How State DOTs Use Infrastructure Management Systems

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MTC Seminar

January 14th, 2005
Outline

- Asset Management Overview
- Tools Used by the Iowa DOT:
  - PMS
  - BMS
  - PPMS
THE ULTIMATE QUESTION!

- How do I make limited budget dollars stretch and provide a highway system that offers a high level of service?
Asset Management

- A strategic approach to managing infrastructure. Its goals are:
  - Build, preserve, and operate facilities in a cost-effective manner
  - Deliver to the customers the best value for each dollar spent
  - Enhance the accountability and credibility of infrastructure investment decisions
Asset Management Process

- Goals and policies
- Asset inventory
- Condition assessment
- Decision support tools
- Short and long term planning
- Program implementation
- Performance monitoring
Why do we need data?

- Support decision making
  - Engineering *(design and operation)*
  - Economic *(budgeting, planning, and programming)*
  - Business *(Legislator and public)*

- Levels of decision
  - Administrative
  - Management
  - Engineering
Why Asset Management?

The Bottom Line:

- Over $1 Trillion investment
- Aging Infrastructure
- Change from construction to preservation
- Change in government role/function
- Performance based management
- Increased accountability

Asset Management
Asset Management Steps

1. **Inventory of Assets**
   - Pavements
   - Bridges
   - Sewer lines
   - Traffic Control

2. **Asset Description**
   - Assessment of Asset Condition
   - Infrastructure Budget
   - Resources

3. **Forecast Asset Condition**
   - Present and future condition

4. **Value Infrastructure Assets**

5. **Resource Allocation Model**
   - Condition after M & R

6. **Agency’s Financial Report**
Asset Management System
(Roads and Bridges)

Pavement Management System
- Inventory
- History
- Current Condition
- Budget

Bridge Management System
- Inventory
- History
- Current Condition
- Budget

Valuation Model
Asset Management System
(Rolling Stock, Facilities and Human Resources)

Fleet Management System
- Maintenance Records
- Mileage
- Condition
- Depreciation

Facilities Management System
- Inventory
- Plans
- Condition

Human Resources
- Job History
- Training
- Turnover Rate

Valuation Model
Asset Management Steps

**Inventory of Assets**
- Pavements
- Bridges
- Sewer lines
- Traffic Control

**Asset description**

**Assessment Of Asset Condition**

**Existing Condition**

**Forecast Asset Condition**

**Present and future condition**

**Infrastructure Budget**

**Resources**

**Value Infrastructure Assets**

**Agency’s Financial Report**

**Resource Allocation Model**

**Condition after M & R**
Condition Assessment

- Measured by
  - Type of condition
  - Extent
  - Severity

- Measured
  - Visually - subjectivity
  - Automated - reliability
Asset Management Steps

Inventory of Assets
- Pavements
- Bridges
- Sewer lines
- Traffic Control

Asset description

Assessment Of Asset Condition

Existing Condition

Infrastructure Budget

Forecast Asset Condition

Resources

Present and future condition

Agency’s Financial Report

Value Infrastructure Assets

Resource Allocation Model

Condition after M & R
Asset Management Steps

**Inventory of Assets**
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**Present and future condition**

**Value Infrastructure Assets**

**Agency’s Financial Report**

**Resource Allocation Model**

**Condition after M & R**
Decision Support Tools

- Inputs
- Mathematical Models
- Results
Decision Support Tools

- **Results:**
  - Resource allocation across assets
  - Network level performance
  - Funding impacts/trade-off
  - Input to the individual management systems:
    - Project selection
    - Rehabilitation and maintenance projects
Resource Allocation

Year 1

- Location

Year 2

- Location
Asset Management Steps

**Inventory of Assets**
- Pavements
- Bridges
- Sewer lines
- Traffic Control

**Asset description** → **Assessment Of Asset Condition** → **Existing Condition**

**Infrastructure Budget**

**Forecast Asset Condition** → Resources → **Present and future condition**

**Value Infrastructure Assets** → **Agency’s Financial Report**

**Resource Allocation Model** → **Condition after M & R**
THE PAVEMENT BANK ACCOUNT

- DEPOSITS ARE THE NEW PAVEMENT CONSTRUCTION, REPAIRS AND RECONSTRUCTION
THE PAVEMENT BANK ACCOUNT

- WITHDRAWALS ARE MADE BY THE PAVEMENT USERS.
THE OBJECTIVE?

