Effective Data Quality Measures for Infrastructure Asset Management

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Background

- Asset management is a valuable tool for managing highway infrastructure
  - **Includes pavement management,**
  - **bridge management,**
  - **Management of other assets**
- High data quality is necessary to effectively utilize asset management tools
  - Applies to both manual, and
  - automated data collection

Importance of a Data Quality Management Plan

- Decisions based on questionable data can lead to ineffective treatment investments and system management.
- Methodology to Validate and verify data which controls the decision making process.
  - The impact of asset management decisions last for many years
  - Impacts asset condition and budgetary needs

Example of Data Quality Impact on Costs

VDOT Findings-Estimated Pavement Cost Reduction due to corrected data, based on a single year of data

- I-81 cost correction of $8.9 million (21%)
- I-95 cost correction of $0.3 million (1%)

TRB Paper:

The Effects of a Comprehensive QA/QC Plan on Pavement Management

Shekharan, Frith, Chowdhury, Larson, and Morian, 2007

Also, State highway agencies are now required to submit a Pavement Data Quality Management Program (DQMP) for FHWA review and approval under MAP-21

- Pavement condition metrics include:
  - International Roughness Index (IRI)
  - Rutting
  - Faulting
  - Percent Cracking
  - Present Serviceability Rating (PSR) – only where the posted speed limit < 40 mph

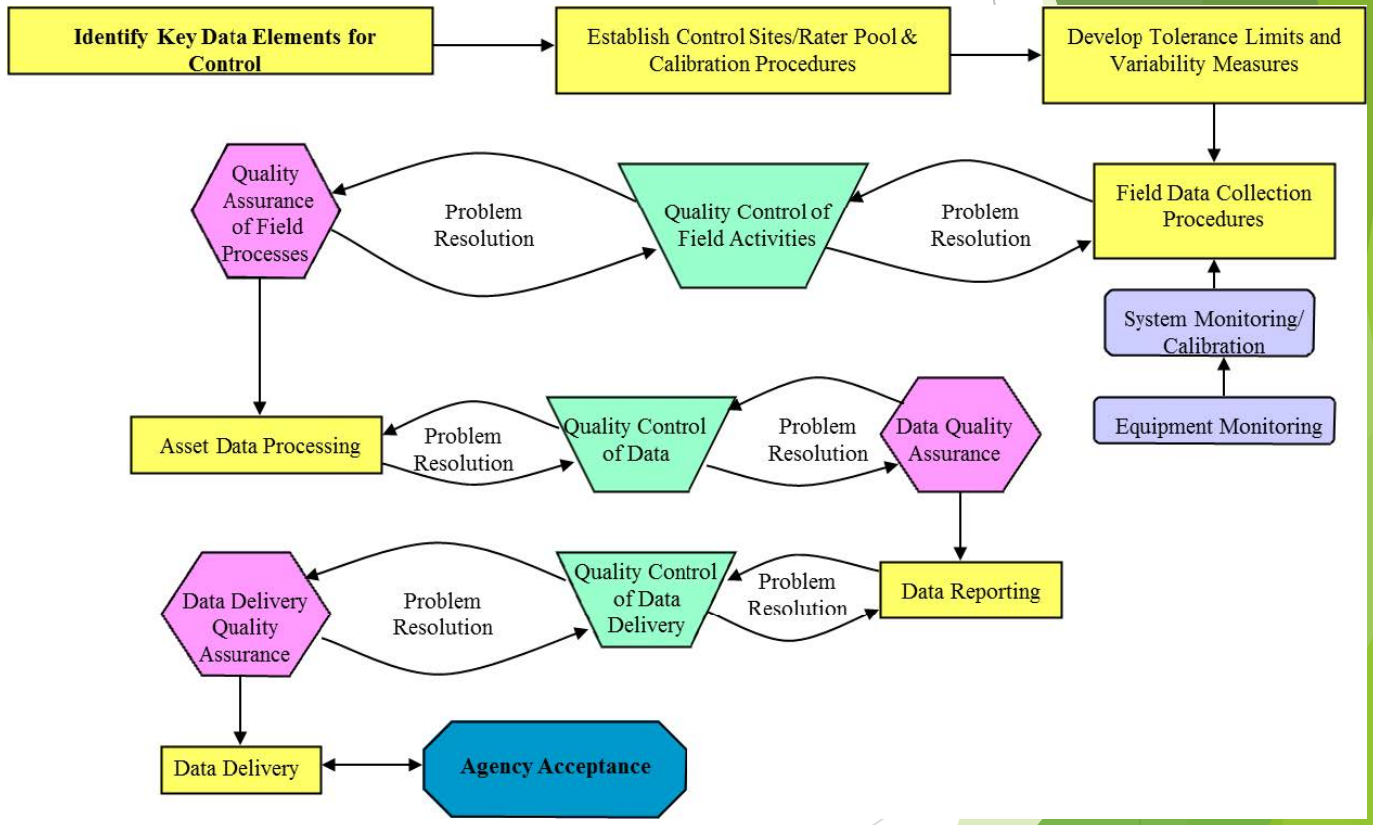
Illustrations of Pavement Management: Example Distresses -Cracking, Rutting, Ride Quality

