

Getting to Know IRI and PCI:

Their Applications for Local Agencies

Sui Tan, PE
MTC

2015 NWPMA Conference, October 20-23, 2015

Why is it Important?

MAP-21 Requirements Focus on:

- **Performance**
- **Accountability**
- **Transparency**



Kudos to FHWA:



The journey of a thousand miles
begins with a single step.

Loo Tzu

Basics

International Roughness Index (IRI)

- Measures pavement smoothness or ride quality
- Uses profiler to collect (low speed and high speed)
- Reported in inches for one mile (inches per mile) in a single wheel path.
- More info:

<http://www.pavementinteractive.org/article/roughness/>

Basics

Pavement Condition Index (PCI)

- Based on ASTM D6433 standard (20 AC and 19 PCC distresses)
- Rating from 0-100, 100 as new pavement
- Measures pavement surface distresses
- Data collected through walking, windshield, and semi-automated.

Basics

Present Serviceability Rating (PSR)

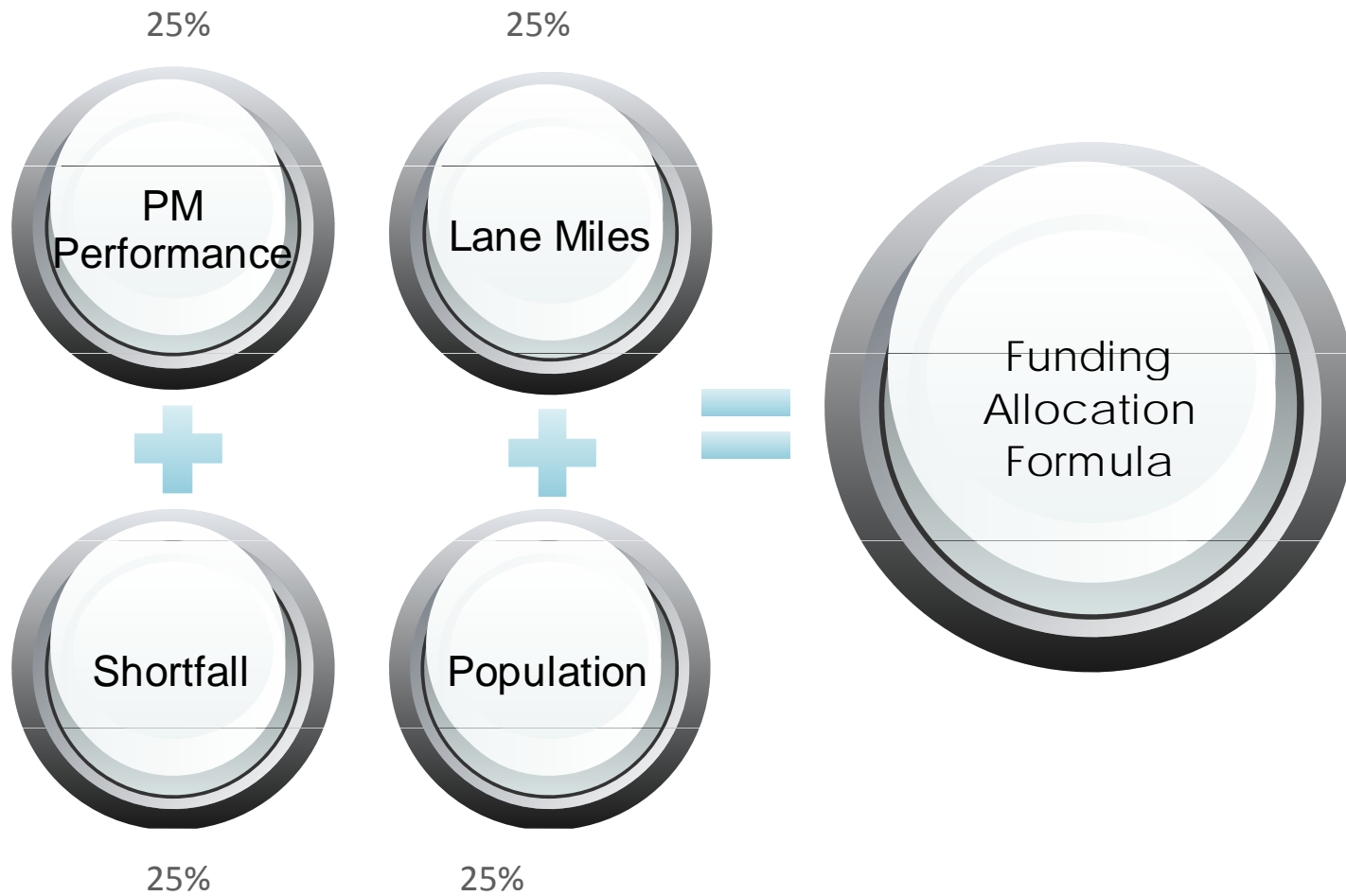
- PCI to PSR conversion (for HPMS reporting):
- PSR is NOT PCI, it is adjusted PCI with low severity cracking removed