- Invest wisely to maximize the return (raise the value of the highway system) through a program that balances long-term and short-term strategies.
Infrastructure Asset Management Tools (Iowa DOT)

- Pavement Management Systems
- Bridge Management Systems
- Pavement Marking Management Systems
Iowa Pavement Management Program
Project Mission

- Support of the **MANAGEMENT**, **PLANNING**, and **PROGRAMMING** needs of transportation agencies

- Provide pavement management information, tools, and training supporting both **PROJECT** level and **NETWORK** level pavement management activities
Automated Data Collection Tools
Distress Data
GIS Tools

Atlantic, Iowa
IPMP GIS Tools
IPMP Additional Products
IPMP Additional Products
PMS Software (dTIMS)
Iowa DOT Primary System
Long Term Pavement Needs

Average Network Condition (Benefits/2200 AADT)/DOT $ for 03, 04, 06 and $100 M until 2012

Condition Index

Analysis Year

- DOT/$100 m
- DOT/$130 m
- DOT/$120
Iowa DOT Primary System
Long Term Pavement Needs

Average Network Condition (Benefits/2200 AADT)/DOT $ for 03, 04, 05 and $120 M until 2012

Analysis Year

Condition Index


- DOT/$100 m
- DOT/$130 m
- DOT/$120
Iowa DOT Primary System
Long Term Pavement Needs

Average Network Condition (Benefits/3000 AADT)/DOT $ for 03, 04, 05 and $100 M until 2012

Condition Index

Analysis Year

DOT$/100 m
DOT$/130 m
DOT$/120
Iowa DOT Primary System
Long Term Pavement Needs

Average Network Condition (Benefit=3000 AADT)/DOT $ for 03, 04, 05 and $120 until 2012
Iowa DOT Primary System
Long Term Pavement Needs

Average Network Condition (Benefits/3000 AADT)/DOT $ for 03, 04, 05 and $100 M + 10% increase every 5 years

Condition Index

Analysis Year


DOT/$100 m
District Analysis

Average Network Condition (District 1)

- 2001: 65
- 2002: 65
- 2003: 65
- 2004: 65

Average Network Condition (District 2)

- 2001: 65
- 2002: 60
- 2003: 55
- 2004: 50

Analysis Year

Note: The graphs show the trend of network condition over the years for Districts 1 and 2.
District Analysis
Maintenance Management and Pavement Management

- Maintenance activities impact on pavement condition

- STEPS:
  - Data Validation
  - Candidate Selection
  - Activity-Condition Assimilation
  - Activity Summary
  - Activity Condition Summary
## Maintenance Options

