Why Allegheny County is doing Enterprise-wide Asset Management

Craig Schorling, GISP
Transmap Corporation
BD/Account Manager
cschorling@transmap.com
614-537-6297 (mobile)

Phil LaMay
Allegheny County
Deputy Director Administration/Operations
plamay@county.allegheny.pa.us
(412) 350-7121

Eric Allen
Allegheny County
Information Systems Manager
eallen@county.allegheny.pa.us
(412) 350-5668
Presentation Overview

• Allegheny County Statistics
• Raw Data Collection
• Distress Analysis
  o Leveraging Industry Standards/Technology Tools
  o Esri ArcGIS
  o ASTM D 6433 - 07
  o Consistent Repeatable Inspection Methodology
  o Transmap's *Hybrid* Approach
• MicroPAVER
• GIS Centric Pavement/Asset Management
• Cityworks
• Results
• What's Next?
• Questions
Allegheny County Statistics

- A county in the southwestern part of Pennsylvania
- Known for the three major rivers that flow through it: Allegheny River and the Monongahela River, which merge to form the Ohio River
- Home to approximately 1,223,348, as of the 2010 census
- Pittsburgh is located in Allegheny County
- Total area of 745 square miles
- Population density of 1,755 people per square mile.
- The City’s Department of Transportation & Environmental Services maintains approximately 400 centerline miles of paved roadways and alleys.
Location of Allegheny County
In March 2008, Allegheny County contracted with Transmap Corporation to complete a pavement condition survey of 385 miles of streets which exist in unincorporated areas. Under the scope of this project, the project team inventoried 10 different classifications of roadways.
## Allegheny County Network Classifications

<table>
<thead>
<tr>
<th>Functional Classifications</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Principal Arterial</td>
<td>Collector</td>
</tr>
<tr>
<td>Other Principal Arterial / Minor Arterial</td>
<td>Collector / Local</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>Local / Collector</td>
</tr>
<tr>
<td>Minor Arterial / Minor Collector</td>
<td>Local</td>
</tr>
<tr>
<td>Collector / Minor Arterial</td>
<td>Other</td>
</tr>
<tr>
<td>Functional Class</td>
<td>Total Length (ft)</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Other Principal Arterial</td>
<td>87992.72</td>
</tr>
<tr>
<td>Other Principal Arterial / Minor Arterial</td>
<td>29659.55</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>625615.67</td>
</tr>
<tr>
<td>Minor Arterial / Minor Collector</td>
<td>31276.79</td>
</tr>
<tr>
<td>Collector / Minor Arterial</td>
<td>28736.16</td>
</tr>
<tr>
<td>Collector</td>
<td>621017.51</td>
</tr>
<tr>
<td>Collector / Local</td>
<td>61137.61</td>
</tr>
<tr>
<td>Local / Collector</td>
<td>15026.07</td>
</tr>
<tr>
<td>Local</td>
<td>294026.01</td>
</tr>
<tr>
<td>Other</td>
<td>236801.82</td>
</tr>
</tbody>
</table>
Raw Data/Field Collection
Traditional Pavement Collection Method

- Inexperienced Rater in passenger seat of vehicle (Windshield Analysis)
- Missing cracks as they glance at the roads
- No repeatability/traceability
- Analysis at 35 MPH
- Fancy laser Smoke Screen
Raw Data Collection Technology

Number of Cameras
- 6 Device Capable
- 3 Cameras / 1 LiDAR

Resolution
- 1628 x 1236 Color image
- 7.5 and 4.8mm lenses
- 2448 x 2048 Pavement Camera
- 5616 x 3744 Pavement Camera

Distance Measurement Instrument (DMI)
- Best Color Profile to Extract Assets
- Both Stereo / Single Image

Sick LiDAR Scanner
Laser Profilometer (rut&ride)
Falling Weight Deflectometer
Approach - Raw Collection Explained
Full 360 Degree View

- Accurate Condition Assessment Required

(13 ft spacing)

PMS Camera
PHP Page Image
Ultra HD Pavement Camera
Transmap Automation - LiDAR Laser Mounted on *Ultra* HD Camera

