Visualization and Communication in Pavement Performance

Final Report
July 2018

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Midwest Transportation Center
U.S. Department of Transportation
Office of the Assistant Secretary for
Research and Technology

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Institute for Transportation

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date
Visualization and Communication in Pavement Performance	July 2018
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Cynthia Corritore and Nalini Govindarajulu	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Department of Business Intelligence & Analytics Heider College of Business Creighton University Omaha, Nebraska 68178	11. Contract or Grant No. Part of DTRT13-G-UTC37

12. Sponsoring Organization Name and Address		13. Type of Report and Period Covered
Midwest Transportation Center 2711 S. Loop Drive, Suite 4700 Ames, IA 50010-8664	U.S. Department of Transportation Office of the Assistant Secretary for Research and Technology 1200 New Jersey Avenue, SE Washington, DC 20590	Final Report 14. Sponsoring Agency Code

15. Supplementary Notes

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16. Abstract

The purpose of this research project was to develop visualization techniques and methods that display pavement performance data and information in a communication-friendly format for a variety of end users. Several possible scenarios of end users and possible questions that they might use visual analyses to answer were envisioned. The researchers believed that the two primary types of end users were county office administrators examining the status of the roads in their counties and the state and engineers working with the data sets. Accordingly, several visualizations are presented that would be useful for both of these end-user groups. For each, a short description is given along with a sample question that the visualizations could be used to answer. The data used to generate these interactive visuals were provided by the Iowa Department of Transportation and outline numerous indicators of pavement performance for the year 2013. Software programs used to produce the visual analyses were Microsoft Excel 2010 and Tableau 9.0.

The visual analyses are interactive and are designed to provide a dashboard at the county level. They can also be modified to display information and visuals at other levels of county groupings.

17. Key Words	18. Distribution Statement
communication—pavement data—pavement performance—visualization techniques	No restrictions.

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
Unclassified.	Unclassified.	30	NA

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Sponsored by
Midwest Transportation Center and
U.S. Department of Transportation
Office of the Assistant Secretary for Research and Technology

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TABLE OF CONTENTS

LIST OF FIGURES

ACKNOWLEDGMENTS

The authors would like to thank the Midwest Transportation Center and U.S. Department of Transportation Office of the Assistant Secretary for Research and Technology for sponsoring this research.

OVERVIEW

The researchers envisioned several possible scenarios of end users and possible questions that they might use visual analyses to answer. They believed that the two primary types of end users of these visualizations were (1) county office administrators examining the status of the roads in their counties and the state and (2) engineers working with the data sets. Accordingly, the researchers presented several visualizations that would be useful for each of these end-user groups. For each, a short description is given along with a sample question that the visualization could be used to answer.

The data set used for these visualizations was PMIS13.xlsx, which included the most recent data available for this purpose. Software programs used to produce them were Microsoft Excel 2010 and Tableau 9.0. PCI-2 was used for all analyses, but it is displayed below as pavement condition index (PCI).

VISUALIZATIONS

End User: County Administrators

This chapter presents the data for all “high” crack types by street in a specific county (see Figure 1). The data points can be selected singly or in a group (by highlighting) to show the specific data for the data point(s). The interactive drilldown information is illustrated in Figures 2 and 3.

Question: Which Streets Have the Largest Numbers of High Cracks in My County?