### Programmed Maintenance Activity Pairs

<table>
<thead>
<tr>
<th>Maintenance Activity Pairs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full depth patching – ACC/PCC</td>
<td>Pavement seal coat (CRS)</td>
</tr>
<tr>
<td>Full depth patching – ACC/PCC</td>
<td>ACC Resurfacing - 2” deep</td>
</tr>
<tr>
<td>Full depth patching – ACC/PCC</td>
<td>ACC Resurfacing - 3” inch deep</td>
</tr>
<tr>
<td>Pavement seal coat – CRS</td>
<td>Joint and crack filling - ACC</td>
</tr>
<tr>
<td>Pavement seal coat – CRS</td>
<td>Joint and crack sealing - ACC</td>
</tr>
<tr>
<td>Pavement seal coat – CRS</td>
<td>Full-depth patching - ACC/PCC</td>
</tr>
<tr>
<td>Pavement seal coat – CRS</td>
<td>Adds ACC surface patches</td>
</tr>
<tr>
<td>Pavement seal coat – CRS</td>
<td>Spot leveling</td>
</tr>
<tr>
<td>Pavement seal coat – CRS</td>
<td>ACC Resurfacing - 3” deep</td>
</tr>
<tr>
<td>Pavement slurry seal – ACC</td>
<td>Slurry leveling</td>
</tr>
<tr>
<td>Spot leveling</td>
<td>Pavement seal coat - CRS</td>
</tr>
<tr>
<td>ACC Resurfacing - 1” deep</td>
<td>Full-depth patching - ACC/PCC</td>
</tr>
<tr>
<td>ACC Resurfacing - 1” deep</td>
<td>ACC partial-depth patching</td>
</tr>
<tr>
<td>ACC Resurfacing - 1” deep</td>
<td>Adds ACC surface patches</td>
</tr>
<tr>
<td>ACC Resurfacing - 1” deep</td>
<td>Adds milling to ACC - 1.5” depth</td>
</tr>
<tr>
<td>ACC Resurfacing - 2” deep</td>
<td>Full-depth patching - ACC/PCC</td>
</tr>
<tr>
<td>ACC Resurfacing - 2” deep</td>
<td>ACC partial-depth patching</td>
</tr>
<tr>
<td>ACC Resurfacing - 2” deep</td>
<td>Pavement seal coat - CRS</td>
</tr>
<tr>
<td>ACC Resurfacing - 2” deep</td>
<td>Adds milling to ACC - 1.5” depth</td>
</tr>
<tr>
<td>ACC Resurfacing - 2” deep</td>
<td>Longitudinal subdrains</td>
</tr>
<tr>
<td>ACC Resurfacing - 3” deep</td>
<td>Full-depth patching - ACC/PCC</td>
</tr>
<tr>
<td>ACC Resurfacing - 3” deep</td>
<td>Spot leveling</td>
</tr>
<tr>
<td>ACC Resurfacing - 3” deep</td>
<td>Adds milling to ACC - 1.5” depth</td>
</tr>
<tr>
<td>Adds heater scarification to ACC</td>
<td>ACC Resurfacing - 1” deep</td>
</tr>
</tbody>
</table>
Contract Maintenance records
Data Integration Process

Programmed Maintenance  Cartography & Inventory  Pavement Condition

GIS Database

Dynamic Segmentation

Data Integration
Data Analysis

Maint. Projects

<table>
<thead>
<tr>
<th>Project Length: X</th>
<th>Project cost: $X</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>$210,000</td>
</tr>
</tbody>
</table>

Pav. History

Section A: Multiple activities. Discontinue analysis.

Section B: Single activity (#2). Continue analysis.

Intersecting Segment Length: 0.5mi
Total Project Length: 1.0mi
Total Project Cost: $210,000
History Section ID: Null
Proportional Project Cost: (0.4/1) * $210K = $84,000
History Section Coverage: 0.4/0.5 = 80%

Project Length: X
Project cost: $X
Section Length: X mi
Section Length: 0.5 mi

Program Database
Cartography & Inventory
Prepared Submission
GIS Database
Operate Segmentation
Data Integration
Results (Correction for age)
### Results

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Mean Observed Change in PCI</th>
<th>Mean Change in PCI After Correction</th>
<th>No. of Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint and crack filling - ACC</td>
<td>1.63</td>
<td>6.33</td>
<td>11</td>
</tr>
<tr>
<td>Joint and crack sealing - ACC</td>
<td>2.14</td>
<td>6.31</td>
<td>21</td>
</tr>
<tr>
<td>Joint and crack sealing - PCC</td>
<td>0.50</td>
<td>1.66</td>
<td>2</td>
</tr>
<tr>
<td>Full depth patching - ACC/PCC</td>
<td>1.08</td>
<td>3.50</td>
<td>23</td>
</tr>
<tr>
<td>ACC Partial depth patching</td>
<td>1.00</td>
<td>5.72</td>
<td>1</td>
</tr>
<tr>
<td>Microsurfacing</td>
<td>2.10</td>
<td>4.76</td>
<td>10</td>
</tr>
<tr>
<td>Pvt. Fog seal - ACC</td>
<td>1.00</td>
<td>6.47</td>
<td>1</td>
</tr>
<tr>
<td>Pvt. Seal coat - CRS</td>
<td>3.33</td>
<td>5.08</td>
<td>3</td>
</tr>
<tr>
<td>Spot leveling</td>
<td>5.28</td>
<td>8.60</td>
<td>7</td>
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<tr>
<td>ACC resurfacing - 2” deep</td>
<td>5.67</td>
<td>11.41</td>
<td>3</td>
</tr>
<tr>
<td>ACC resurfacing - 3” deep</td>
<td>8.16</td>
<td>11.03</td>
<td>6</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>92</strong></td>
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</table>
Bridge Asset Management:
Data Integration, Performance, and Decision Support Tools
Project Mission

- Develop, implement, and operate an integrated bridge asset management system (IBAMS)

- IBAMS will enable the Iowa DOT to make objective, cost effective, and timely decisions regarding bridge maintenance, rehabilitation, and replacement programs (MR&R).

