Quantifying the Benefits of Pavement Asset Management

By

W. Ronald Hudson, Ph.D., P.E.
and Ralph Haas, Ph.D., P.E.
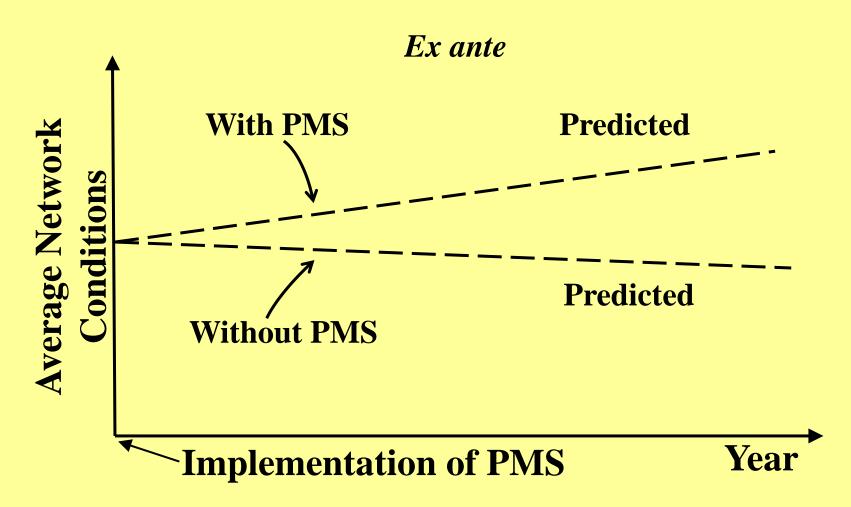
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Outline

1. **McNeil Concepts of Benefit Evaluation**
2. **Kercher Examples for Cities**
3. **ADOT Actual Benefits**
4. **2015 Benefits Example**
5. **Pinellas County Florida Benefits**
6. **Complex Design Calculation vs PMS Solutions**
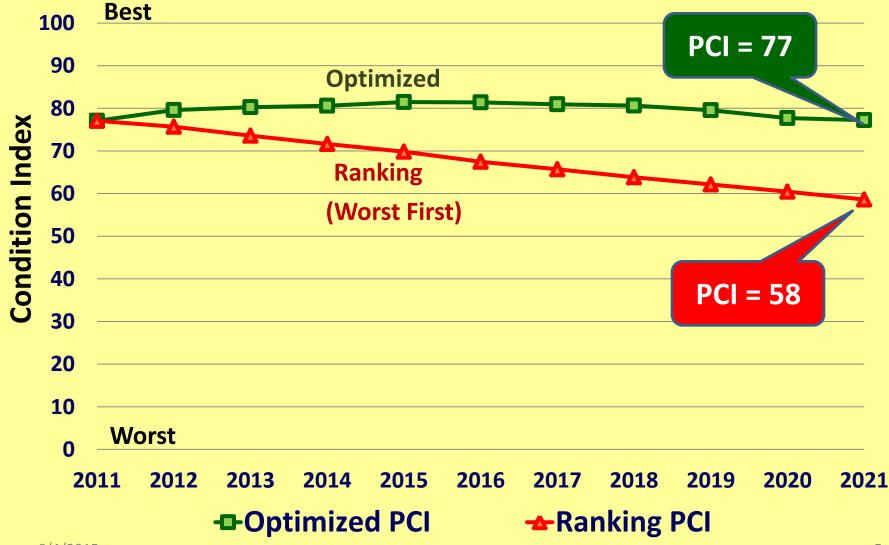
PMS (Transportation AMS) Maturity Scale (*6*)