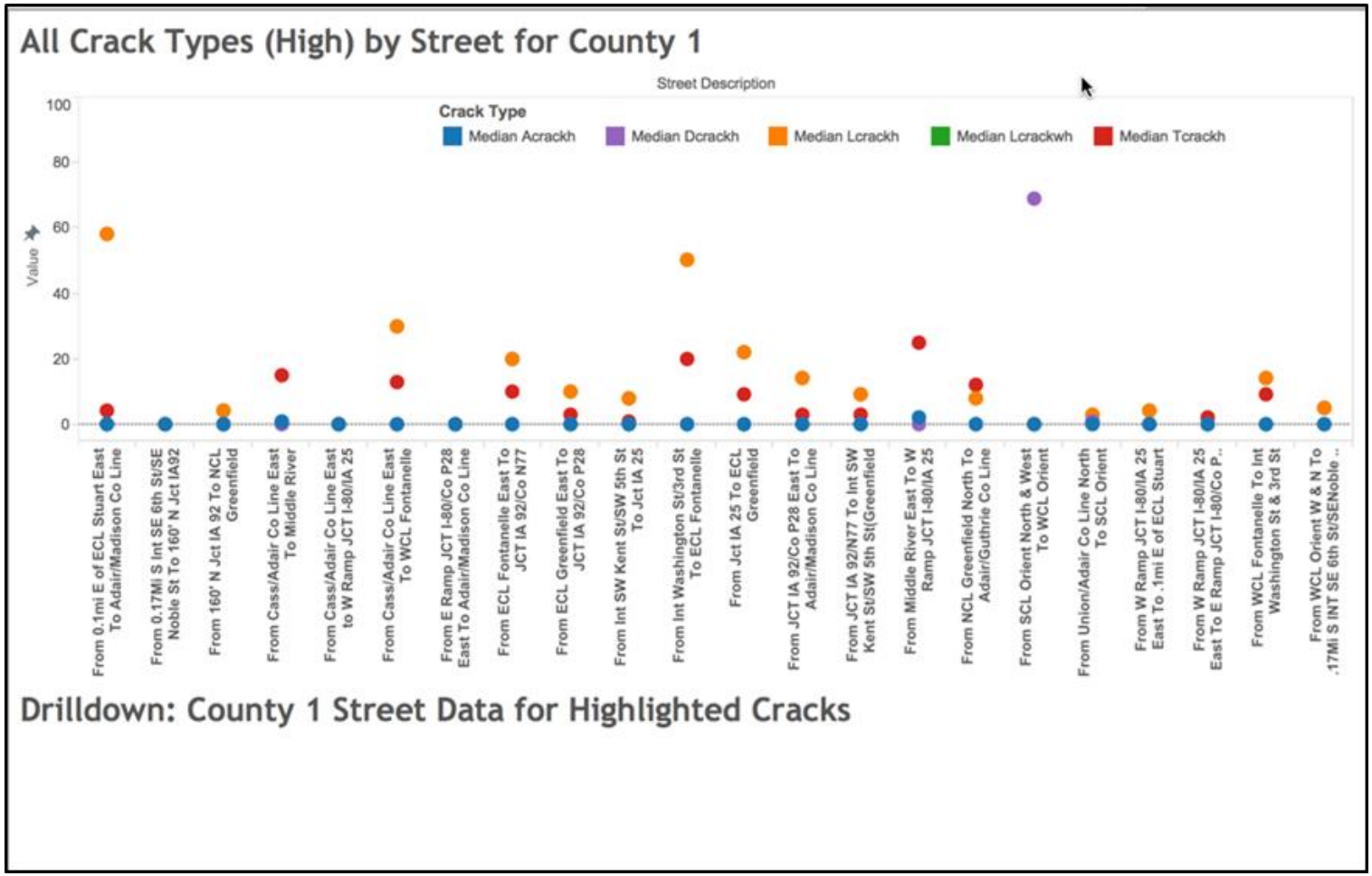

Figure 1. High crack data for all crack types by street in County 1

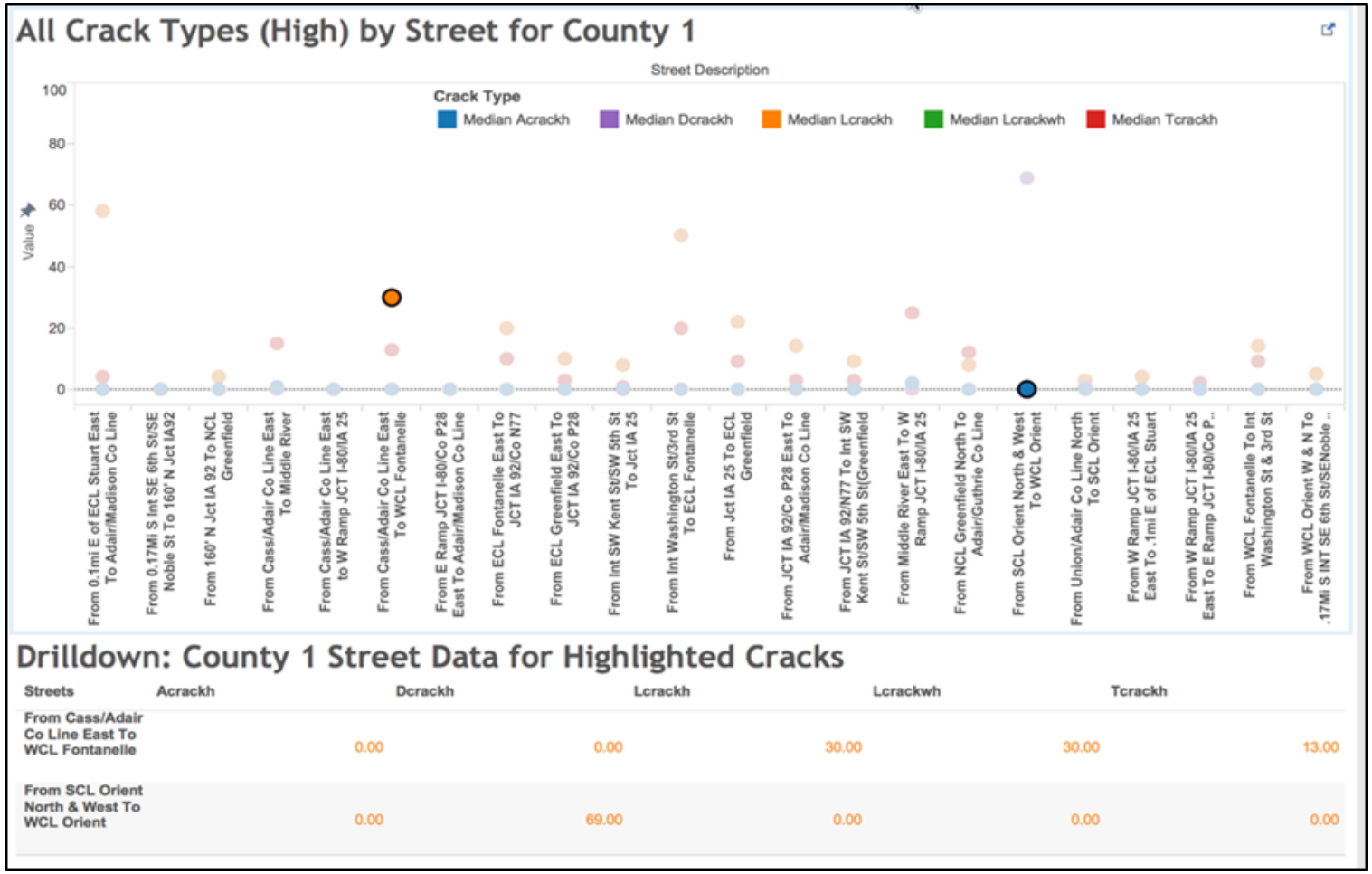

Figure 2. High crack data for all crack types by street in County 1 with drilldown for two specific streets