- IBAMS will also integrate and supplement the current Iowa DOT data collection (performance, visual, and structural) efforts.
Structural Evaluation

Strain gauges and other instrumentation devices
PONTIS (BMS)
**Needs and Projected Work for Scenario: Default scenario**

**Years 2002 - 2005**

<table>
<thead>
<tr>
<th>Year</th>
<th>Needs</th>
<th>Programmed Work</th>
<th>Benefit ($ from Meeting All Needs)</th>
<th>Benefit ($ from Programmed Work)</th>
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<tbody>
<tr>
<td>2002</td>
<td>96,499,957</td>
<td>9,981,326</td>
<td>8,337,411</td>
<td>4,655,703</td>
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<tr>
<td>2003</td>
<td>85,391,080</td>
<td>9,979,074</td>
<td>5,591,584</td>
<td>1,600,335</td>
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<tr>
<td>2004</td>
<td>70,399,934</td>
<td>9,978,168</td>
<td>9,324,307</td>
<td>4,461,686</td>
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<tr>
<td>2005</td>
<td>53,862,955</td>
<td>9,975,883</td>
<td>7,743,731</td>
<td>1,881,696</td>
</tr>
<tr>
<td>Total</td>
<td>39,914,451</td>
<td></td>
<td>12,598,420</td>
<td></td>
</tr>
</tbody>
</table>
Overview

- To develop a comprehensive Bridge Asset Management System for the Iowa DOT:
  - PONTIS Customization
  - PDA applications to assist in collecting:
    - Element inspection data
    - Structural testing data
  - Data integration into PONTIS
Element Inspection (PDA)
PDA Application + Sync

**Element Inspection**

- **Bridge ID:** 00000000003410
- **Element Number - Short Name:** 12 Unp Conc Deck
- **Inspection Date:** 8/1/2002
- **Quantity:** 5400.0 IN (SF)

<table>
<thead>
<tr>
<th>State</th>
<th>Old</th>
<th>New</th>
<th>Total</th>
<th>Enter Qty</th>
<th>Notes</th>
<th>Finish</th>
<th>Cancel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100.0</td>
<td>100.0</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
<td>1</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**PDA-Pontis Sync**

- **Interface to Sync Element Data Between PDA and Pontis Database**
- **Settings**
- **Synchronize**
- **Help**

Log File:

- Load PDBs to Device
- Quit
Structural Evaluation (PDA)
PDA Application

Calculates New Load Rating based on actual testing
PONTIS Implementation

Bridge Rating in PONTIS
DOT Uses (Health Index)

Health Index, Scenario: 50million budget
Years 2004 - 2013

Number of Structures by Health Index Category

<table>
<thead>
<tr>
<th>Year</th>
<th>Cat 1 &lt;25</th>
<th>Cat 2 25-50</th>
<th>Cat 3 50-75</th>
<th>Cat 4 &gt;75</th>
<th>Total</th>
<th>Avg. Health Index (%)*</th>
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<tbody>
<tr>
<td>2004</td>
<td>1</td>
<td>34</td>
<td>3,534</td>
<td>3,569</td>
<td>3,569</td>
<td>94.2</td>
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<tr>
<td>2005</td>
<td>37</td>
<td>3,532</td>
<td>3,569</td>
<td>93.3</td>
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<tr>
<td>2006</td>
<td>37</td>
<td>3,532</td>
<td>3,569</td>
<td>92.4</td>
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<tr>
<td>2007</td>
<td>49</td>
<td>3,520</td>
<td>3,569</td>
<td>91.5</td>
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<td></td>
</tr>
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</table>
## DOT Uses (Concrete Railing)

