Is all Data Created Equal?
A Look at Pavement Condition Collection Practices

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Importance of Pavement Management Data

A pavement management system provides a rational engineering decision for selecting the right project for the right roadway at the right time. Nonetheless, a PMS is only as strong as the data that it is comprised of.

High quality data can be achieved through different data collection methods.

<u>However, distress data collected through automated methods does not match distress data from manual surveys and generally there are no adjustment factors that can be applied.</u>

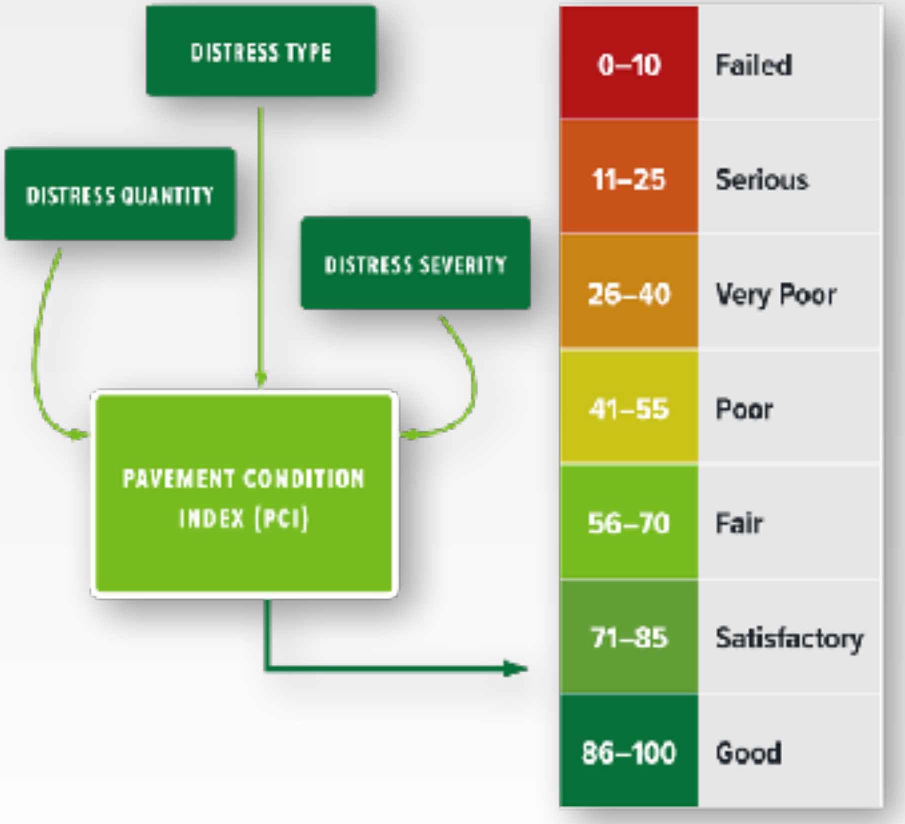
> "The cost (of pavement management) is worth it. You only have one chance to make the right decision, and pavement management helps you do that."
>
> -Stark County, IL

Ref: Research Report ICT-11-094-1; Implementing Pavement Management Systems for Local Agencies; Wolters, A., Zimmerman, K., Schlatter, K., Rietgraf, A.

Pavement Condition Metrics

Multiple pavement metrics are used throughout the nation. However, PCI is the most commonly used metric nationally for assessing pavement condition.

- A published specification for collecting and calculating PCI exists (ASTM D6433).
- Walking or Automated Data Collection can be used for the calculation of the PCI.
- A detailed survey documenting type, severity, and extent of each distress is necessary.
- 0 – 100 Scale



Automated Condition Data Collection

- Automated condition data collection - efficient method to document the condition of your network.
- It is necessary to understand the facts and myths when considering use of this incredible technology
- Not all quotes are created equal

Key Concepts

- Standards
- Data collection
- Processing data to measures
- Using data to make accountable decisions