Overview of Methods for achieving high quality data- Pavement Application

- For automated data collection-maintain equipment calibration and certification.
- Similarly for manual data collection- maintain calibration and certification processes.
- Implement data quality control measures before and during data collection.
- Perform ongoing checks and review of sampled data.
- Establish appropriate data acceptance criteria
- Identify a procedure for the resolution of errors, includes reprocessing data for problem sections

Process Flowchart of DQMP

1. Identify key data elements for control
2. Identify sources and range of variability
3. Define control items and limits
4. Control site evaluations
5. Levels of control
6. Production level quality assurance (includes problem resolution
7. Improve Process based on lessons learned



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Calibration and Certification Processes

- Select limits for calibration and certification of collection equipment to achieve a desired minimum accuracy in relation to
  - a reference profiler or
  - manual ‘ground truth’ survey
- Collect repeat runs to achieve a establish minimum repeatability
- Use a reference pavement condition survey manual that includes
  - methodology for determining distress type and
  - severity
- Annual or semi-annual rater training to calibrate and certify for manual data collection

Define Control Parameters and Threshold Values

- Control the data that affects pavement management decisions
  - Identification of the key data elements to be controlled
  - Determine the criticality of each element and expected variability
  - Establish control data
  - Develop tolerance limits and variability measures

Control Parameters and Threshold Values (Continued)

- Processes must be Practical
- Utilize Applicable Statistically Based Techniques
- Distress Definitions for
  - Individual distress types and/or severities
  - Index values
- Range and completeness checks

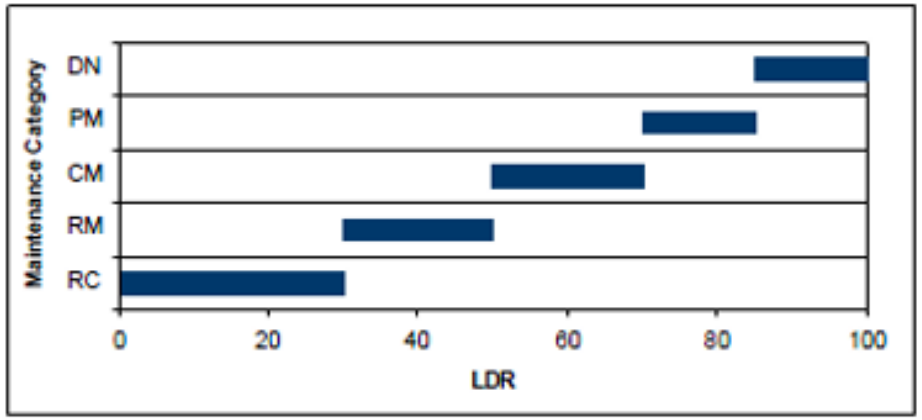
Example Process- VDOT

- Began Virginia quality monitoring contract in 2005
- Developed a statically based data QA plan in 2000 to control decision making data
- VDOT uses Automated data collection (originally 2D, then 3D beginning in 2016)
- Historically collection includes:
  - All Interstate (~2,400 miles)
  - All Primary (~12,000 miles)
  - 20 – 25% of Secondary (~13,000 miles)
  - Total ~50,000 miles managed

