Comparison of Automated Pavement Distress Data Collection Procedures for Local Agencies

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ABSTRACT

Many local agencies use manual surveys to collect pavement distress data, and they calculate pavement condition index (PCI) values for use in pavement management. Many of these agencies then use pavement performance curves and trigger values in their decision trees or matrices based on these resulting PCI values and derived parameters as major components of the agencies' pavement management decision support systems.

Automated pavement distress data collection procedures are available, but all of the available procedures and equipment do not necessarily reproduce the pavement condition index values from manual surveys. These differences in pavement condition index values from different distress data collection methods can lead to substantially different pavement treatment recommendations, fund needs, and related information.

A project was conducted for the Pavement Management Program (http://www.mtcpms.org) of the Metropolitan Transportation Commission (MTC) of San Francisco Bay area to evaluate the impact of using different methods to determine pavement condition parameters. The study included statistical analyses and comparison of seven types of pavement distress for asphalt surface pavements and the resulting pavement condition index parameters. Discussion, interpretation, and findings from this study are presented. Practical recommendations for future use of automated pavement distress data collection procedures for local agencies will be also presented.

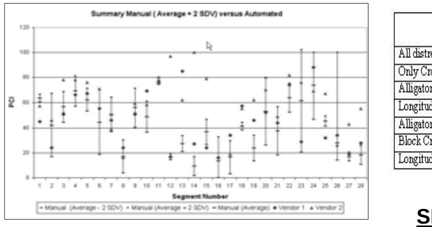
OBJECTIVES

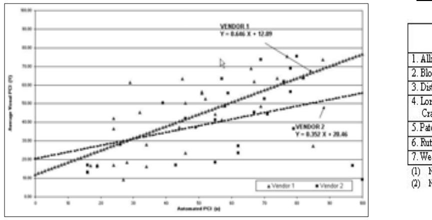
To compare the manual and automated methods of collecting pavement distress data used to compute the Pavement Condition Index (PCI) by StreetSaver. Only asphalt surface pavements were used in this analysis for the following seven distress types used by StreetSaver: Alligator Cracking, Block Cracking, Distortions ,Longitudinal and Transverse Cracking, Patching & Utility Cut Patching, Rutting & Depressions , Weathering & Raveling.

FINDINGS

Comparing Vendor 1 and Vendor 2 to ground truth, Vendor 1 PCI was found to be statistically significant as a predictor of ground truth PCI whereas Vendor 2 PCI estimates were consistently higher and more variable than ground truth. The prediction intervals for Vendor 2 were significantly larger than Vendor 1. One of the main reasons for this difference is that Vendor 2 equipment was calibrated only for the three crack type of distresses.

PCI MANUAL VERSUS AUTOMATED





PCI FOR DIFFERENT SCENARIOS

Case Scenario	PCI Average Visual	PCI Vendor 1	PCI Vendor 2
All distresses	42	46	59
Only Cracks	57	62	64
Alligator + Block Cracking Only	54	55	64
Longitudinal + Block Cracking Only	82	79	84
Alligator Cracks Only	60	51	65
Block Cracks Only	77	82	87
Longitudinal Crack Only	84	83	87

SECTIONS REPORTING DISTRESS

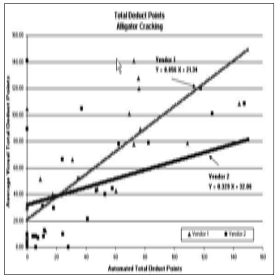
Distress Type	Manual	Roadware		Adhara	
		(1)	(2)	(1)	(2)
1. Alligator Cracking	27	15	14	24	21
2. Block Cracking	4	11	3	16	2
3. Distortion	8	2	1	4	1
4. Longitudinal and Transverse Cracking	26	24	22	22	21
5. Patching	20	18	16	17	12
6. Rutting	9	5	1	1	0
7. Weathering and Raveling	29	27	26	4	4

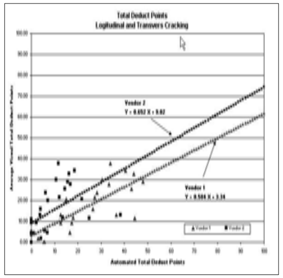
(1) Number of sections reporting distress
(2) Number of sections reporting distress in the same section

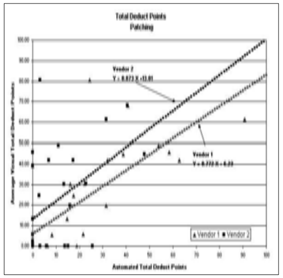
TEST COMPARISON BY TOTAL DEDUCT SEVERITY VALUES

Distress type	Statistic	Manual	Vendor 1	Vendor 2	p-value (* = sig)
1. Alligator	Mean	48.04	31.20	48.50	0.449
	Variance	2029.26	1687.06	6361.14	0.001 *
2. Block	Mean	1.61	7.56	14.67	NA
	Variance	42.99	192.36	2029.56	0.001*
3. Distortion	Mean	2.50	2.50	1.20	NA
	Variance	65.89	175.65	34.74	0.001*
4. Longitudinal	Mean	14.96	19.93	9.11	0.009 *
	Variance	137.00	263.64	88.07	0.001*
5. Patching	Mean	21.64	19.98	9.89	0.490
	Variance	605.35	567.23	175.98	0.001*
6. Rutting	Mean	3.18	0.46	0.00	NA
	Variance	42.82	1.49	0.00	0.001*
7. W&R	Mean	21.36	21.96	1.10	NA
	Variance	81.20	242.31	17.06	0.001*

REGRESSION ANALYSIS FOR TOTAL DEDUCT POINTS







The only distresses that had sufficient information to allow comparisons were Alligator, Longitudinal and AC Patching. In all cases, Vendor 1 was a significant predictor of ground truth. Vendor 2 had significantly larger variability and wider prediction intervals. It is worth to mention that Vendor 1 took images from field and collected the distresses in office by looking at the images while Vendor 2 used its computarized expert systems to analyze crack distresses.

CONCLUSIONS

1. Automated pavement distress data collection procedures do not necessarily reproduce the pavement condition index values from manual surveys. These differences in pavement condition index values from different distress data collection methods can lead to substantially different pavement treatment recommendations, fund needs, and related information.
2. Results on PCI estimates may vary from vendor to vendor. In the pilot study, it was found that PCIs obtained from Vendor 1 data was a good predictor of manual PCIs, while Vendor 2 PCI estimates were consistently higher and more variable than manual PCIs. In general, cracking patterns were better identified than rutting, distortion, patching, raveling and weathering. Differences in PCI estimates may be due not only to the type of distress but also to the severity level.
3. Calibration of distress identification procedures used by automated equipments, and the type of distress being recorded in the survey are two of the main factors that influence the results. Calibration implies to compare PCI estimates from data collected by automated equipments to PCI estimates from manual surveys conducted by experienced raters. It is recommended that three experience raters conduct distress surveys to determine the "ground truth" to be used for calibration. The PCI estimates from experience raters should be subjected to statistical analysis to determine if there is no significant difference among the measurements.