Raw Laser Point Cloud Data
Transmap collects LiDAR data. LiDAR is used for road slope/contour, automated sign detection/emissivity, and overhead bridge height measurements.
Distress Analysis
Transmap PMS "Our System"

- Raw Data Collection
  - Detailed Surface Crack Analysis
- Centerline File in GIS Esri Geodatabase
- Network Definition
  - Network, Branch, Section, and Inspection
  - Family Assignments (Pavements with similar performance characteristics)
  - Pavement Functional Classification (Primary, Secondary)
  - Linear Reference System
  - Construction / Major M&R Dates
- Distress Analysis
  - Alligator Cracking, Edge Cracking, Potholes, Weathering & Raveling,
  - Transverse/Longitudinal, Block Cracking, Patching & Utility Cut, Rutting
- MicroPAVER Loading
  - Automated Database Load
- PCI Calculations
- Web-Based Results/ Reporting
  - ArcGIS Server PCI Layer
  - Extents and Location of Distresses
- Ad-Hoc Reporting
  - In MicroPAVER
  - Custom Reports
  - Web-Based
Network and Project Level

- (M.Y Shahin)
  - "For roads and parking lots, it is difficult to justify a high degree of sampling, unless a project-level evaluation is being performed". "To limit the resources required for an inspection, a sampling plan was developed so a reasonably accurate PCI could be estimated by inspecting only a limited number of the sample units in the pavement section".
Typical Collection Method ASTM D6433-99

Samples - The lowest order of the defined pavement network. All samples must belong to a network, branch and section. All pavement sections will be divided into 300 foot pieces, with the sample portion taken from the beginning of each 300 foot piece. The length of the sample area will depend on the width of the roadway. Transmap looks at the total width of the roadway on non-divided average roads. In general, the goal is to have sample areas between 1,500 sq. ft and 3,500 sq. ft.

Pavement Management for Airports, Roads, and Parking Lots
M.Y. Shahin
Transmap Classifies The Type of Cracking and The Extent

<table>
<thead>
<tr>
<th>Distress</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alligator Cracking</td>
<td>Fatigue cracking that consists of a series of interconnecting cracks formed by repeated traffic loading.</td>
</tr>
<tr>
<td>Potholes</td>
<td>Holes that are formed from alligator cracking.</td>
</tr>
<tr>
<td>Transverse/Longitudinal Cracking</td>
<td>These cracks are longitudinal or transverse in nature, which form for a variety of reasons.</td>
</tr>
<tr>
<td>Edge Cracking</td>
<td>Cracking along the edge of the roadway.</td>
</tr>
<tr>
<td>Weathering &amp; Raveling</td>
<td>The wearing away of the pavement surface caused by the loss of the asphalt or tar binder.</td>
</tr>
<tr>
<td>Block Cracking</td>
<td>Interconnected cracks that form blocks, typically caused by the hardening of the asphalt surface.</td>
</tr>
<tr>
<td>Patching &amp; Utility Cut Patching</td>
<td>An area that has been replaced with new material to repair existing pavement.</td>
</tr>
<tr>
<td>Visual Rutting</td>
<td>Surface depression in the wheel path.</td>
</tr>
</tbody>
</table>

Asphalt Pavement Distresses
Network and Project Level

- (M.Y Shahin)
  - "For roads and parking lots, it is difficult to justify a high degree of sampling, unless a project-level evaluation is being performed". "To limit the resources required for an inspection, a sampling plan was developed so a reasonably accurate PCI could be estimated by inspecting only a limited number of the sample units in the pavement section".

- Transmap standard is a network level pavement evaluation. The standard network level "systematic random" sample unit is 10-25 percent of the total network reviewed. Due to Transmap "systematic random" standard sampling method, we evaluate an average of 28 percent of the total network.
Why Sample?