- Conversion equation:
 - <http://www.dot.ca.gov/hq/tsip/hpms/hpmslibrary/hpmspdf/2006wkbk.pdf>

PCI Applications

- Treatment Strategy Selection
 - $70 < \text{PCI} < 90$ – Preventive Maintenance
 - $50 < \text{PCI} < 70$ – Minor Rehab (load vs non-load related)
 - $25 < \text{PCI} < 50$ – Major Rehab
 - $\text{PCI} < 25$ – Reconstruction
- Performance Measures
 - Develop key performance indicators related to pavement preservation

Performance-Based Funding Allocation



Pavement Preservation Index (PPI)

$$\frac{\text{Actual PM \%}}{\text{Recommended PM\%}}$$

IRI Applications

- HPMS Reporting
 - Required by FHWA since 1990
 - All state DOTs have to report
 - Includes interstate and non-interstate NHS
 - Non-interstate NHS = other principle arterials = Mostly local

Estimated MAP-21 NHS Mileages

| State | Pre MAP-21 NHS | Non-NHS PAS* | Post MAP-21 NHS | Change |
|------------|----------------|--------------|-----------------|--------|
| California | 7,155 | 6,994 | 14,149 | 98% |
| Oregon | 3,751 | 632 | 4,383 | 17% |
| Washington | 3,410 | 1,166 | 4,576 | 34% |

*PAS - Principal Arterial System

Source: 2011 HPMS

IRI Applications

- New Construction Specifications
 - Use in some state DOTs – Washington, Virginia, Arizona, Kansas
 - Virginia DOT – Acceptable 55 to 70 in/mi, bonus below 55 in/mi
 - WSDOT – Acceptable at 60 in/mi
 - One municipality – City and County of Denver
 - Hot In-Place Recycle with 1” finishing course = 165 in/mil

IRI Applications

- Treatment Filter
 - Caltrans - poor IRI (without distresses) triggers capital preventive maintenance vs major rehabilitation/reconstruction
 - Local agency – County of Charleston, SC
 - Overall Condition Index – based on IRI, cracking and rutting. Will soon get rid of IRI.

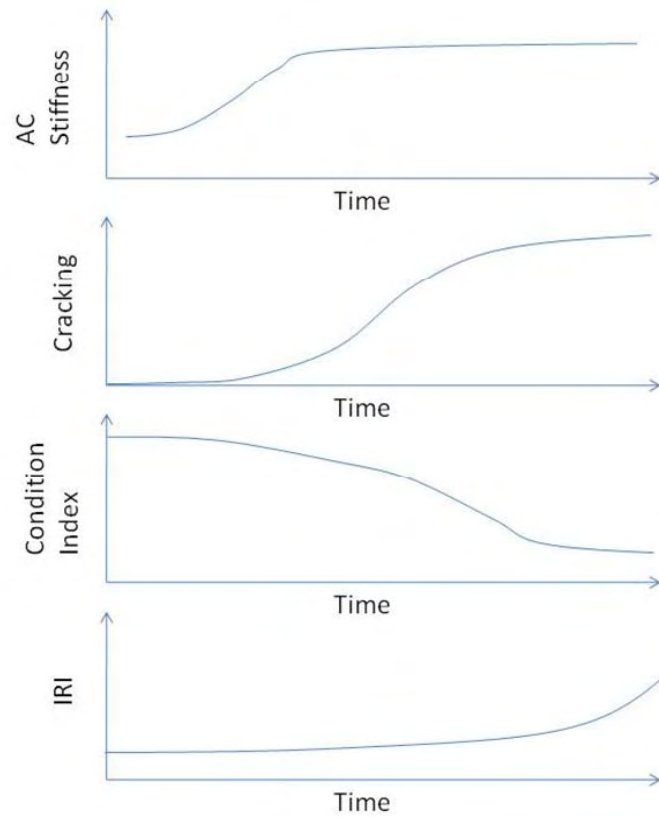
IRI Applications

- Vehicle Operating Costs
 - Consider VOC in pavement investment strategies
 - Rougher roads, higher VOC
 - Model developed based on IRI - NCHRP 720