Standards

- AASHTO M328-14: Standard Specification for Inertial Profiler.
- AASHTO PP 67-16: Standard Practice for Quantifying Cracks in Asphalt Pavement Surfaces from Collected Images Utilizing Automated Methods.
- AASHTO PP 68-14: Standard Practice for Collecting Images of Pavement Surfaces for Distress Detection.
- AASHTO PP69-14: Standard Practice for Determining Pavement Deformation Parameters and Cross Slope from Collected Transverse Profiles.
- AASHTO PP70-14: Standard Practice for Collecting the Transverse Pavement Profile.
- AASHTO R 36-17: Standard Practice for Evaluating Faulting of Concrete Pavements.
- AASHTO R48-10 (2013): Standard Practice for Determining Rut Depth in Pavements.
- AASHTO R56-14: Standard Practice for Certification of Inertial Profiling Systems.
- AASHTO R57: Standard Practice for Operating Inertial Profilers and Evaluating Pavement Profiles.
- ASTM D6433 – 16: Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys.
- ASTM E1656 – 11 (2016): Standard Guide for Classification of Automated Pavement Condition Survey Equipment.
- ASTM E950/E950M – 09: Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.
- ASTM E2560 – 17: Standard Specification for Data Format for Pavement Profile.

Standards (Cont'd)

Although there are standards for automated data equipment, faulting, rutting, and profiling. There are currently no published standards to correlate automated distress data to manual distress data.

Nonetheless, automated distress data is being utilized nationwide to generate a PCI not necessarily consistent with ASTM D6433.

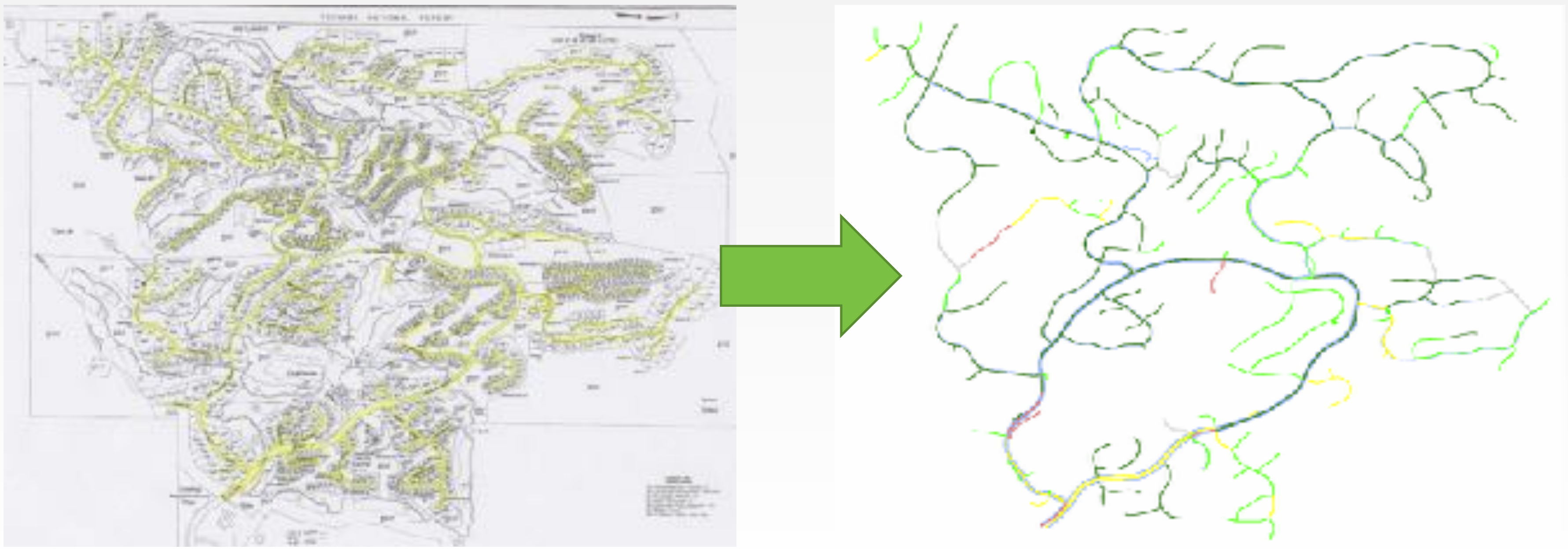
Data Collection Process

Regardless of the data collection process to be employed, a series of steps must be followed to successfully collect data:

- Acquire or develop a GIS shapefile of the area where data is to be collected.
- Develop a data collection plan
- Collect data.
- Carry out field QC.