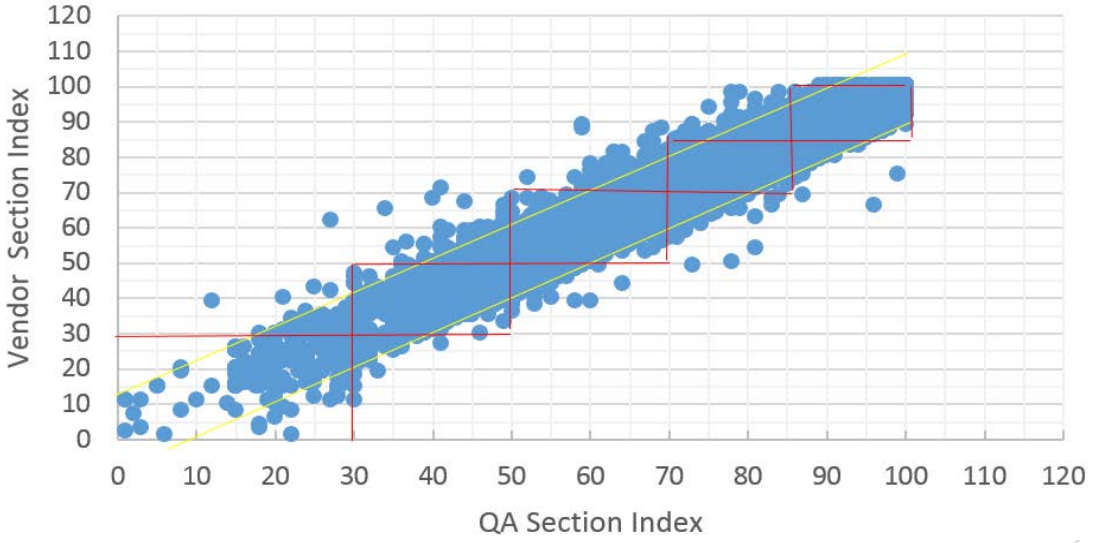
VDOT Example

Recommended Exclusive Ranges for BIT Pavement

Maintenance Category	LDR Index		NDR Index	
	Max	Min	Max	Min
RC	30	0	30	0
RM	50	> 30	50	> 30
CM	70	> 50	70	> 50
PM	85	> 70	85	> 70
DN	100	> 85	100	> 85



LDR Variation for BIT Pavements – Recommended



Elements of VDOT Process

- Control uses VDOT index values
  - Load Related Distress Index (LDR), 0-100
  - Non-Load Related Distress Index (NDR), 0-100
  - Critical Condition Index (CCI), 0-100
- Control limits are 10 points (determined from rater pooled data)
- 95% of all QA samples must be within limits for an acceptable deliverable

Production Level Quality Assurance

- Verify based on key data elements
- Perform independent distress evaluations
- Use High level data range checks
  - Quantities do not exceed section limits or reasonable boundaries
- Year-to-year consistency checks
  - Pavement does not improve without reason
  - Pavement does not deteriorate at an unreasonable rate
  - Can be affected by weather or season of the year