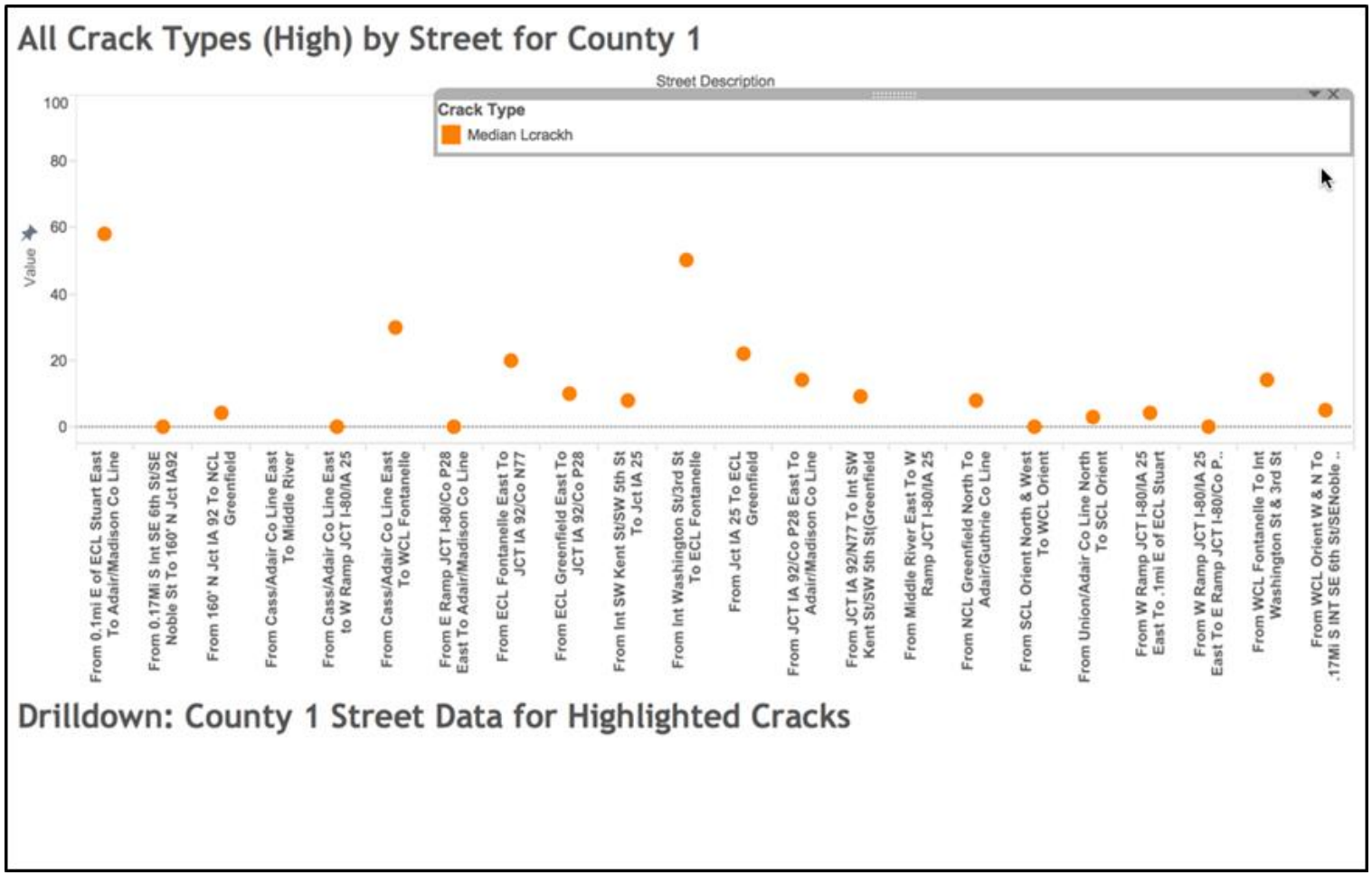

Figure 3. High crack data for L-cracks by street in County 1

The following shows two charts combined into one dashboard. The first shows the PCI and all pavement condition indices for a chosen county compared to the same data for all counties combined. The second shows the data for all high cracks for the chosen county compared to all counties (see Figure 4). Detailed information about each bar can be obtained, as shown in Figure 5.

Question: How Does My County Compare to All of the Counties Combined for Condition and Distress Data?

