Next Generation Pavement Management System

Magdy Mikhail, P.E.
Outline

• What is the purpose of a Pavement Management System?
• Generations of Pavement Management
• What do we want or expect from the next generation?
• Expected Benefits
• Summary and Questions?
What is the Purpose of a Pavement Management System?

*Improve the overall condition of pavements within given funding by using longer-lasting treatments applied at the right place and at the right time...*
Evolution of Pavement Management Systems

1st Generation – Databases
Evolution of Pavement Management Systems

2nd Generation – Databases with heuristic decision tree, single-period benefit/cost analysis
Evolution of Pavement Management Systems

3rd Generation – Arizona 1982; the first true network multiyear optimization system; linear & dynamic programming + decision-option trees + Markov deterioration forecasting
Evolution of Pavement Management Systems

4th Generation – Web-based, Multi-year Linear Programming optimization by road segment with streamlined algorithms, Enhanced GIS Capabilities
History of PMIS in TxDOT

• PMIS development began in May 1990 in response to a Federal mandate that every State have a Pavement Management System in place by February 1993.

• PMIS was an expansion of the existing Pavement Evaluation System (PES), PES used 2-mile rating sections instead of the 0.5-mile sections now used in PMIS.
Federal Requirements

The new Federal transportation bill, MAP-21, contains a requirement that all states have a pavement management system (PMS), as a condition of continued funding.
Federal Requirements

- The Secretary will promulgate a rulemaking establishing the process for States to use in developing a risk-based, performance-based asset management plan for preserving and improving the condition of the NHS. States are encouraged to include all infrastructure assets within the right-of-way corridor.

- The plan must include at least the following:
  - Summary list, including condition, of the State's NHS pavements and bridges
  - Asset management objectives and measures
  - Performance gap identification
  - Lifecycle cost and risk management analysis
  - Financial plan
  - Investment strategies
Federal Requirements

- Each State's process must be reviewed and recertified at least every 4 years. If certification is denied, the State has 90 days to cure deficiencies.

- If a State has not developed and implemented an asset management plan consistent with requirements by the beginning of the 2nd fiscal year after the establishment of the process, the Federal share for NHPP projects in that fiscal year is reduced to 65%.
Options for TxDOT

• Option 1: Continue as is
• Option 2: in House Development
• Option 3: Use off the shelf system
Options for TxDOT

Continue Current PMIS System

- Pros
  - The least expensive option
  - Map Zapper will be available

- Cons
  - PMIS is a legacy mainframe system
  - Unable to communicate with other databases
  - Not well integrated with other systems
  - Limited ability to answer administrative questions
  - Several stand alone applications
Options for TxDOT

In-House Rewrite of PMIS

- **Pros**
  - In house staff to support the system
  - Produced system will be similar to what users are accustomed to using
  - Continue Map Zapper

- **Cons**
  - IT development staff
  - Upgrade focus on moving existing system not analytical improvements
  - Several stand alone applications
Options for TxDOT

Purchase an off the Shelf Pavement Management System

➢ Pros
  ✓ Improved integration
  ✓ Web-based environment
  ✓ User friendly
  ✓ Better communication with other databases
  ✓ Optimization based on linear programming
  ✓ Eliminate a number of stand alone applications

➢ Cons
  ✓ More expensive than continuing as is
  ✓ Learning a new system
What do we expect from the next generation Pavement Management System

• Web-based
• User Friendly
• Dash Boards
What do we expect from the next generation Pavement Management System

- Maximize the use of the right of way images
- Propose projects to meet the network level optimization and budget needs
- Answer questions how much money is needed to maintain the current condition
- Answer questions how much money is needed to achieve a target condition goal
What do we expect from the next generation Pavement Management System

• What are the consequences of the current budget level on the network for the next five or ten years?

• What are the consequences of decreased budget level on the network for the next five or ten years?

• What are the consequences of increased funding levels for the next five or ten years?
What do we expect from the next generation Pavement Management System

• The system must communicate status and plans outside the department

• Help with developing a preservation program
Case Studies on benefits of implementing a Pavement Management System
Case Studies

Analytical Basis:

1. Alberta DOT implementation
2. Arizona DOT implementation
3. New Brunswick DOT implementation
4. Virginia, Iowa, and TTI analyses
Case 1 Study: Alberta

With a fixed budget, in first five years of PMS implementation, Alberta DOT achieved a 7.9% improvement in road network condition (relative to the previous five years) despite the addition of 7.2% of road surface, an aging system, and decreasing value of the dollar.

Agency* savings (increase in value of road)..............................$ 550 million
Agency cost (development & data costs).................................$  3.8 million

* Not including vehicle operating cost savings of $492 million.

Case Study 2: Arizona

The state spent $46 million 1975-1980 to maintain the 1975 pavement condition. Following implementation of the PMS, the same level of service was reached with only $32 million over the following 5 years.

This was a savings of $14 million, or 30 percent.

Case Study 3: New Brunswick

In 2010 New Brunswick DOT implemented a 4th generation PMS which applied an optimal life-cycle cost approach to replace the traditional worst-first planning protocol used previously.

Agency savings over 20-year planning horizon (PV)..........................$ 1,400 million
Agency savings, annual (PV).............................................................................................................$ 72 million
Agency cost (system development costs)..........................................................................................$ 2 million

Case Study 3: New Brunswick

Case Studies 4: Virginia & Iowa DOT & TTI

- **Modern PMS**
  - Maximum condition over multiple years taken together.

- **Single-Year Optimization**
  - Maximum condition each year taken one at a time.

- **C/B Ranking**
  - Most common heuristic method – “worst first.”

- **Multi-Year Optimization**
  - Most common analytical methods – rank Cost/Benefit or decision tree.

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** Source: “Quantifying the Benefits of Pavement Management,” O. Smadi, Research Scientist, Iowa State University.

Expected Efficiency Benefits

“My gut feel is that it (efficiency increase) would obviously be at least 1% especially when optimization tools are utilized. Additionally, the new federal transportation legislation requires an Asset Management system of which a PMS would be integral. It is time for TxDOT to move forward from a mainframe-based pavement evaluation system to a comprehensive 21st century web-based management system with timely updates and effective support.”  
- Bobby Littlefield, Paris District Engineer

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“In the Austin district we believe that a true optimizing PMS will allow us to identify critical projects in excess of $55 million and produce cost savings well in excess of $7 million.”
- Mike Arellano, P.E., Materials & Pavement Engineer, Austin District

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“We estimate districts, who currently use our Map Zapper application, would change 20% of projects currently selected annually. The changes would be to better optimize the type of work performed and selection of the projects most critical. The low side would be a savings of 10% to a high of 50% on these project changes. The net improvement of funds expended would then be a range of 2% to 10% or cost savings of $400,000 to $2,000,000 per year.”
- Howard Holland, Maintenance Division Director
Summary & Conclusions

• TxDOT needs a new pavement management system

• Pavement Management System is a Federal requirement

• TxDOT will move into a new generation pavement management system

• The system will be a tool to help districts

• The districts will still select their projects
Questions