<table>
<thead>
<tr>
<th>Bridge ID</th>
<th>Maint. #</th>
<th>Elem.</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<tr>
<td>31950</td>
<td>5233.0O080</td>
<td>331</td>
<td>60</td>
<td>0</td>
<td>40</td>
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<tr>
<td>602468</td>
<td>3570.7L035</td>
<td>331</td>
<td>0</td>
<td>70</td>
<td>30</td>
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<tr>
<td>45380</td>
<td>7825.0L080</td>
<td>331</td>
<td>75</td>
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<tr>
<td>14360</td>
<td>0656.8S218</td>
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<tr>
<td>24250</td>
<td>3227.4S004</td>
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<td>75</td>
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<td>50510</td>
<td>9089.2L034</td>
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<td>90</td>
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<td>604950</td>
<td>0740.2O020</td>
<td>331</td>
<td>0</td>
<td>90</td>
<td>10</td>
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</table>
Pavement Marking Management System
Goal:
Provide an appropriate pavement marking on all highways, 365 days per year.
Develop recommendations to incorporate cost effectiveness of materials, crew safety, installation quality, performance monitoring, and budget/forecast tools.
Develop long-term pavement marking practices and match short-term actions to these practices.
Task Force Activities:

- Evaluate existing practices and performance
- Evaluate promising materials/methods
- Develop application matrix
- Recommendations
Districts Needs (Reflectivity)
District Needs
RECOMMENDATIONS
Issue – Marking Damage

Task Force worked with state climatologist to review 30 year average snowfall by Iowa DOT district as shown. This variability, along with winter maintenance policies, create differences in the frequency individual routes are plowed each year and obviously impact the potential damage to surface applied pavement markings. Existing snow plow and sanding activities are recorded on a person-hour or quantity basis and not by route/milepost.

District staff documented a drop from over 400 mcd to a little over 100 mcd due strictly to maintenance of edge rutting. Task Force also discussed a variety of examples where heavy traffic and/or turning movements have a significant impact on marking performance. Data were also evaluated which confirmed that marking performance was worse on older paved driving surfaces.

Recommendations

Short Term

• Document salt, sand, brine, and plowing operations by route and milepost over the winter season. Evaluate impacts to marking performance and compare these on a district basis. Evaluate winter maintenance practices in contrast to marking performance by district.

• Evaluate potential solutions, such as GPS, to allow for the tracking of winter maintenance activities by route. Such information would allow for quick mapping and could tie directly to a GIS format for looking at pavement marking needs and performance.

• Evaluate edge rut maintenance practices and develop a statewide approach which minimizes damage to edge line markings.

• Incorporate urban vs rural traffic demands and pavement condition into materials selection matrix.

Long Term

• Implement GPS or other tracking techniques for winter maintenance.

• Integrate differences in winter exposure, shoulder edge maintenance, etc. into overall marking application matrix and selection of marking materials, applications, performance, cost, on a district by district basis.
Issue – Measurement

In the spring of 2004, the Iowa DOT purchased 3 more Handheld Delta LTL-X machines for a total of 6 (one per district). Each unit has the ability to record a GPS latitude and longitude with each reading along with the default of entering in the route and milepost. The Iowa DOT has one Lazerlux Van which takes continuous readings on Interstate and major 4-lane highways. The van does not have any GPS equipment thus relying on route and milepost for reference. The van also has a reliance on problematic floppy disks to transfer readings to other computers for analysis or storage. Contractor readings are completed on occasion for verification or dispute resolution. In the Spring of 2004, district crews completed measurements on the entire system and this information was mapped using GIS as shown later in this report. Some districts have a dedicated person to run the LTL-X and others do not. Some crews use this device during their painting season to monitor initial reflectivity.

Recommendations

Short Term

• Implement use of the LTL-X for all DOT crew applied long-line painting operations.
• Require Contractors to provide initial reflectivity readings for all projects.
• Consider additional LTL-X units and training for designated staff to obtain 1-month follow-up readings, other readings within the district, or to monitor Contractor applied markings.
• Consider requiring Contractors to provide 1-month after installation readings or readings at some time period after the excess beads have been removed.
• Incorporate GPS and reflectivity measurement readings into other painting operations such as curb markings, legends, transverse markings etc.
• Evaluate options to incorporate using GPS readings with the Lazerlux Van readings to improve accuracy of route/milepost and to assist in mapping of findings.
• Upgrade the computer equipment in the Lazerlux Van.
• Standardize staffing and schedules for Van measurements along with consideration of how the Van will be used to assist Districts in monitoring Contractor applied markings.