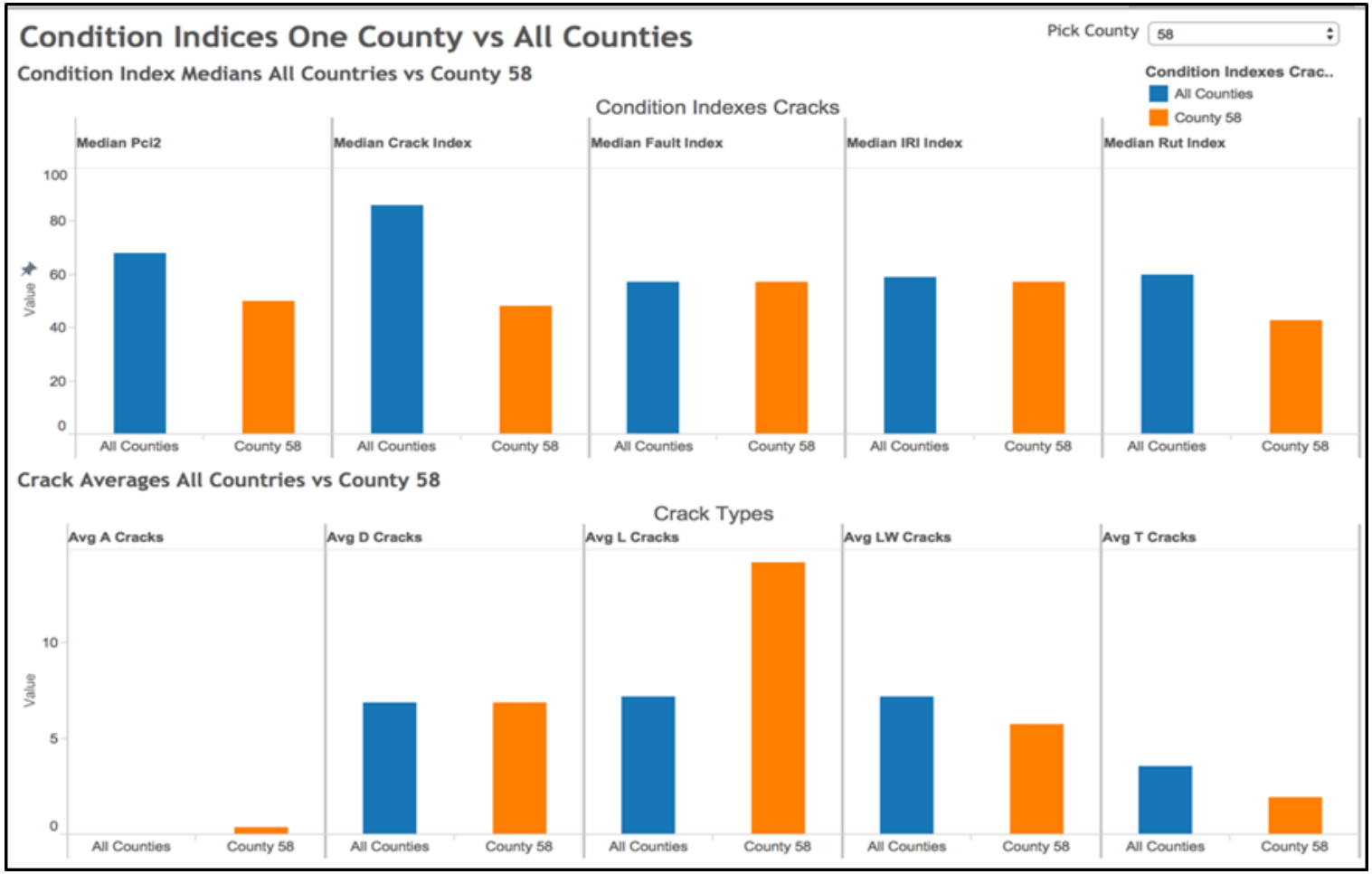

Figure 4. Comparison of condition indices and high cracks for County 58 compared to all counties combined

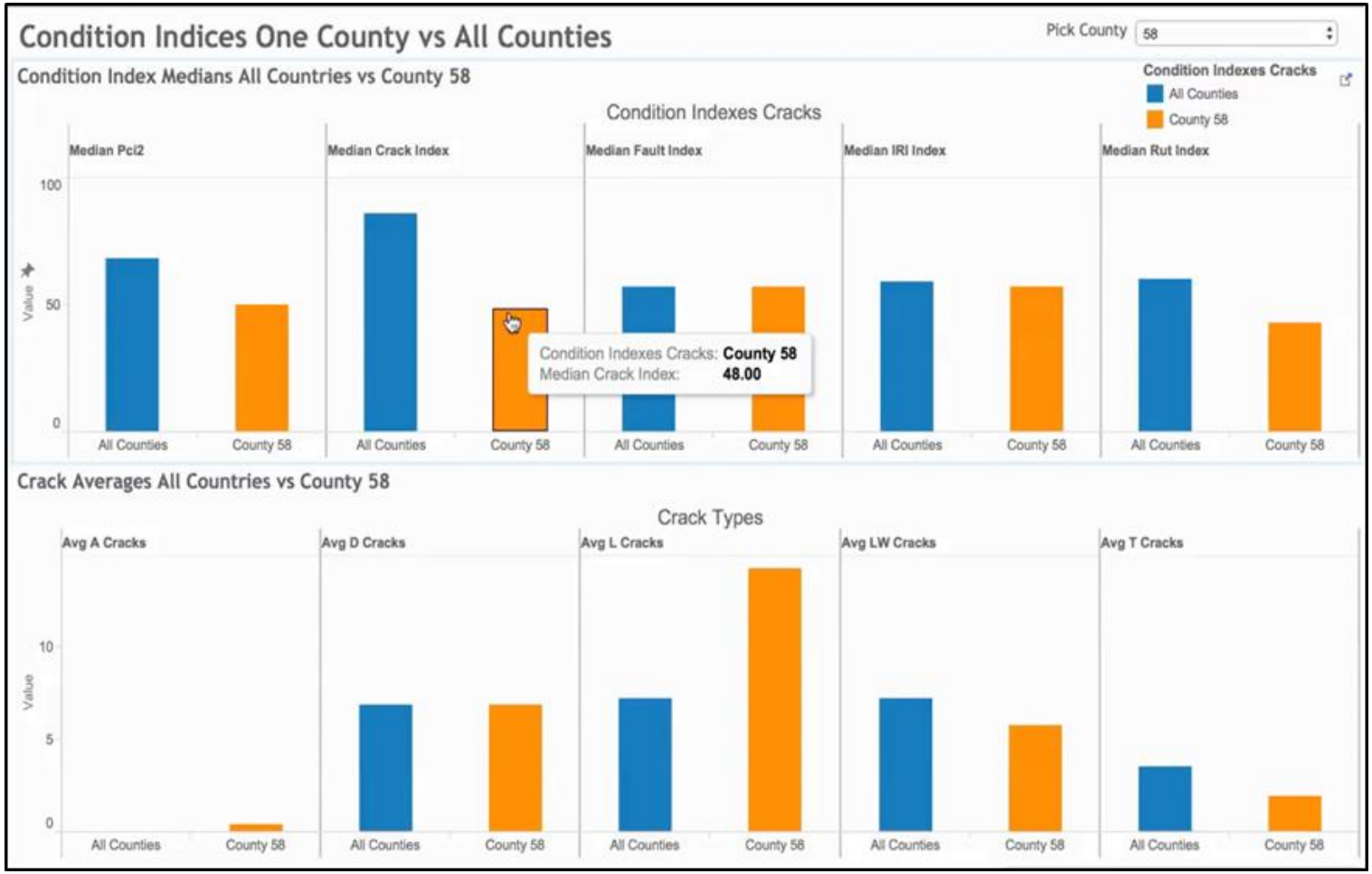

Figure 5. Comparison of condition indices and high cracks for County 58 compared to all counties combined with tooltip details

The following shows four charts combined into one dashboard. The first, third, and fourth show PCI, joints with spalling, and severity patches (bad condition) for each pavement type. The second shows all crack types (high) for each pavement type (see Figure 6). The specific detailed data for each bar can also be obtained, as shown in Figure 7.

Question: What Is the Performance of the Different Pavement Types in my County? Which Pavement Type Has the Highest PCI in my County?