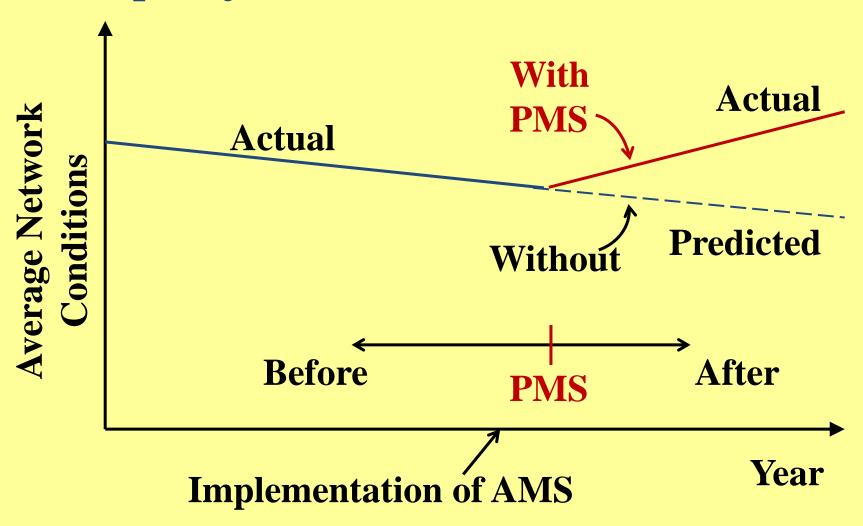| PMS Maturity Level	Description
1. Initial 1970's	No use of tools, processes, or strategy
2. Awakening	Recognize need, basic data collection. There is often a champion.
3. Structured	Shared understanding, motivation, & coordination. Develop processes & tools.
4. Proficient	Expectations and accountability drawn from PMS tools, processes, & strategy.
5. Best Practice 2000 - DATE	PMS strategies, tools, and processes are evaluated improved and merged into AMS.

McNeil and Mizusawa Concept of *ex ante* evaluation *(2)*

Ex ante

With PMS

Predicted

Average Network Conditions

Without PMS

Predicted

Implementation of PMS

Year

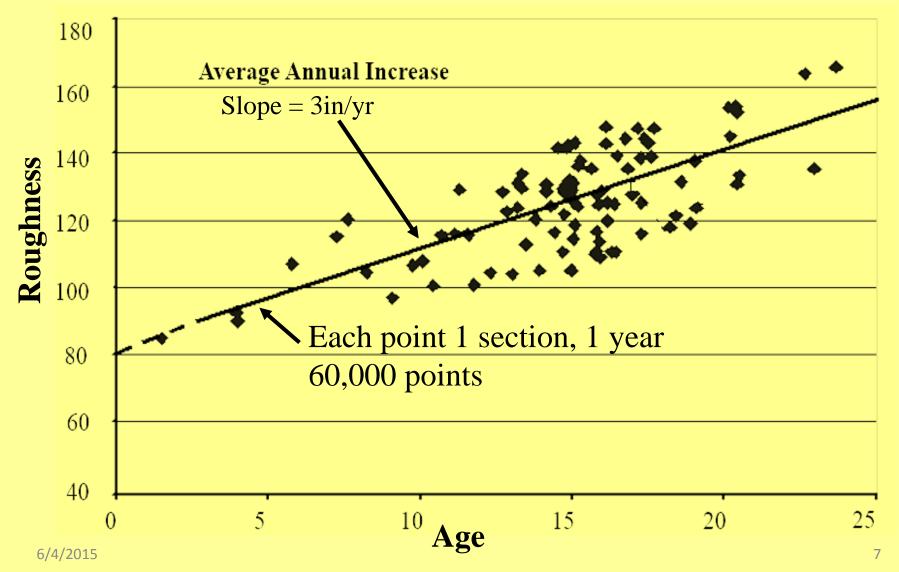# Overall Condition Index (PCI)
Optimized vs. Ranking – Same 10 Yr. Budget (*12*)
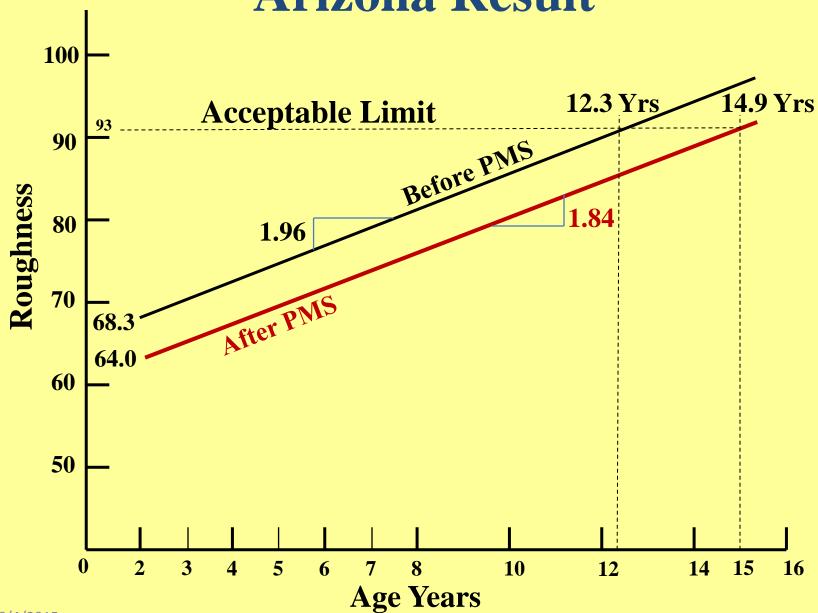
McNeil and Mizusawa Concept of *Ex post facto* Benefits Evaluation *(2)*
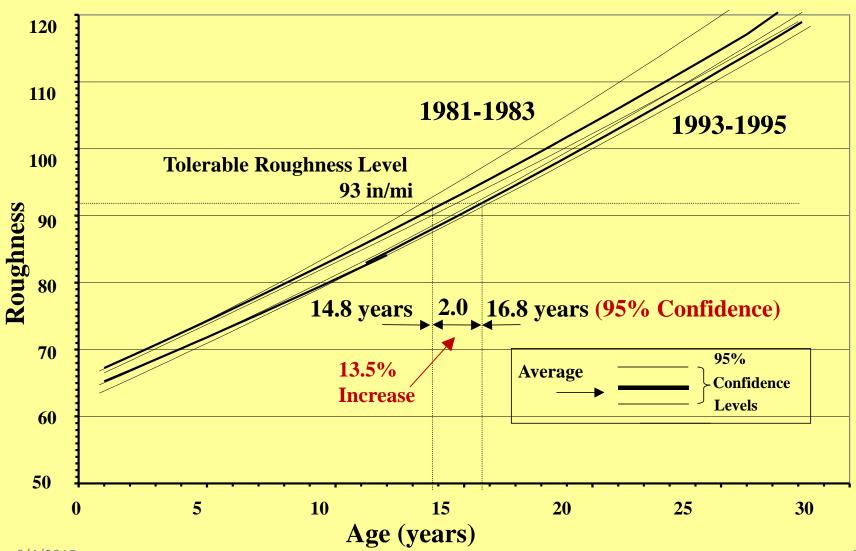
Regression for Roughness Data Before PMS in ADOT