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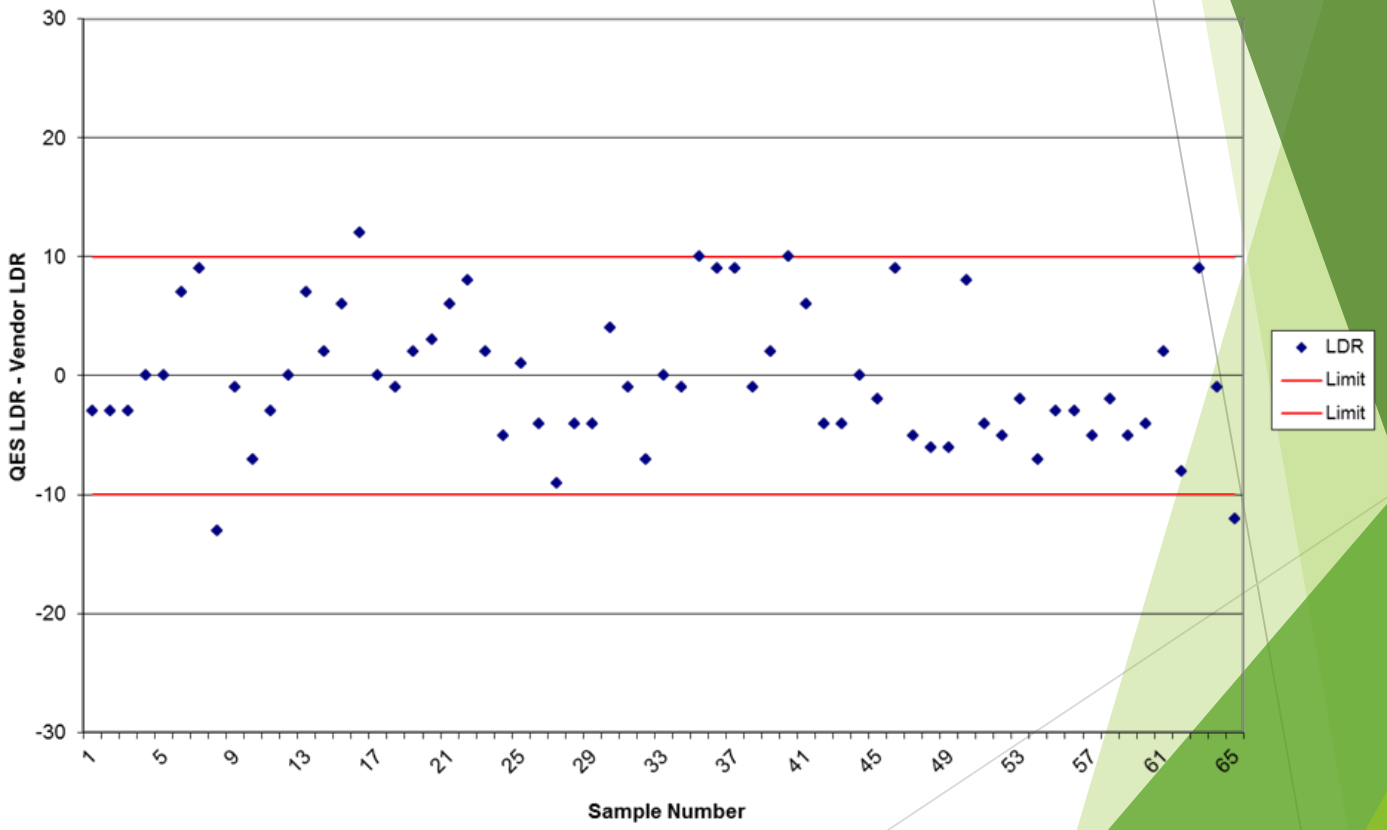
VDOT Process Illustration

- 5% random sample per deliverable
- Independent distress rating
  - Compare LDR & NDR Index Values
    - Within 10 index points for 95% of the samples
  - Compare concrete Index Values
    - Within 10 index points for 95% of the samples