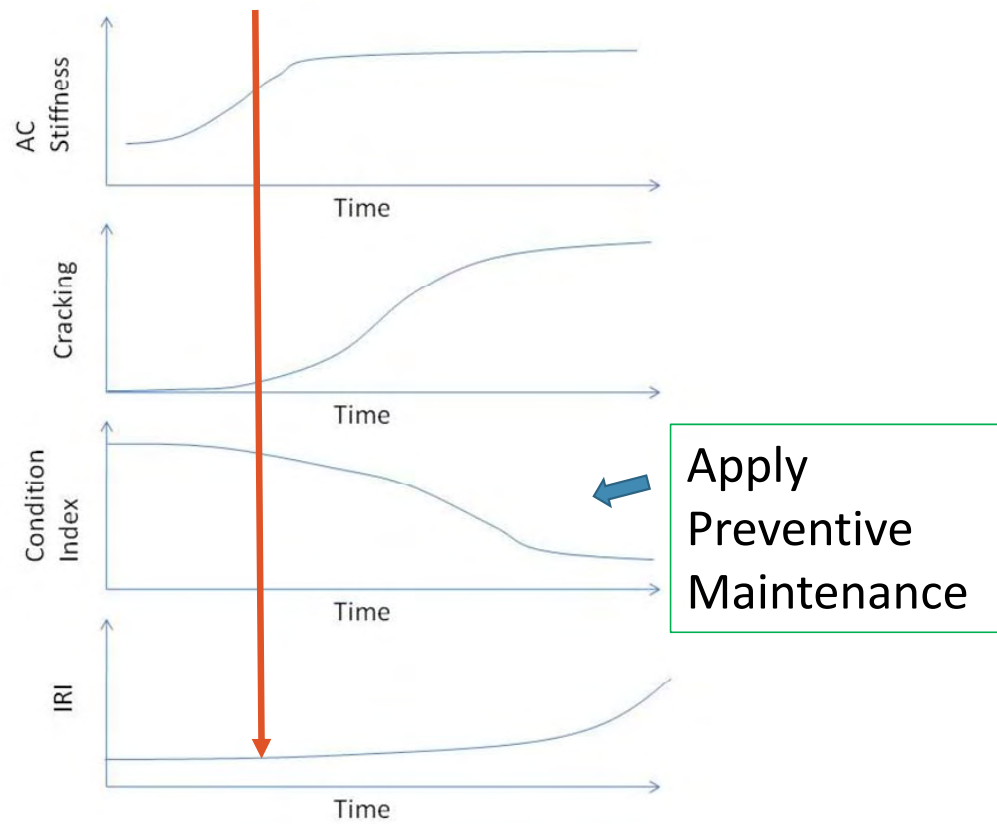
A Word of Caution for Planners

IRI  PCI

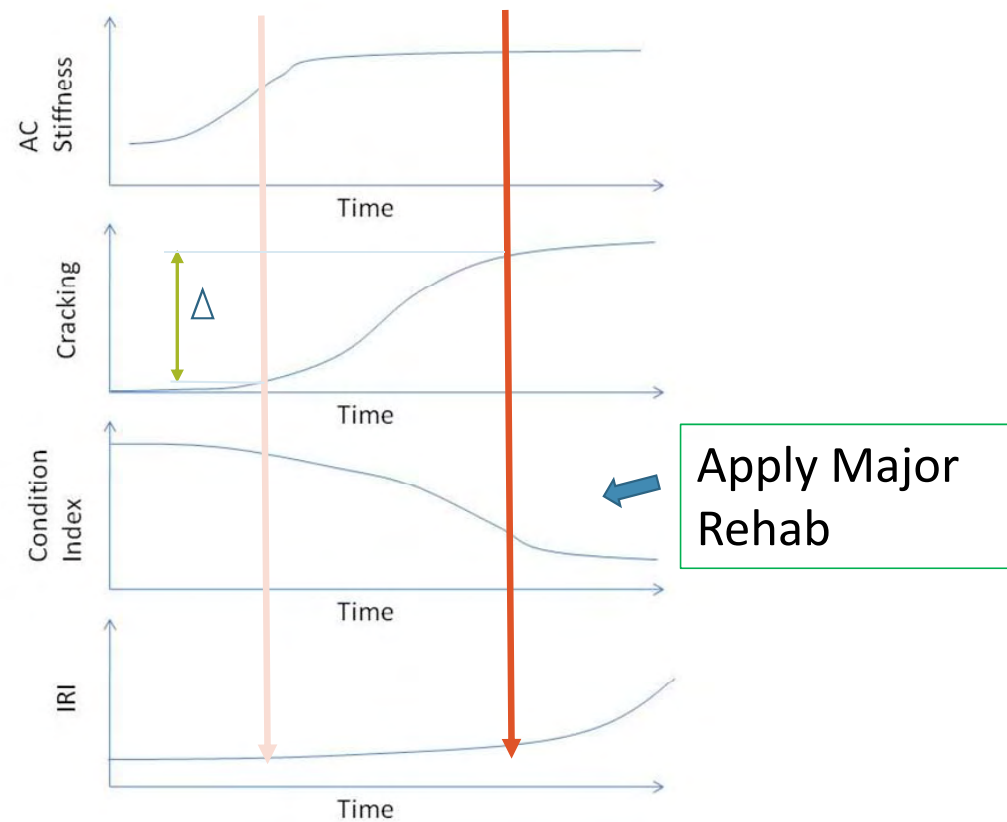
Engineering Behavior of IRI and PCI



When Pavement in Good Condition



When Pavement in Poor Condition



Pavement Preservation

- PCI
 - Detect low severity cracks
 - Provide maintenance intervention earlier
- IRI
 - Ignore low severity cracks
 - Use for non-cracking, construction defects type of treatment

Performance Management

Leading Indicator

Activities you must undertake to achieve the desired outcome

Lagging Indicator

“output” oriented, easy to measure but hard to improve

My Daily Food Plan

Based on the information you provided, this is your daily recommended amount for each food group.



SAMPLE

VS



Performance Management

Leading Indicator

PCI

Detect low severity
cracks early

Lagging Indicator

IRI

Will only detect cracks
when they are sizable

IRI Collection Challenges in Urban Setting

- Utility castings (manhole)
- Difficult to control travel speed (signals & stop signs)
- Short vertical curves and cross crowns
- Grade breaks (drainage)
- Street sections are shorter