Average Annual Increase

Slope = 3in/yr

Each point 1 section, 1 year
60,000 points

Arizona Result
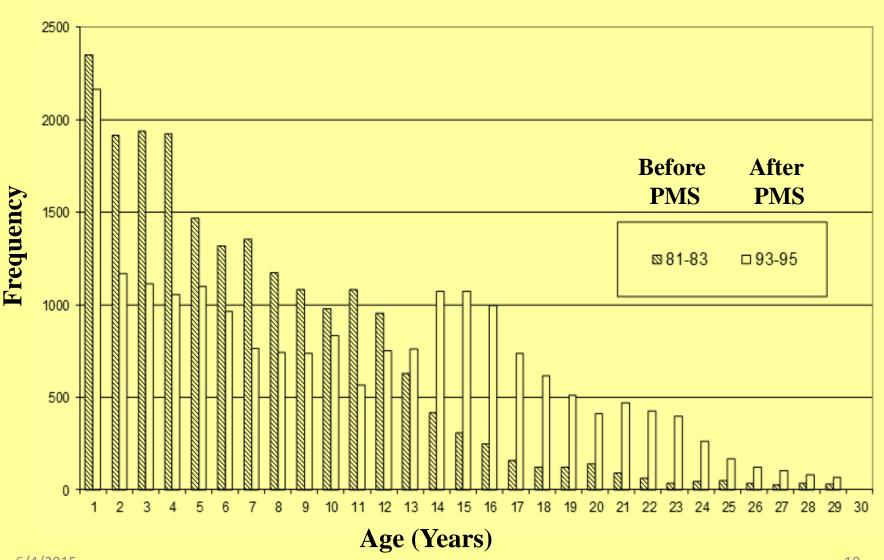
Roughness vs. Age, Square Root Model