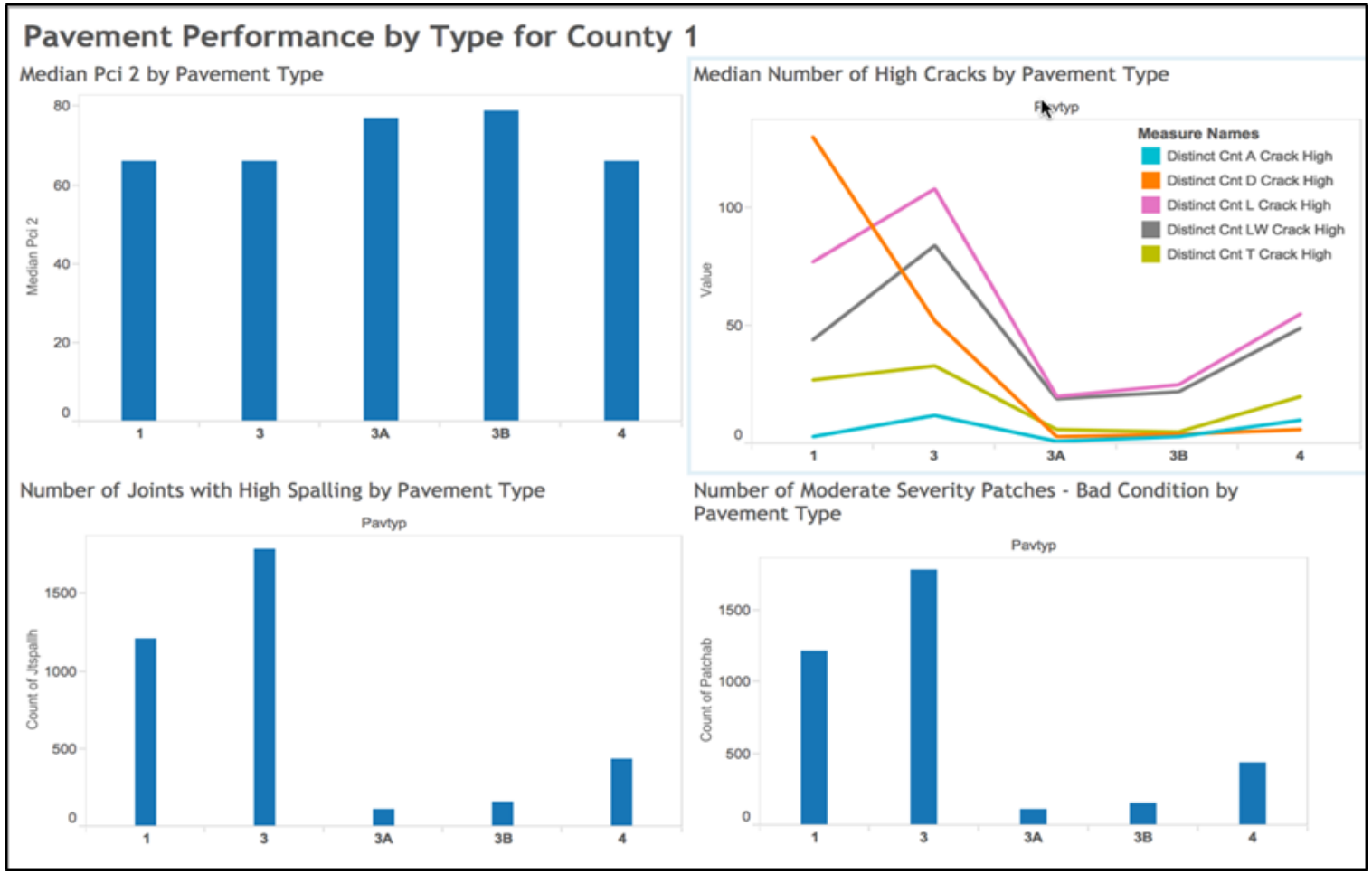

Figure 6. Performance of each pavement type for County 1

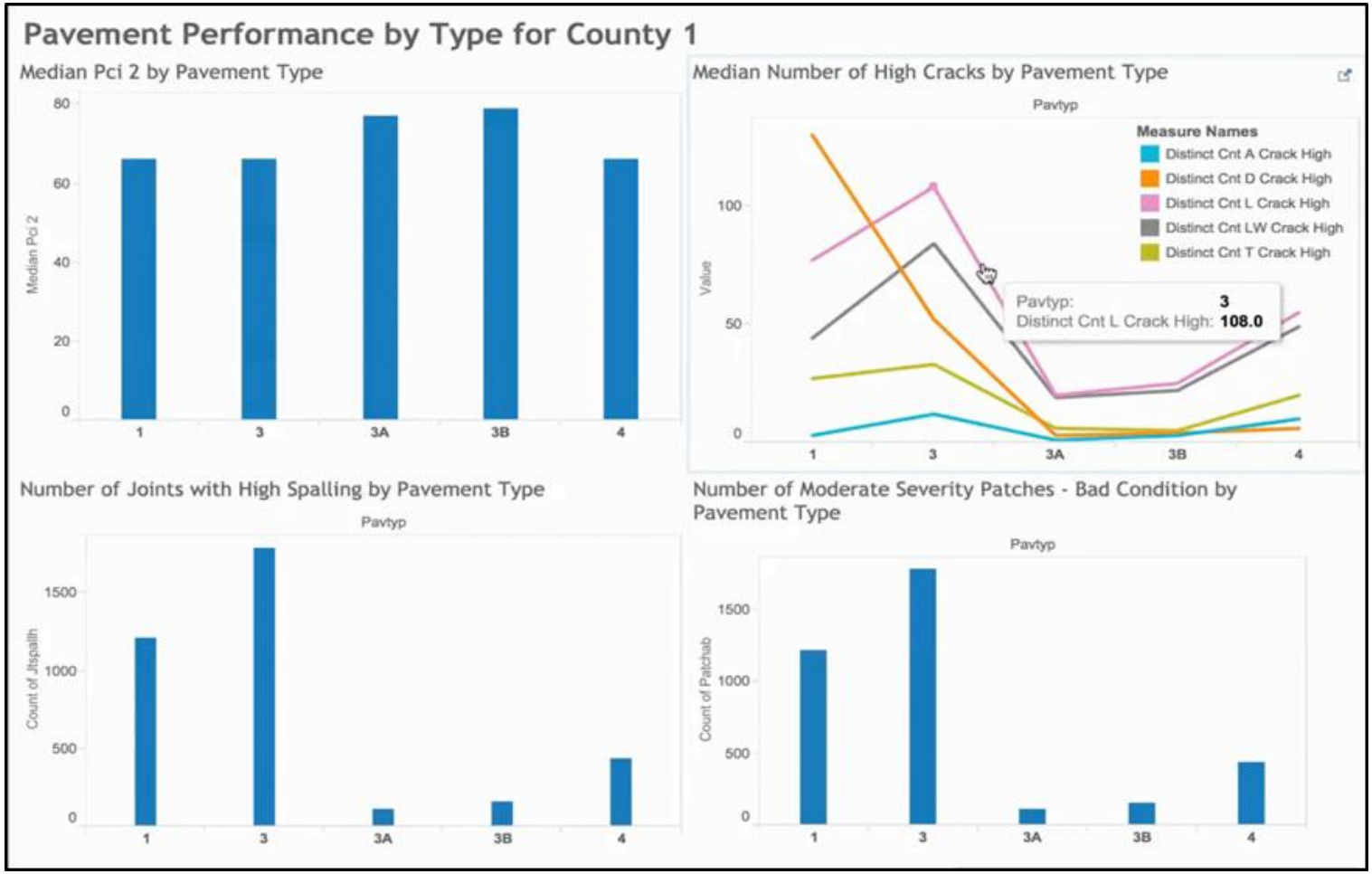

Figure 7. Performance of each pavement type for County 1 with tooltip details

End User: Engineers

The following shows three charts combined into one dashboard (see Figure 8). The first shows the mean PCI, average daily traffic (ADT), and trucks for a selected county and all counties combined. The second shows all three traffic kips for the selected county and all counties combined. The third shows all five traffic data metrics for 2012 to 2014 for the selected county. Detailed information about each bar can be obtained, as shown in Figure 9.