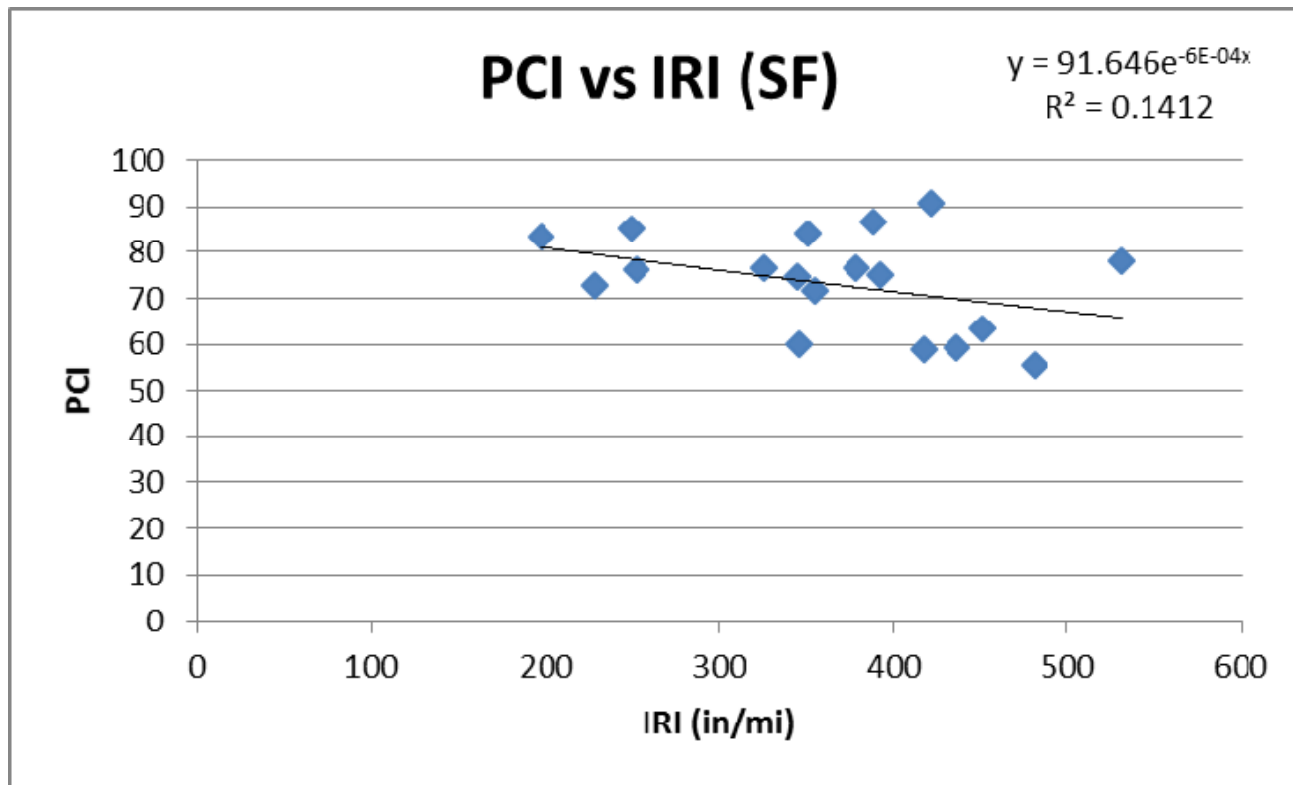
IRI Collection Challenges in Urban Setting

- Urban IRI is highly localized
 - New York – Poor roads IRI > 800 in/mi (2001 study)
 - Washington DC – (2014 Study)