- Scott McDonald (Certified MicroPAVER Trainer) says to think of the pavement analysis like a bell curve.
- Real information is inside the sweet spot.
- If you measure too little, the appropriate amount of information is not getting attributed to the segment.
  - This will skew your PCI to be higher.
- If you measure too much, you're wasting your time (Same Results).
- Measuring at a specific interval (middle range).
Need to Establish A Constant Repeatable Inspection Methodology

- Sample same areas every 3 years depending on communities M&R and funding
- Start building Life cycle curves for different pavement families
- Communicate what is really happening to your pavement
- Maintain flexibility in adjusting standard inspection approaches and interpretation of PCI values to accommodate local conditions (road geometry, traffic patterns) and M&R strategies
Sample Buffers
Transmap Hybrid Approach

- Repeatability
- Real photogrammetric measurements
- Database designed for analysis (no fat fingers)
- Analysis that stands up to field walk-outs
- NOT a windshield survey
Longitudinal/Transverse Cracking - Low
Block Cracking - Moderate
MicroPAVER
• Used by over 600 Cities, Counties, Airports

• Site License only $600 a year in maintenance

• American Society for Testing and Materials (ASTM) standard D6433-99

• Standard D6433-99 is the only pavement rating methodology recognized for rating road and parking lot pavements

• Full compliance with the Modified Approach to accounting for infrastructure in the Government Accounting Standards Board (GASB) Standard 34

Training - Transmap has trained many municipalities in pavement management and MicroPAVER across the country. Within the last year Transmap has trained 3 municipalities on proper ASTM pavement methods. We can train your whole group. Proper training is key to Pavement Management. As software tools advance, so should an agency’s training.
The Relationship Between the Pavement Centerline and the Pavement Distress Data

Centerline File

Networks – Highest order of the defined pavement inventory. All categories must belong to a network. Each will receive a name and network ID. ID included: Interstate, Super, Major, Minor, Local and Proposed.

Branches – Second highest order. Typically, branches will correspond to individual routes. However, a route can be broken into multiple branches if different functional classes exist within the route. Each branch will receive a Branch ID.

Sample Points – Created every 305 ft. on the centerline file.

Sections – the third order of the defined pavement network. All sections must belong to a branch and a network. Sections will be created depending upon segmentation of the basemap. Each segment will become a section. All sections will receive a section ID.

Distress data from each sample is put into MicroPaver and applied to each section.

Distress data is measured and applied to the samples and buffers.

Inspection – Created for MicroPaver. Matches the Section ID with a prefix of ‘INS’.

MicroPaver creates the MicroPaver e50 file which produces the PCI results.

The data produced by the MicroPaver files (PCI) is attached to the valid Section ID and packaged for delivery.
Pavement Management

- Extend the life of your pavement
- Defend your budget
- APWA and ASTM Standards
Pavement Management Life Cycle

- Pavement Management Process
- Understanding Pavement Condition Score

FIGURE 2. The Pavement Preservation Concept

- Original Pavement
- Major Rehabilitation Trigger
- Pavement Preservation Actions

Pavement Condition vs. Time (Years)
Typical Pavement Deterioration Curve

- GOOD
- SATISFACTORY
- FAIR
- POOR
- VERY POOR
- SERIOUS
- FAILED

TIME

$1.00 FOR REHABILITATION HERE

SIGNIFICANT DROP IN CONDITION

SMALL % OF PAVEMENT LIFE

WILL COST $4.00 TO $5.00 HERE
## Pavement Management Life Cycle Continued

<table>
<thead>
<tr>
<th>PCI</th>
<th>Description</th>
<th>Remaining Life</th>
<th>Rehabilitation Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>86-100</td>
<td>Good</td>
<td>15-25 Years</td>
<td>Little or no maintenance required</td>
</tr>
<tr>
<td>71-85</td>
<td>Satisfactory</td>
<td>12-20 Years</td>
<td>Routine maintenance – patching, crack sealing with surface treatments</td>
</tr>
<tr>
<td>56-70</td>
<td>Fair</td>
<td>10-15 Years</td>
<td>Thin overlays, hot mix rubberized asphalt overlays</td>
</tr>
<tr>
<td>41-55</td>
<td>Poor</td>
<td>7-12 Years</td>
<td>Routine Moderate to thick overlays</td>
</tr>
<tr>
<td>26-40</td>
<td>Very Poor</td>
<td>5-10 Years</td>
<td>High percentage of surface to full reconstruction</td>
</tr>
<tr>
<td>11-25</td>
<td>Serious</td>
<td>0-5 Years</td>
<td>High percentage reconstruction with possible subgrade stabilization</td>
</tr>
<tr>
<td>0-10</td>
<td>Failed</td>
<td>None</td>
<td>Complete reconstruction</td>
</tr>
</tbody>
</table>
Network Level Implementation