Question: How Does My County Compare to All of the Counties Combined for Truck Traffic and Kips?

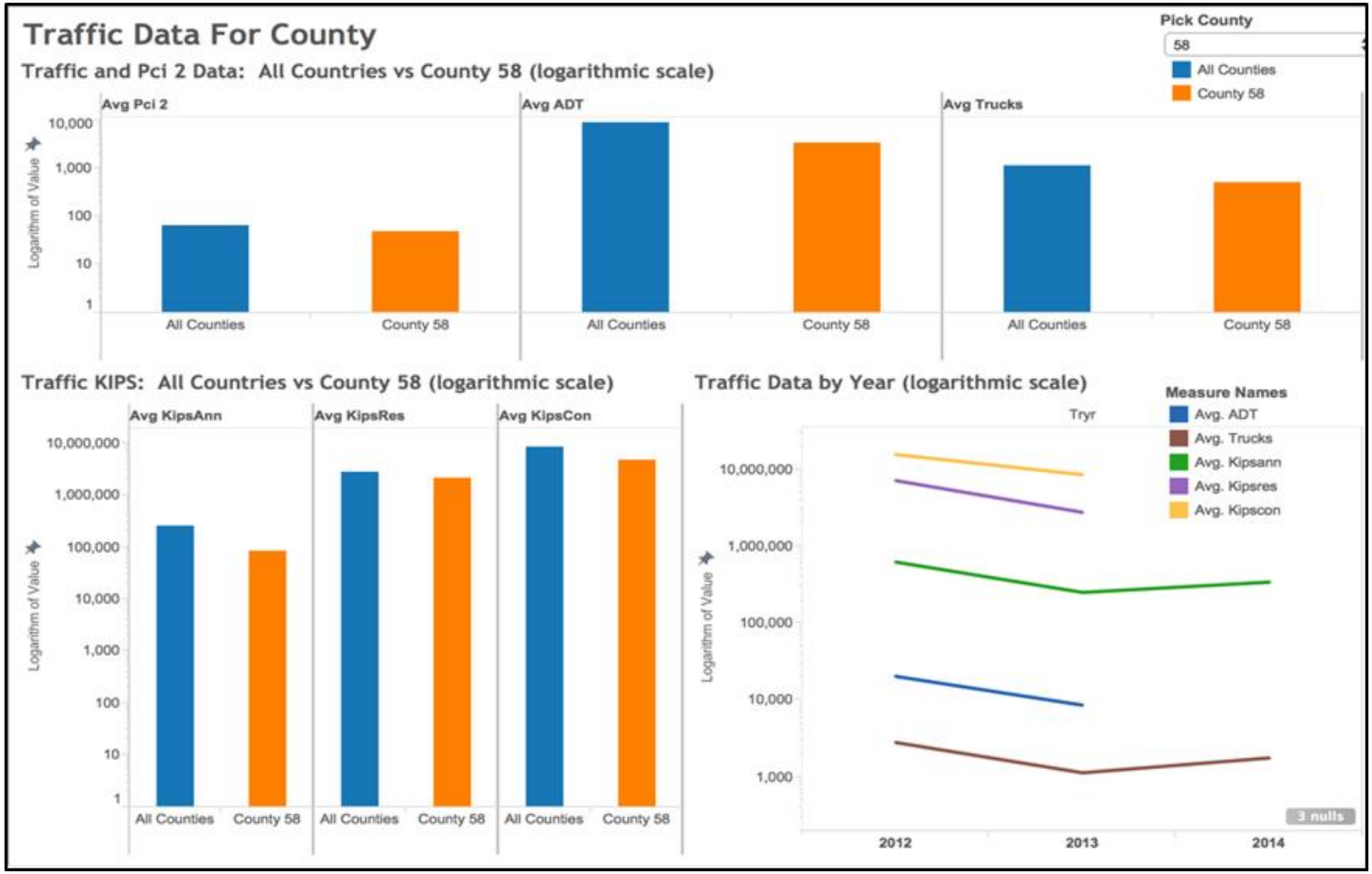

Figure 8. Comparison of traffic data for County 58 compared to all counties combined

Figure 9. Comparison of traffic for County 58 compared to all counties combined with tooltip details

The following shows two charts combined into one dashboard that focuses on PCI and International Roughness Index (IRI) for different pavement types. Data can be filtered by district, county, system, pavement type, age, and speed (see Figure 10).