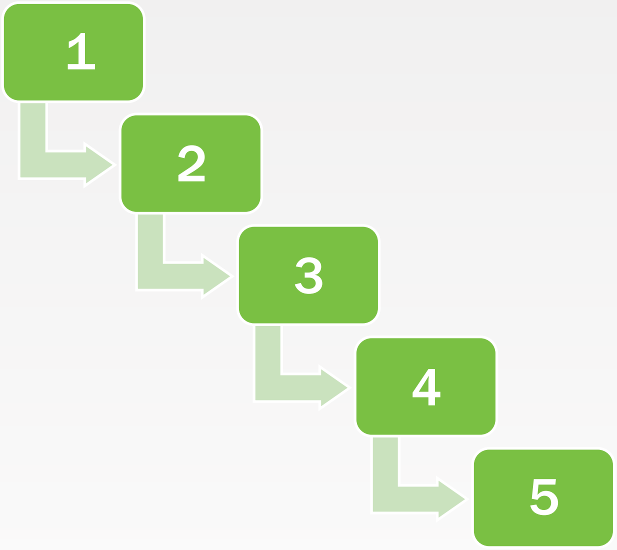
Develop or Acquire GIS shapefile

- Valuable to develop an accurate data collection plan.
- Useful tool for condition maps and maintenance plans.



Develop a Data Collection Plan

- Minimizing data collection time while ensuring deliverables are completed on schedule.
- Consider inclement weather, construction sites, equipment malfunctioning, etc.
- All members of the data collection crew must be familiar with the plan and trained according to the data collection procedure.



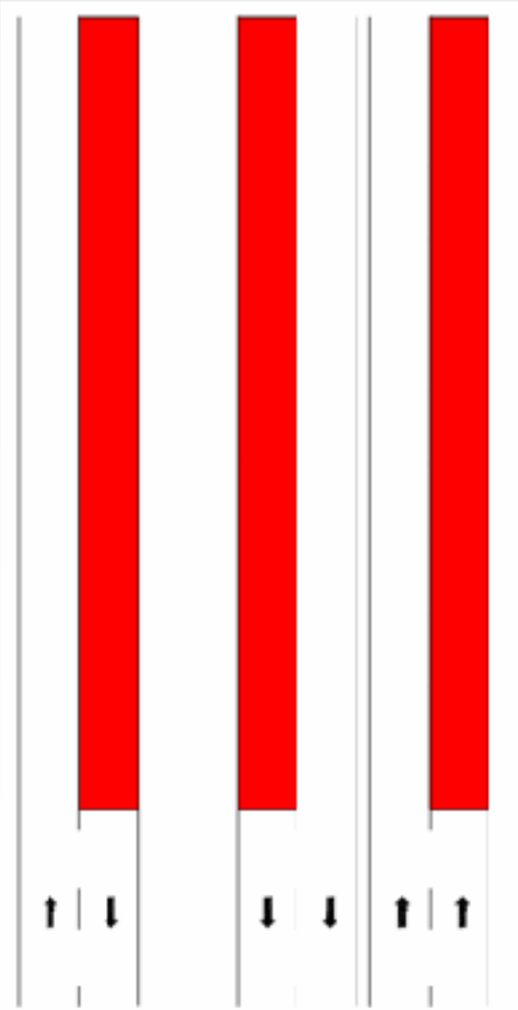
Collect Data and Field QC

Automated and semi-automated methods are different than manual and windshield data collection.