 - Mean IRI for local roads = 362 in/mi
 - Mean PCI for local roads = 71

Conclusion:

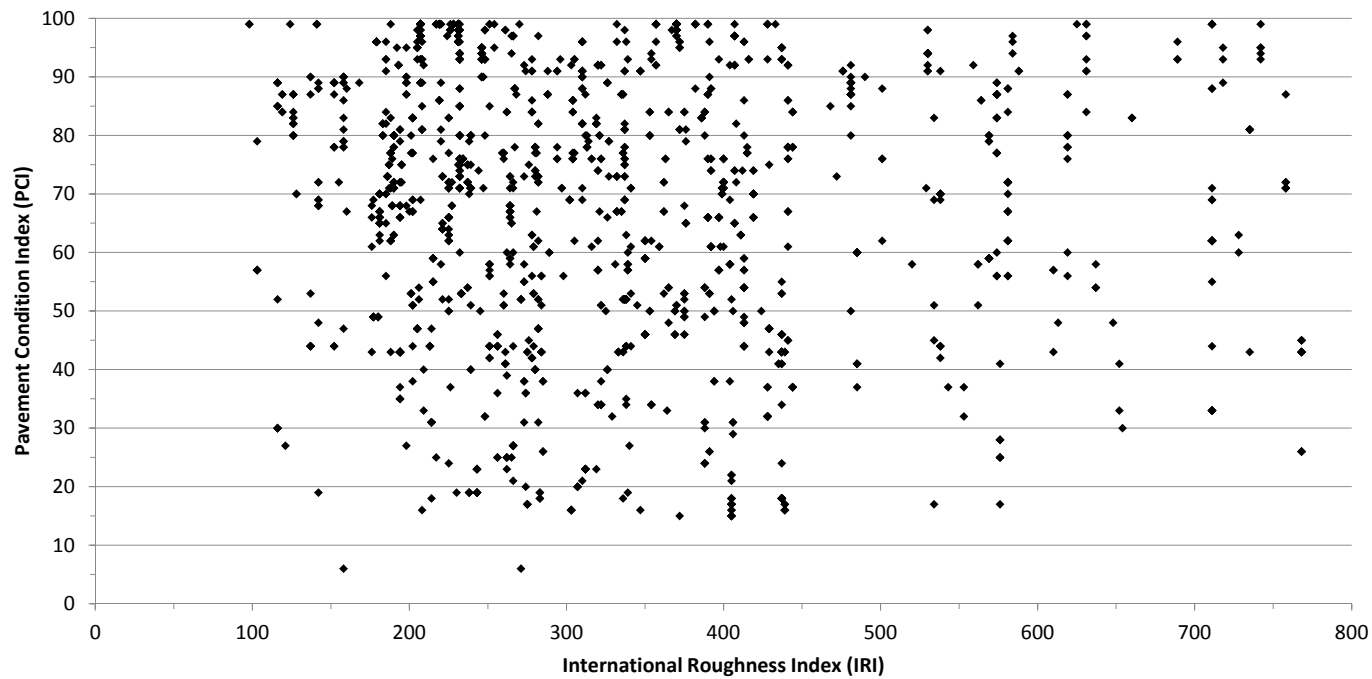
“... models developed could not be adequately used to predict PCI from IRI.”