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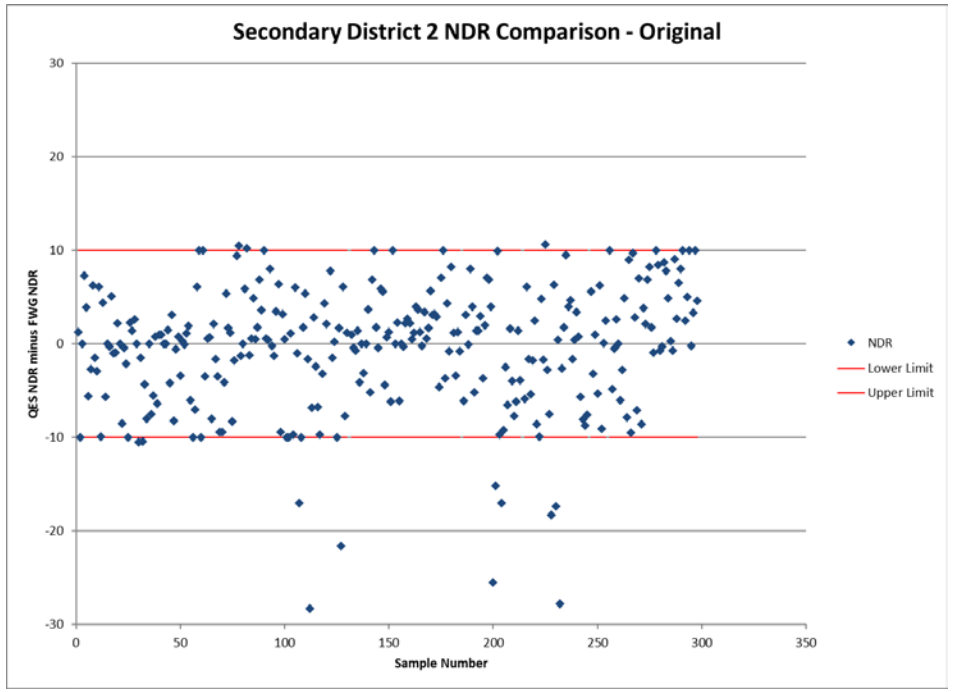
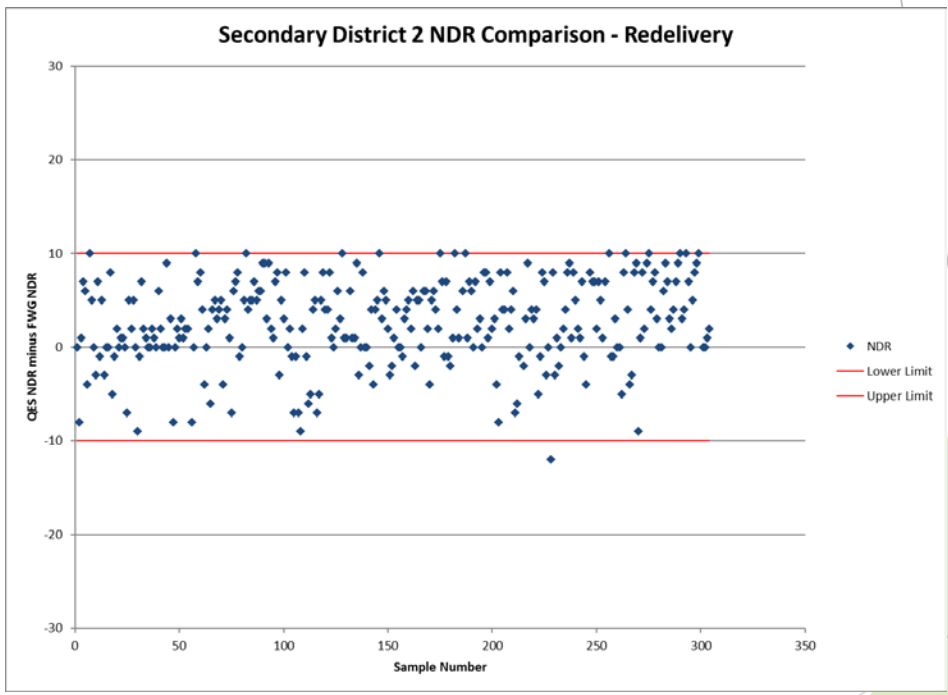
2016 Secondary District 2 NDR REDELIVERY