Question: How Do PCI and IRI Vary by Pavement Type?

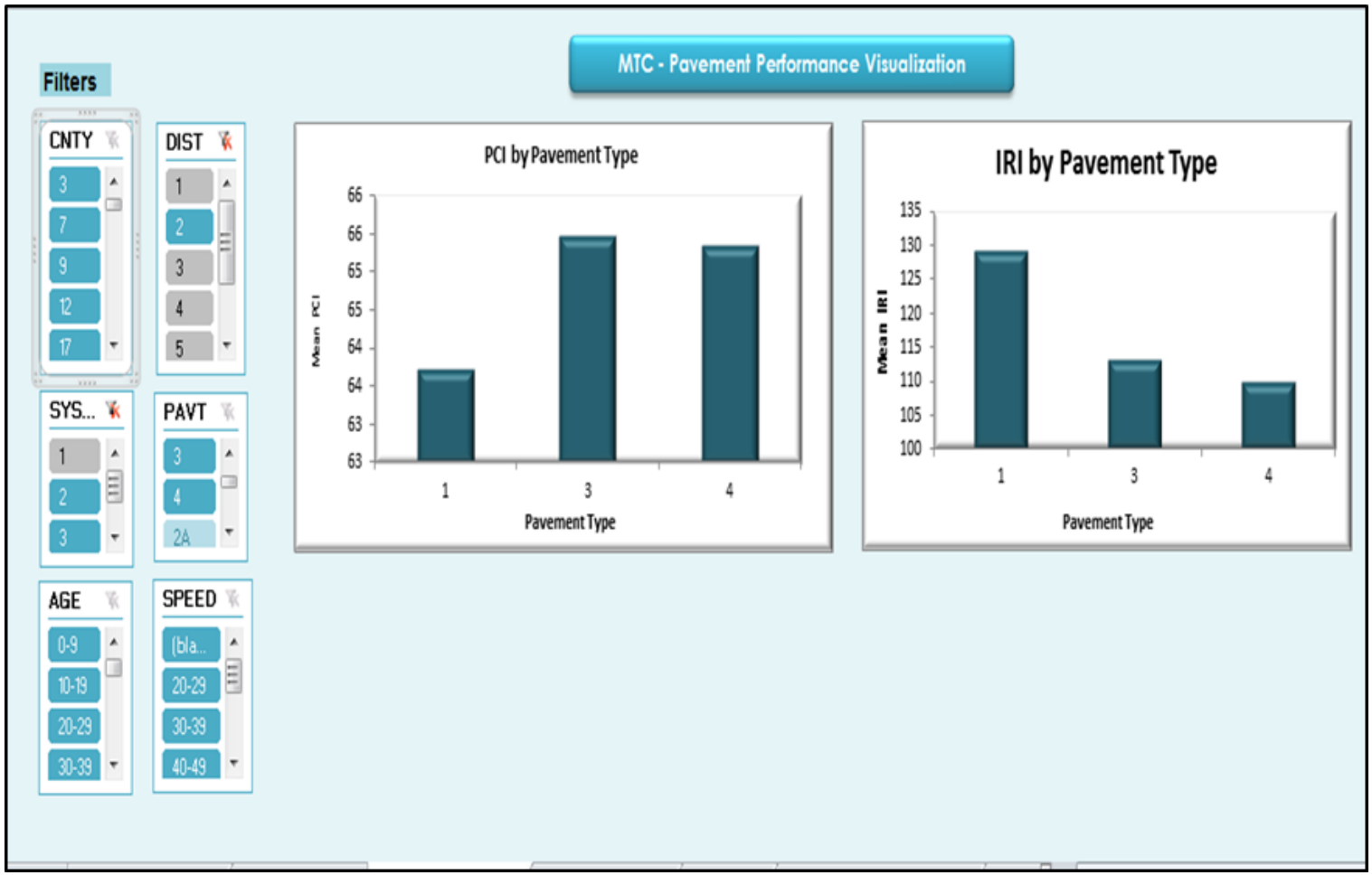

Figure 10. Pavement performance for District 2; Pavement Types 1, 3, 4; and Systems 2 and 3

The following shows four charts combined into one dashboard that focuses on four types of high cracks: A-cracks, D-cracks, L-cracks, and T-cracks. For each, data can be filtered by district, county, system, pavement type, age, and speed (see Figure 11).

Question: How Do High Cracks Vary by Pavement Type?