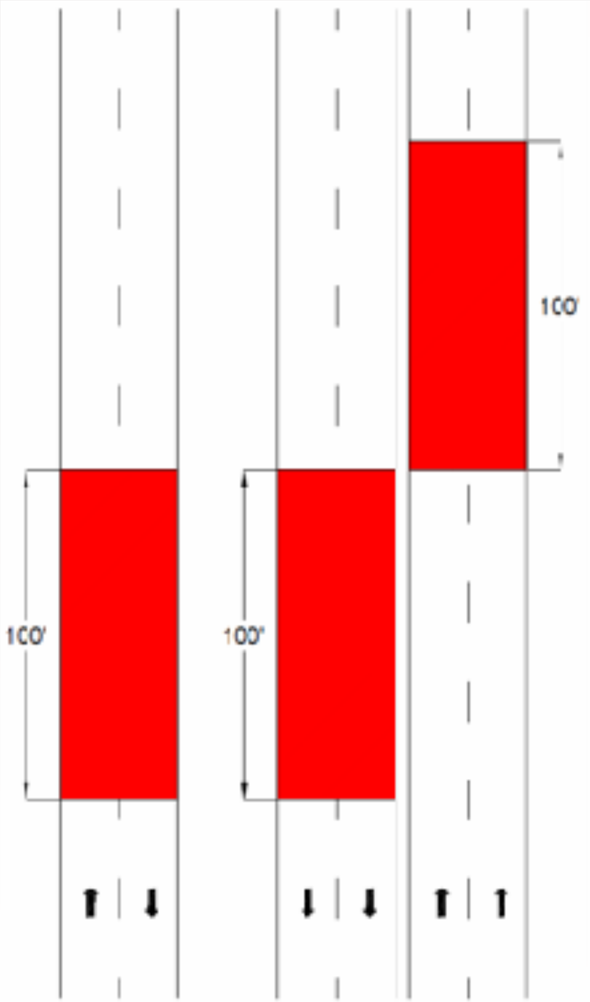
- Manual
  - 2500 ± 1000 ft^2 sample units.
  - Typically full width by 100 ft long.
  - Can accommodate parking areas.
- Windshield
  - Covers entire street length visible to the inspector.
- Automated and semi-automated
  - One lane one direction for two lane roads.
  - One lane each direction for roads with two or more driving lanes per direction.

Data Collection Process (Cont'd) Collect Data and Field QC

Automated and semi-automated.



Manual and windshield



Collect Data and Field QC

Although a certain variation exists from one method to the other, overall the main QC efforts for data collection are:

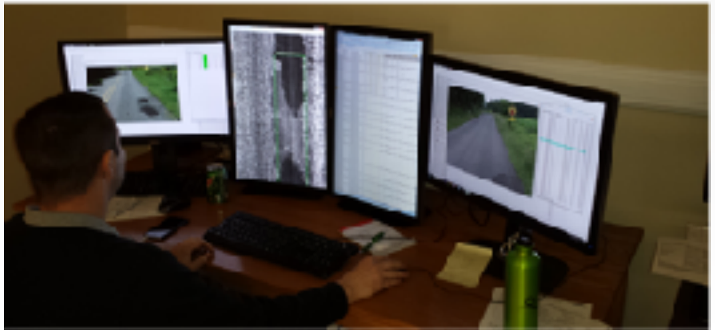
- Check data for:
  - completion at the end of every field day.
  - unexpected values at the end of every field day.
- Check images for clarity and correct geospatial information.

Data Processing Automated Data

- Collection van is driven over the network to generate sensor readings.
- Distress type, severity, and quantity are interpreted by software that utilize image distress detection algorithms.
- Fully automated typically collects:
  - Rutting
  - Cracking
  - Surface macro-texture (raveling)

Data Processing Semi-Automated Data

- Collection van is driven over the network to generate sensor readings.
- Distress type, severity, and quantity are identified:
  - Visually on computer screens by trained personnel using collected frame imagery and,
  - Automatically interpreted by software that utilize image distress detection algorithms.
- All ASTM distresses can be recorded.