96.2%



99.3%

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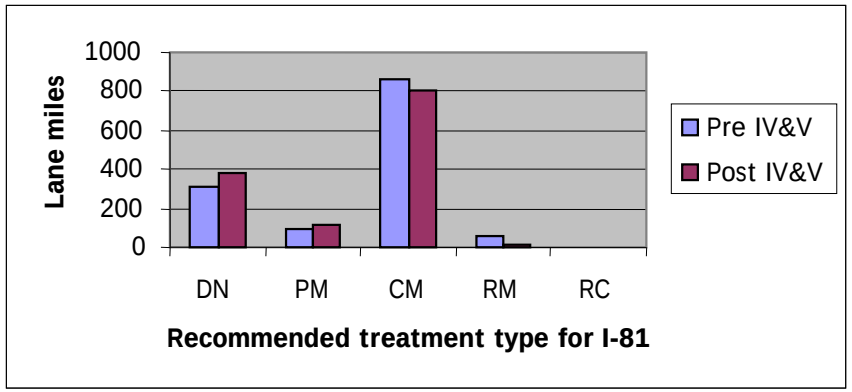
Economic Benefits of DQMP

- Incremental investment to ensure data quality, vs. unreliable data which will impact effective budget management
- Accurate and consistent data reduces the need for additional, costly data recollection/verification
- Pavement network is a long term investment
  - quality data provides a return on this investment by
  - improving the cost effectiveness of budget and condition management