ADOT Age – All Roads – All Pavements

ADOT BCR (1990's Costs) *(3)*

Documented Costs of operating ADOT PMS over 16 years:

TOTALED: $8.3 million

Benefits over 16 years based on improved roughness and longer life:

TOTALED $423 million

Overall for ADOT BCR over <u>50:1</u>
Average – 13.5% longer life

ADOT BCR *(3)*

Even if half the benefits are due to better materials and construction

<p style="color:darkred;">Minimum PMS BCR is 25:1</p>

Using World Bank estimates, User Cost Savings of 4 for 1, up to 10 for 1.

The BCR to Traveling Public and Tax Payers = Minimum 100:1

MODERN PMS
2015 - Example DOT

40 – 80,000   **Centerline Mile Highways**

20 – 100   **Licensed Users**

$700M   **Annual Pavement Budget**

2015 - Example DOT

Software Acquisition and Training

   $700k – $1.3 million,   average   = $1.0M

      Amortized 5 years $1.0M/5 yrs   = $200K/yr

Annual Software Maintenance and

      User Licenses $200 – $700K average   = $450K/yr

Agency Operation/Data Collection   = $600K/yr

Average Annual Costs of PMS TOTAL = $1.250M

Annual Benefits

If only 1% Savings (of $700M) = $7.0M

$$\text{B/CR} \quad 7.0/1.25 = 5.5{:}1$$

with 5% Savings = $35M

$$\text{B/CR} \quad 35/1.25 = 28{:}1$$

with 10% Savings = $70M

$$\text{B/CR} = 70/1.25 = 56{:}1$$

User Cost Savings at least 4 X Agency Cost

$$\text{True Total BCR} = 22{:}1 \text{ to } 220{:}1$$

Findings Pinellas County, Florida

In 2011 PCPW reported major cost savings, much greater organizational efficiency and higher productivity including the following qualified benefits (*1*):
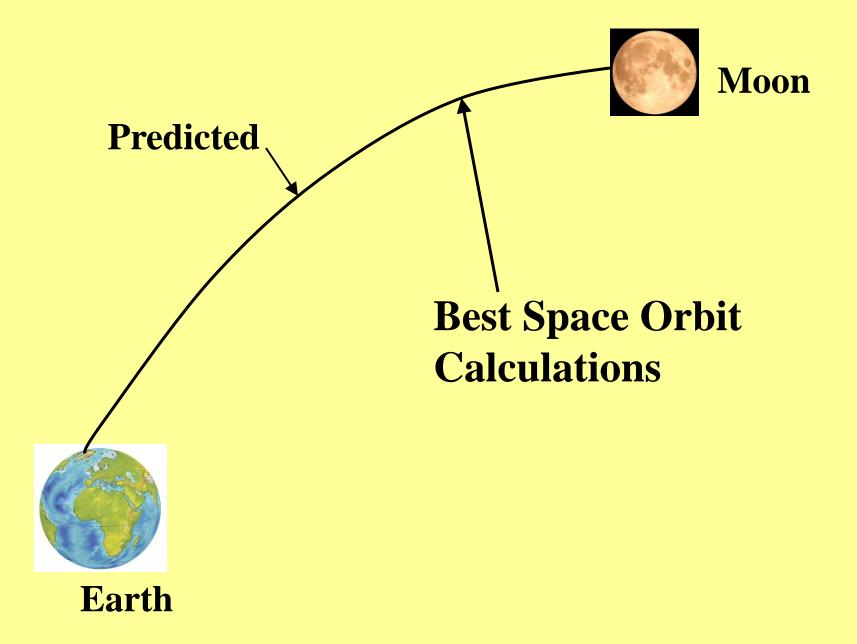
- The new MMS eliminated the need for 2 other systems, saving $500,000.