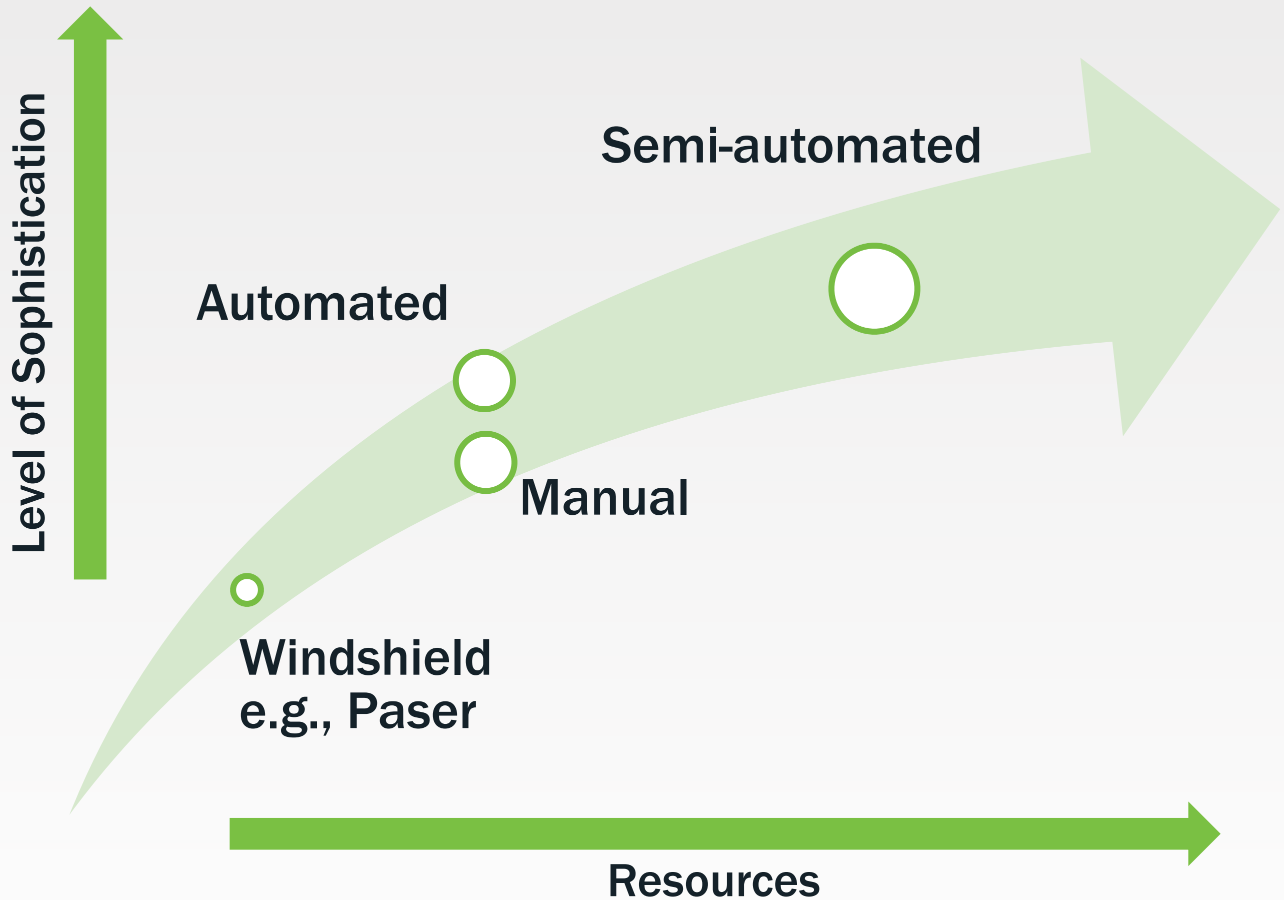
Data Processing Windshield Data

- Inspector conducts the survey from the vehicle as it travels along the street. Less time and effort than walking surveys.
- Low severity distress types are often not visible and the direction of the sun relative to the observer significantly affects accuracy of distress type, severity, and quantity identification.
- Data is recorded in paper or a handheld device, typically a rating related to the observed distresses is used as opposed to recording individual distresses.

Data Processing Manual Data

- Walking distress survey to calculate a PCI according to ASTM D6433.
- Inspection units are defined in which every distress type, severity, and quantity is recorded.
- Data is collected in paper and later on translated to a software like PAVER that will calculate a PCI or in a handheld device that has the capability to calculate the PCI in the field.

Balancing Detail with Available Resources



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Data Collection Method Pros and Cons

Category	Automated and Semi-automated Data Collection	Manual Survey	Windshield Survey
Cost	$$$$	$$$	$$
Pros	Reduced impact on vehicular traffic. Rutting and profiling can be measured. High data collection rate. Image collection. Full pavement coverage can be achieved.	Meets ASTM D6433. Rut depth can be measured. Limited images collected (typically two per section.	Reduced impact on vehicular traffic. High data collection rate. Image collection is limited to contract requirements (typically none).
Cons	Will not meet all ASTM D6433 requirements.	Time consuming. No profiling. High surveyor exposure to traffic. Traffic interruptions may be necessary.	No rutting or profiling. Limited distress data detail (qualitative data). Will not meet all ASTM D6433 requirements.