Correlation of PCI and IRI



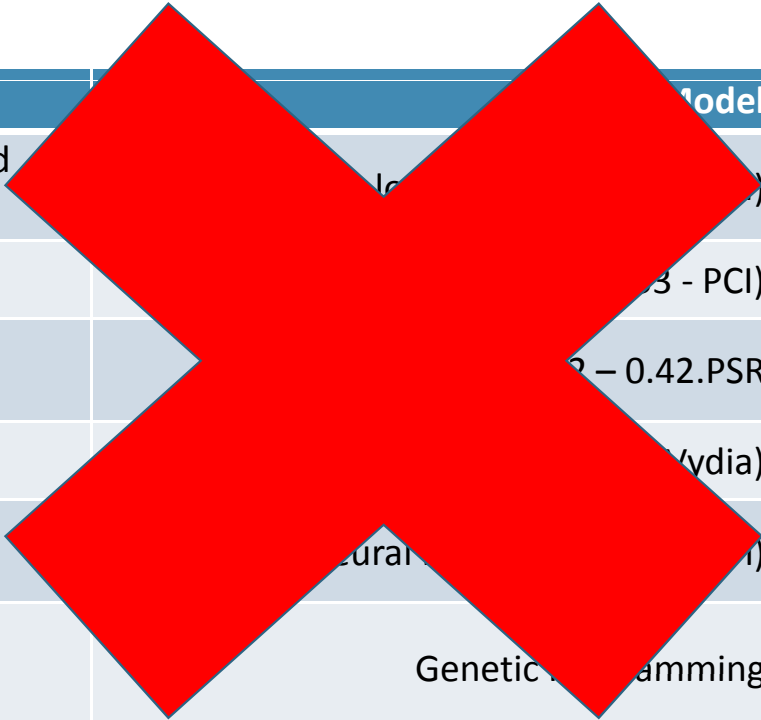
City of Seattle (preliminary results)

**SDOT 2013 Pavement Condition Index (PCI) vs.
WSDOT 2013 International Roughness Index (IRI)**



◆ SDOT 2013 PCI vs. WSDOT 2013 IRI

Literature Reviews



| Jurisdiction | Model | R2 | MSE |
|-----------------------------------|---------------------|------|-------|
| US Mid-Atlantic States and Canada | | 0.59 | - |
| California | | 0.53 | - |
| Washington, DC | | 0.55 | - |
| India | | 0.86 | 0.041 |
| Iran | | 0.99 | 0.99 |
| Iran | Genetic Programming | 0.98 | 2.63 |

Lessons Learned

- Understand the limitations of the study
 - “...model for IRI is limited to the range of 46-127 in/mile.” (Park & Lee 2007)
 - “ ... model was based on data collected for construction zones...” (Vidya et al. 2013)
- Many studies used data from national database like LTPP
- Definitions on distresses, severity, and extends
- The only **VALID** study to compare IRI and PCI on urban streets:
 - Both are collected on the same section
 - Both are collected within reasonable time frame
 - PCI is based on ASTM D6433
 - IRI is collected using low speed profiler



Questions

Sui Tan, PE

StreetSaver Program Manager

stan@mtc.ca.gov

510-400-8428