Long Term

• Implement GPS or other tracking techniques with data collection.
• Provide initial and follow-up reflectivity measurements with any DOT crew applied long-line markings and all Contractor applied markings.
**Issue – Paint Equipment**

The DOT has a variety of on-board quantity tracking devices such as the Bradley device shown here. These units are critical in adjusting paint quality as well as in keeping track of quantities by route and milepost. This information is entered into a database on a weekly basis.

Staff has made considerable efforts to track weather conditions with paint tips, paint rates, mill thicknesses, truck speeds, etc.

**Recommendations**

**Short Term**

- Evaluate options to incorporate GPS with these units to eliminate manually entering the data into the DOT database.
- Standardize equipment being used from paint trucks to paint guns, tracking equipment, etc. to eliminate the many variables faced by individual crews.
- Continue to test combinations of truck and material settings based upon ranges of environmental conditions.
- Continue to evaluate zero velocity bead guns to improve operations.
- Evaluate staff demands and provide training and opportunities to work with other crews to maximize performance, production, and safety.
- Continue to evaluate opportunities to apply more durable products using existing equipment and DOT crews.

**Long Term**

- Implement GPS or other tracking techniques for painting operations.
- Develop working relationships with manufacturers (paint, beads, truck equipment) to maximize the performance of both DOT crew and Contractor applied markings.
Issue – Durable Markings

The DOT has a number of road miles of durable markings which are typically installed as part of a construction contract. The tracking of this information is less than ideal with the occasional issue of maintenance crews painting over these markings. The task force worked at developing an overall durable marking database and in incorporating this information into a graphical GIS format. An example of this is shown here. The Task Force developed alternative techniques to enter the durable marking data through the same technique used for pavement management called a section tool. Such a tool allows for pointing and clicking on the limits of the durable marking. A demonstration of this was developed specific for pavement markings.

The initial cost and cost of maintaining durable markings places a significant burden on maintenance budgets as this impact has been documented by earlier Task Force actions. The pavement marking application matrix which appears later within this report is an attempt to provide guidelines on how markings will be maintained on a long term basis.

Recommendations

Short Term

• Finalize durable marking database and eliminate records which have faulty route/milepost information or are missing location information.
• Develop section tool for districts to use to report and track installation and performance of durable markings.
• Track initial and interim reflectivity and performance of durables which are Contractor applied.
• Continue to evaluate opportunities for DOT crews to apply durable paint products.

Long Term

• Manage durable markings either put down by DOT or by Contractor through a focus on long term performance and consistency of pavement markings on DOT maintained roadways.
• Minimize disconnect between Construction practices versus how these markings will be maintained long term.
• Evaluate methods, materials, and specifications.
• Evaluate strategies for continued maintenance on the highest categories of roads.
Issue – Analysis Tools

Gathering of paint and reflectivity information on a statewide basis quickly produces a great deal of data. The Task Force placed a high priority on finding ways to present and interpret the field information collected. The most effective tools for this was through the use of GIS which graphically representing the information directly on a roadway segment basis. Following the spring 2004 assessment, the Lazerlux Van and Handheld data were graphically represented in a number of ways as shown on this page.

Recommendations

Short Term
• Continue to explore opportunities to use GIS in interpreting both paint and reflectivity data
• Work with district staff to understand format and level of detail desired to be able to interpret and use the paint and marking information data.
• Explore opportunities to streamline the mapping of this data and elimination of errors.

Long Term
• Along with implementing GPS, use GIS to support district paint and marking decision making.
• Evaluate where GIS capabilities would reside and staffing/training/hardware/software needs for such this critical component of a pavement marking management system.
Issue – Database

The Task Force spent time outlining the components of a potential pavement marking management system as shown to the right. Such a system is only as good as the information it is based upon. Accordingly, a focus was placed on existing and future inventory information consisting of (pavement marking, pavement condition, and operations). The first of these two will be discussed next. The operations database does not exist and would represent factors such as the difficulty for crews to place markings in certain areas, heavy weaving or turning areas, areas requiring significant traffic control or night-time operations. The pavement condition data already exists from the DOT pavement management system and it was shown how this can be merged with marking data.