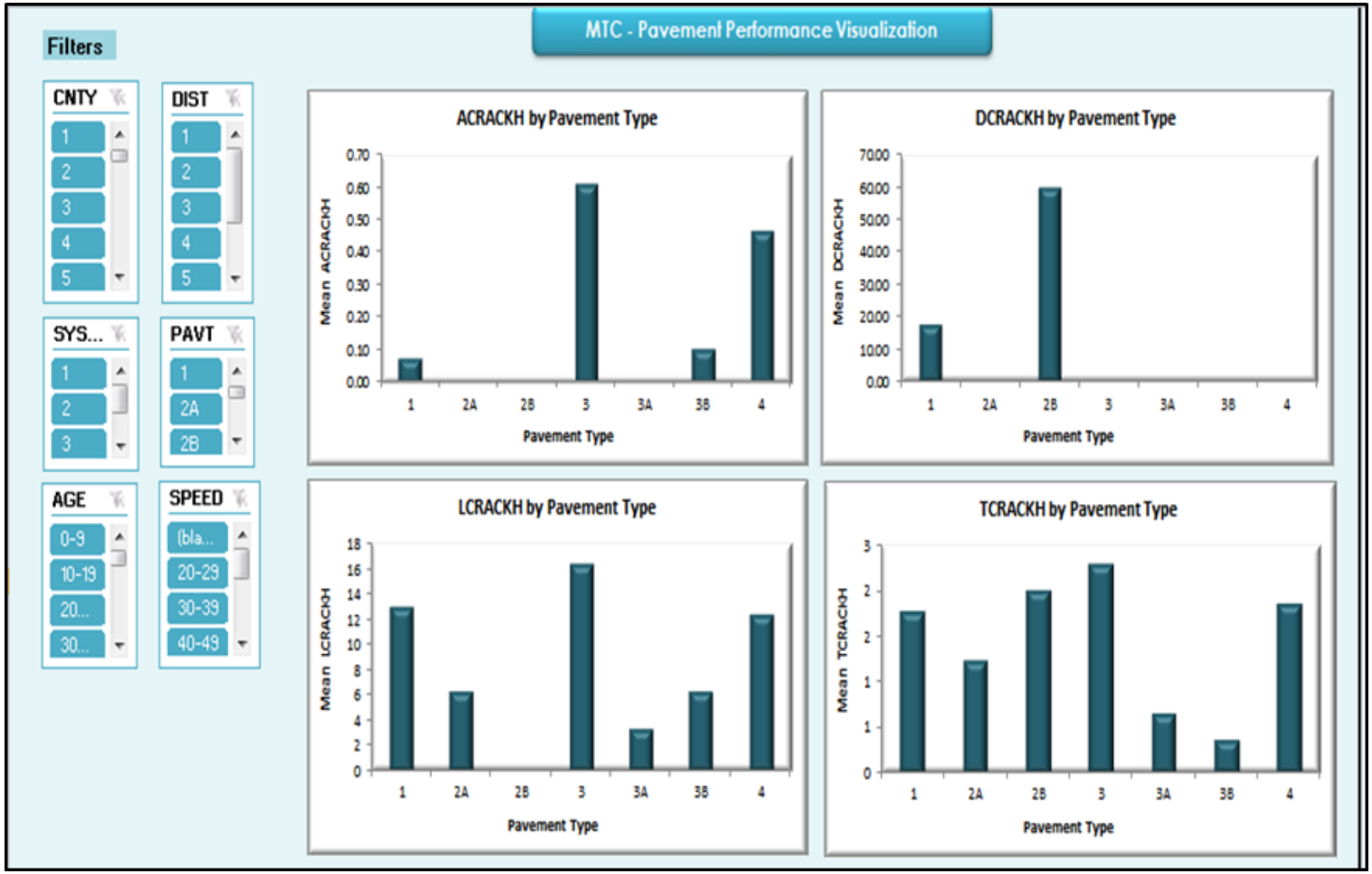

Figure 11. Crack performance over all districts, counties, systems, age, speed, and pavement types

The following shows four charts combined into one dashboard that focuses on the mean PCI by four high crack types: A-cracks, D-cracks, L-cracks, and T-cracks. For each, data can be filtered by district, county, system, pavement type, age, and speed (see Figure 12).

Question: How Does PCI Vary across High Cracks?

Figure 12. Mean PCI by crack type (high) and performance over District 1; Pavement Types 1 and 3; and speed limits of 30 to 39 and 40 to 49 mph

The following shows mean PCI for the age of the pavement, for up to four pavement types (see Figure 13).

Question: Has PCI Changed over the Age of the Pavement for All Pavement Types?

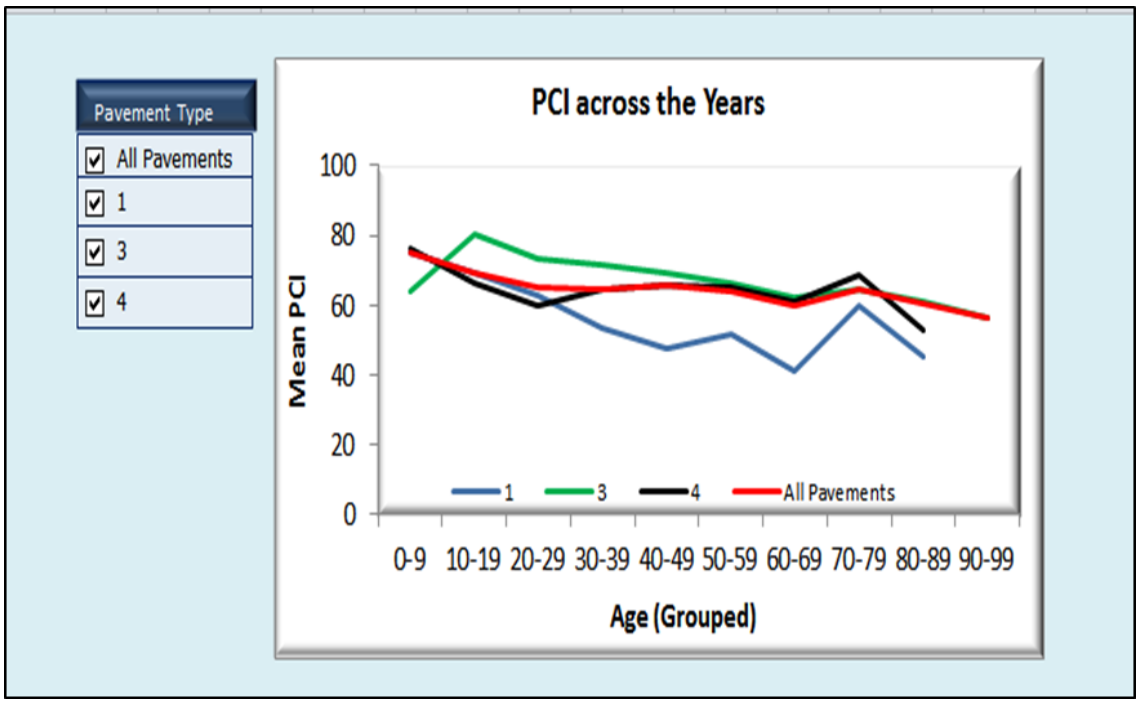

Figure 13. PCI over time for all pavement types

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