of Texas will look at the Pathway images

ALODT will re-visit distress procedure and acceptance criteria