• Transmap loads all the sample locations and analysis data into MicroPAVER in one massive data load.
• The traditional walk-out method is to load the data one section at a time, while you are collecting distress data.
GIS Centric
Pavement/Asset Management System
GIS Centric

- Esri ArcGIS Pavement Centerline
- PCI results on centerline
- Sample areas defined as polygons
- Linear Reference System
- Work orders linked to ArcGIS
- ArcGIS Server applications
GIS Focused

- Everything Transmap does is centered on GIS
  - Roadway features extracted as GIS layer
  - PCI results
  - Geodatabase
  - ArcGIS Server
  - Image viewer
  - SDE Server
- Esri Developers
  - 13 years ESRI Business Partnership
  - Value Added Reseller (VAR)
  - Development Partner
  - Partners on multi-year City of El Paso, TX project
Go to:
www.transmap.com/allegheny
Cityworks
Cityworks

Cityworks is the GIS Centric application that Allegheny County Public Works uses to leverage our road and bridge investments.
GIS and Cityworks allow our users to select a road or road feature to create a work request, review current work on the feature, or gather historical data on the road or road feature.
The user gets a complete work history of the feature that is highlighted.
Here is another example of Cityworks ability to track and display work.
Results
Overall, the majority of Allegheny County's roadways in unincorporated areas are in the **Good or Satisfactory** range.
<table>
<thead>
<tr>
<th>Condition Category</th>
<th>Pct Sections</th>
<th>Pavement Area Unit</th>
<th>Pct Area</th>
<th>Sections</th>
<th>Age at Report</th>
<th>Vf Avg</th>
<th>Avg Condition</th>
<th>Vf Avg Condition</th>
<th>Avg Age at Insp</th>
<th>Vf Avg Age at Insp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed</td>
<td>0</td>
<td>Feet</td>
<td>0</td>
<td>0</td>
<td>34</td>
<td>34.00</td>
<td>18.63</td>
<td>16.96</td>
<td>33.00</td>
<td>33.00</td>
</tr>
<tr>
<td>Serious</td>
<td>1</td>
<td>Feet</td>
<td>1</td>
<td>9</td>
<td>34</td>
<td>34.00</td>
<td>36.56</td>
<td>37.56</td>
<td>33.00</td>
<td>33.00</td>
</tr>
<tr>
<td>Very Poor</td>
<td>2</td>
<td>Feet</td>
<td>3</td>
<td>5</td>
<td>34</td>
<td>34.00</td>
<td>38.40</td>
<td>39.40</td>
<td>33.00</td>
<td>33.00</td>
</tr>
<tr>
<td>Poor</td>
<td>12</td>
<td>Feet</td>
<td>15</td>
<td>87</td>
<td>34</td>
<td>34.00</td>
<td>50.15</td>
<td>50.15</td>
<td>33.00</td>
<td>33.00</td>
</tr>
<tr>
<td>Fair</td>
<td>24</td>
<td>Feet</td>
<td>26</td>
<td>181</td>
<td>34</td>
<td>34.00</td>
<td>63.03</td>
<td>62.62</td>
<td>33.00</td>
<td>33.00</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>32</td>
<td>Feet</td>
<td>33</td>
<td>240</td>
<td>34</td>
<td>34.00</td>
<td>78.58</td>
<td>78.7</td>
<td>33.00</td>
<td>33.00</td>
</tr>
<tr>
<td>Good</td>
<td>28</td>
<td>Feet</td>
<td>25</td>
<td>305</td>
<td>34</td>
<td>34.00</td>
<td>92.69</td>
<td>91.54</td>
<td>33.00</td>
<td>33.00</td>
</tr>
</tbody>
</table>
The following graphs illustrate various distresses and associated severity:
What's Next?
What is Next?

- Re-inspection of surface distress every 3 years
- Project level Structural-Falling Weight Deflection (FWD) testing
- Ground penetrating radar (establish asphalt thickness)
- Core Samples
- IRI rut data
Questions?
Thank you for your time.

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