Recommended Treatments



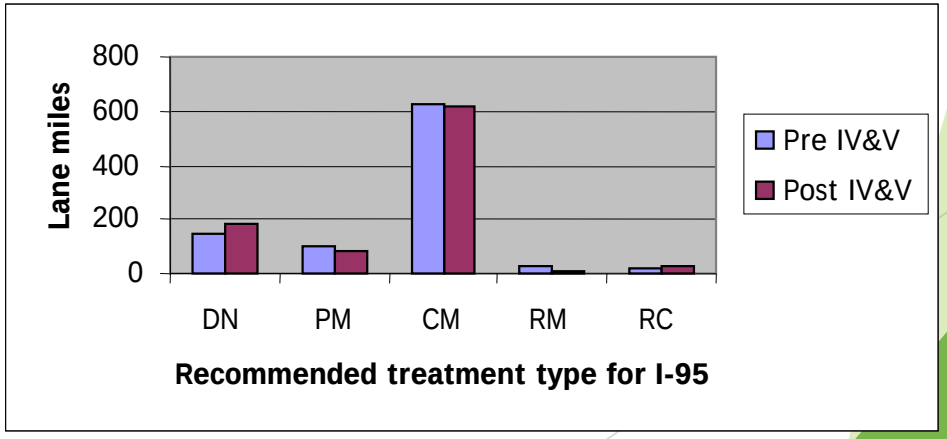
DN = Do Nothing

PM = Preventive Maint

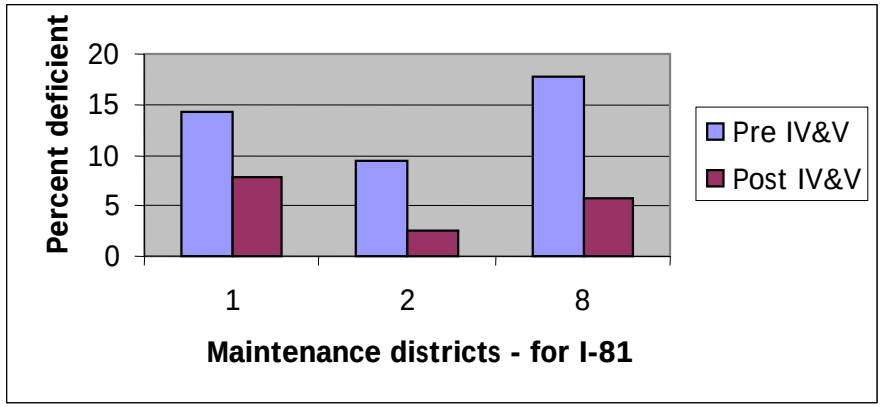
CM = Corrective Maint

RM = Restorative Maint

RC = Reconstruct

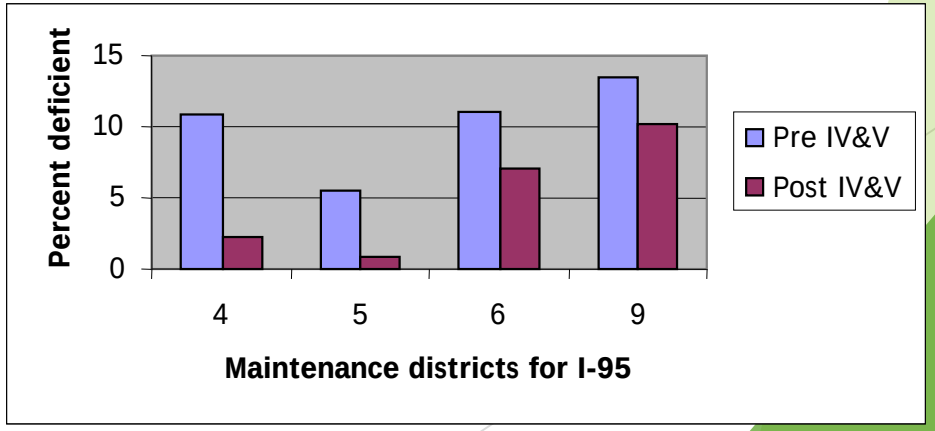


District Implications

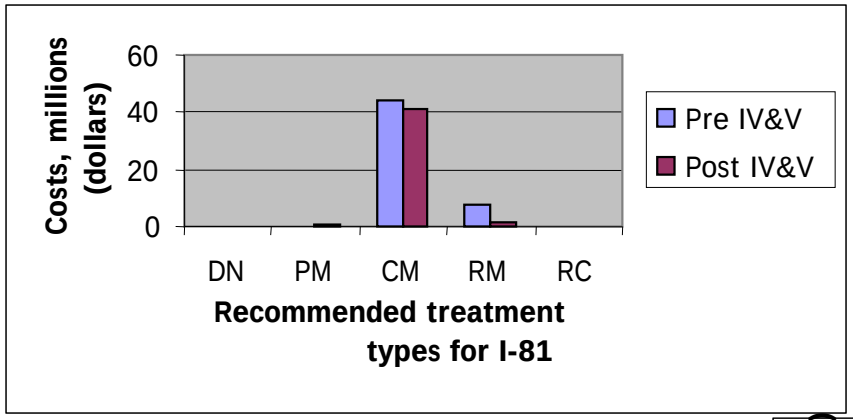


- 25% fewer deficient lane miles on I-81

- 20% fewer deficient lane miles on I-95



Cost Ramifications



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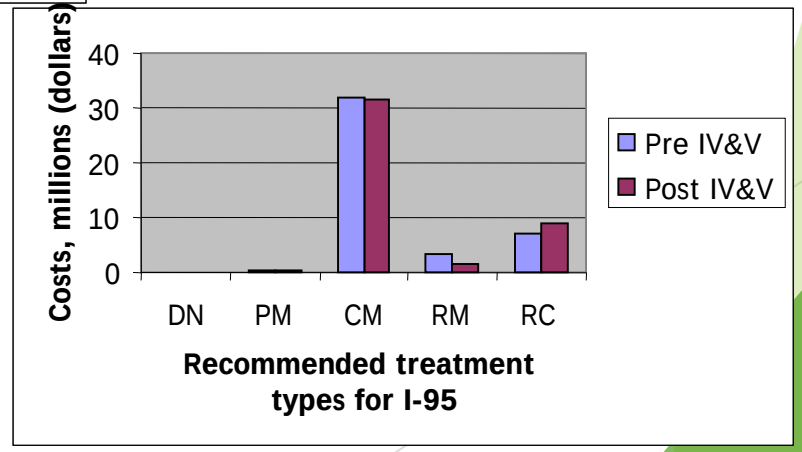

SUMMARY

- Quality data is important!
- Enables confident decision making
- Apply principal of continuous improvement to the quality monitoring process
- Be willing to make adjustments to the process

THANK YOU!

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