Comparison of Methods

High definition forward view video and intensity and range 3D imagery using LCMS was collected on 65 miles of asphalt surface road network in Illinois.

- The LCMS imagery data was manually identified by trained personnel as well as with automated distress identification and processing. Distress data for both methods were used to calculate a PCI for comparison.
- The video data was used to determine a VPCI (modified definitions of PCI distress and severity) and a 1 to 10 PSCI.

Comparison of Methods (Cont'd)

The road network was divided into 18 sections with similar construction and condition.

- A random sampling methodology (approx. 10% of the section area) was followed in selecting the sample units for all 18 sections for which a semi-automated PCI would be calculated.
- Automated PCI was based on full pavement coverage for 10 sections.
- Video distress data for 100% of the network was used to calculate both VPCI and PSCI.

Comparison of Methods (Cont'd)

Automated vs Semi-Automated

$R^2 = 0.929$

Section	Length (km)	Semi-Automated PCI	Automated PCI	Difference
1	0.8	90	84	6
2	1.2	69	56	13
3	1.6	92	87	5
4	1.6	100	99	1
5	2.0	84	85	1
6	2.0	82	78	4
7	2.9	100	99	1
8	3.2	79	75	4
9	4.1	75	72	3
10	4.9	74	72	2

Automated vs VPCI

$R^2 = 0.678$

Section	Length (km)	Automated PCI	Video PCI	Difference
1	0.8	84	73	11
2	1.2	56	65	9
3	1.6	87	74	13
4	1.6	99	100	1
5	2.0	85	88	3
6	2.0	78	85	7
7	2.9	99	94	5
8	3.2	75	77	2
9	4.1	72	62	10
10	4.9	72	68	4

Comparison of Methods (Cont'd)

Semi-Automated vs VPCI $R^2 = 0.846$

Section	Length (km)	Semi-Automated PCI	Video PCI	Difference	Section	Length (km)	Semi-Automated PCI	Video PCI	Difference
1	0.8	90	73	17	10	4.9	74	68	6
2	1.2	69	65	4	11	4.7	51	49	2
3	1.6	92	74	18	12	7.6	51	47	4
4	1.6	100	100	0	13	8.9	94	79	15
5	2.0	84	88	4	14	8.9	89	75	14
6	2.0	82	85	3	15	10.7	53	58	5
7	2.9	100	94	6	16	12.8	40	39	1
8	3.2	79	77	2	17	12.9	52	55	3
9	4.1	75	62	13	18	12.9	91	83	8

Semi-Automated and VPCI vs PSCI

PCI Scale	PCI Category	Semi Automated	VPCI	PSCI	PSCI Category	PSCI Rating
70 to 100	Satisfactory to Good	51%	50%	40%	Excellent to Good	7 to 10
55 to 70	Fair	14%	17%	14%	Fair	5 and 6
25 to 55	Very poor and poor	32%	24%	38%	Poor	3 and 4
10 to 25	Serious	3%	10%	8%	Very Poor	2
0 to 10	Failed	0%	0%	0%	Failed	1

Comparison of Methods (Cont'd)

Overall, the results showed:

- An acceptable consistency between type, severity, and quantity of distress data across the survey methods.
- Most common defects observed were L&T cracking, weathering and raveling, ***alligator cracking***, and block cracking.
- The automated survey allows for larger pavement coverage at reduced time and labor costs. Nonetheless it is not ASTM D6433 inspection nor is there a specification for the rating or correction factor.

Summary

- Periodic assessment of your transportation assets is necessary and important.
- How you do it should be based on your available budget and the information you need to make decisions.
- Consistency is important to avoid future misinterpretations or misleading results – document the process.
- Some choices limit other downstream options so it is wise to make a plan before implementation. This will also identify options for quality management if desired.

Questions?

Need Additional Assistance?

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Thank you!