Collecting data strictly on a route and mile post basis creates a number of problems in interpreting the information given concurrent routes and GIS issues at county borders. This effort identified alternative tools to locate segments for paint or reflectivity readings along with the tracking of durable markings.

The Task Force examined pavement marking data input and developed a common listing of data input items as shown at the bottom of this page.

Recommendations

Short Term
• Work with IT to evaluate opportunities for one input screen with simplified data.
• Explore how GPS could simplify storing and mapping marking, reflectivity, and new durable installation information.
• Implement a section tool to simplify locating durable markings along with supplementing any other markings that are desired to be part of the DOT database such as legends, symbols, curb and transverse markings, etc.
• Eliminate the need for paint crews to re-type data into database.

Long Term
• Implement GPS or other tracking techniques for database.
• Simply input form and ability to query data using GIS tools.
• Integrate with other DOT database and referencing systems.
• Develop operations database specific to markings.
Issue – Field Tests

The Task Force spent considerable effort in beginning a 3-year test along Hwy 5 and 65 within the Des Moines metro (which is the only known test of its size and quality nationwide) to evaluate two types of durable waterborne paints and glass beads. Since the materials were put down using DOT crews, this demonstration has already provided valuable knowledge regarding how to install these new products. The reflectivity results to date have shown very good results with expectations that these materials will support 3 seasons of service life.

The task force is also evaluating how to groove pavement as part of initial construction to accommodate recessing of the pavement markings.

Recommendations

Short Term

• Document findings from the Hwy 65/5 demonstration and continue to monitor over the 3-year period.
• Track winter maintenance activities along both Hwy 65 and 5 for the 3-year period.
• Continue to rely on NTPEP test deck as the primary determinant of evaluating new products for use on Iowa DOT roadways.
• Continue to evaluate grooving practices such as its benefits or the cost and effectiveness of creating a groove as part of the initial paving.

Long Term

• Implement additional test sections statewide.
• Work with industry to monitor and evaluate results and to evaluate other materials, methods, and applications.
• Work with vendors to demonstrate/evaluate other products if they fit within the Iowa DOT Application Matrix and needs.
Issue – Specification

DOT staff have established initial marking thresholds of 300 millicandela/square foot per foot candle (hereinafter “mcd”) for white and 200 for yellow lines. Ideally they would prefer to see the lines above 150/100 for two or three years. No parameters exist for favoring the type of line (center versus edge) at this time. Markings are not washed prior to measurement, however, the DOT prefers to measure after some spring rain has washed the pavement.

DOT specifications are geared toward Contractor installations. The Standard Specifications outlines minimum durable retroreflectivity values. These numbers are based upon providing a good line using available products. The DOT has previously compared these thresholds to other states and notices little variation (25 mcd). There are a number of approved durable products as well as a variation in retroreflectivity required values. A partial list is shown here.

Recommendations

Short Term
• Include requirements for the measurement and reporting of reflectivity by Contractors both initially and at some designated period after the excess beads have been blown away.
• Review specifications to include durable waterborne materials and beads.
• Reference the Task Force developed Application Matrix to begin the process of matching initial installation with long-term maintenance.
• Incorporate the Application Matrix into the DOT design manual and other documents.

Long Term
• Consider the benefits of a program where the DOT measures all new markings installed by Contractors for quality assurance purposes.
• Work with industry to maintain effectiveness of specifications and to modify requirements over time.

<table>
<thead>
<tr>
<th>Std Spec</th>
<th>I.M.</th>
<th>Product</th>
<th>White</th>
<th>Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td>4183.04</td>
<td>483.04</td>
<td>Durable Paint Pavement Markings</td>
<td>300</td>
<td>200</td>
</tr>
<tr>
<td>4183.06 A.</td>
<td>483.06</td>
<td>Pavement Marking Tape (Removable)</td>
<td>550</td>
<td>325</td>
</tr>
<tr>
<td>4183.06 B.</td>
<td>483.06</td>
<td>Pavement Marking Tape (Regular)</td>
<td>550</td>
<td>325</td>
</tr>
<tr>
<td>4183.06 C.</td>
<td>483.06</td>
<td>Preformed Polymer Marking Material</td>
<td>325</td>
<td>150</td>
</tr>
<tr>
<td>4183.06 E.</td>
<td>483.06</td>
<td>Profiled Pavement Marking Tape</td>
<td>700</td>
<td>350</td>
</tr>
<tr>
<td>4183.06 F.</td>
<td>483.06</td>
<td>Intersection Marking Tape</td>
<td>150</td>
<td>100</td>
</tr>
</tbody>
</table>