- The Mowing department alone saved $1.7 million by a better match between quantity and quality, inventory and methods of mowing

- The labor pool was reduced to 70 pieces of equipment (about 30%)

- The productivity in work units per hour increased by 45%

- In 2004 annual savings of $2.5 +/- million were predicted. Actual documented budget reduction was actually $6 million.
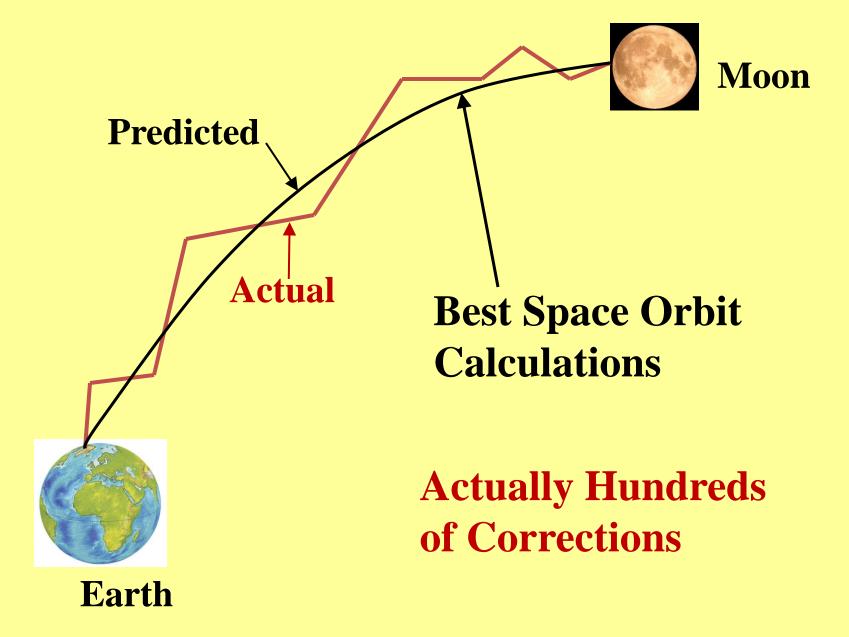
Other reported general benefits were:

- **Joint participation of Senior Management, Supervisors, and all staff members improved the common goal and team spirit in the organization.**

- **Improvements in efficiency, decision making, organizational development, accountability, planning, reporting, speed of information gathering, and transparency.**

- **Public Works now accounts for all maintenance work and resources. Cost, Location, and Accomplishment are fully tracked.**

Can complex MEPDG equations replace PMS?

Some people seem to think so.

Moon

Predicted

Best Space Orbit Calculations

Earth

Moon

Predicted

Actual

Best Space Orbit Calculations

Actually Hundreds of Corrections

Earth

Predicted with Best Pavement Design Calculations

Actual

Very Good 5

Very Poor 0

Failure

Age

Design Life

In last 10 - 15 years, the US has spent $50-100 million to produce MEPDG with 350 variables, many more if you consider traffic spectrums by load, season, day, and hour.

Almost every US state and FHWA are conducting training courses and calibration studies for MEPDG

WHAT ABOUT INPUT ERRORS?

Simple example –

What is probability of predicting any pavement variable correctly and constructing properly?

For this example say 90% of the time correct input

If 90% probability (chance) of predicting each variable correctly

Number of Variables		% of Time Answer	
		Right	**Wrong**
1	Joint Probability	90	10%
2	Joint Probability	81	19%
4	Joint Probability	66	34%
8	Joint Probability	43	57%
16	Joint Probability	19	81%

Answer with 350 variables? You can calculate; approximately **0%**

With only 7 variables, the predicted performance will be wrong over 50% of the time.

PMS provides the corrective decisions and actions needed to correct the errors to meet your goals.

If 95% probability (chance) of predicting each variable correctly

		% of Time Answers	
		Right	**Wrong**
1	**Variable**	**95**	**5%**
4	**Variables**	**81**	**19%**
8	**Variables**	**66**	**34%**
16	**Variables**	**44**	**56%**
32	**Variables**	**19**	**81%**

350 Variables? You can calculate near 0%

PMS still is needed to get good performance.

IN SUMMARY

1. Many proven $$$ Benefits from PMS.
    BCR = 5 – 200
2. The ability of DOTS to manage,
    organize, and do many things better.
3. The ability to correct Design input
    and Construction errors.
4. Helps you allocate Budgets to the
    right action, right place, right time.