Specific Luminance in mcd/sq.ft./ft-cdl.
The Task Force developed a materials application matrix based upon meeting drivers needs, consideration of roadway type, pavement service life, the performance of materials, and cost. This initial matrix reflects the fact that very little information is available to track material performance over a range of conditions on DOT roadways. However, this information can be collected and used to consider modifications to the application matrix developed.

### Roadway Characteristics

<table>
<thead>
<tr>
<th>Remaining Pavement Surface Life</th>
<th>Primary 2 Lane</th>
<th>Primary 3 Lane</th>
<th>Primary 4+ Lane</th>
<th>Interstate</th>
</tr>
</thead>
<tbody>
<tr>
<td>= 2 yrs</td>
<td>72% / 7,251</td>
<td>3% / 230</td>
<td>15% / 1,059</td>
<td>10% / 787</td>
</tr>
<tr>
<td>3 - 5 yrs</td>
<td>96% / 290</td>
<td>85% / 40</td>
<td>66% / 556</td>
<td>75% / 258</td>
</tr>
<tr>
<td>5+ yrs</td>
<td>96% / 290</td>
<td>85% / 40</td>
<td>66% / 556</td>
<td>75% / 258</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Centerline Miles</th>
<th>RURAL</th>
<th>URBAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary 2 Lane</td>
<td>72%</td>
<td>96%</td>
</tr>
<tr>
<td>Primary 3 Lane</td>
<td>3%</td>
<td>85%</td>
</tr>
<tr>
<td>Primary 4+ Lane</td>
<td>15%</td>
<td>66%</td>
</tr>
<tr>
<td>Interstate</td>
<td>10%</td>
<td>75%</td>
</tr>
</tbody>
</table>

| Totals           | 100%  | 89%   | 11%   |
## Issue – Matrix

The Task Force developed a materials application matrix based upon meeting drivers needs, consideration of roadway type, pavement service life, the performance of materials, and cost. This initial matrix reflects the fact that very little information is available to track material performance over a range of conditions on DOT roadways. However, this information can be collected and used to consider modifications to the application matrix developed. The following matrix was developed:

### Longitudinal Pavement Markings

<table>
<thead>
<tr>
<th>Remaining Pavement Surface Life</th>
<th>Primary 2 &amp; 3 - Lane</th>
<th>Primary 4+ - Lane</th>
<th>Interstate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RURAL + URBAN</strong> ≤ 55 mph</td>
<td></td>
<td><strong>URBAN High Traffic</strong></td>
<td><strong>URBAN</strong> &gt; 35,000 ADT</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7,051 center line miles (76% of total)</strong></td>
<td><strong>6,550 center line miles (5% of total)</strong></td>
<td><strong>2,695 center line miles (2.5% of total)</strong></td>
</tr>
</tbody>
</table>

- **≤ 2 yrs**
  - Waterborne

- **3 - 5 yrs**
  - Durable Waterbourne, Waterborne, Epoxy, Polyurea

- **5+ yrs**
  - Durable Waterbourne, Waterborne, Epoxy, Polyurea, Tape

### Recommendations

**Short Term**

- Adopt Application Matrix and as following years performance information is obtained refine the content of the selection criteria.

**Long Term**

- Consider all relevant factors which influence performance of pavement markings and incorporate into the Application Matrix.
- Work with industry to evaluate the effectiveness and cost impacts of the matrix and identify future enhancements, improvements, and evaluations for new methods and materials.
Goal:
Provide an appropriate pavement marking on all highways, 365 days per year.

Next Steps

- 2005 Spring Assessment
- Operations Plan
- Implementation Plan
Next Steps

- HERS-ST Implementation
- Sign Management System
- Work with the Iowa DOT LRS for Integration