GIS and Pavement Management

Presented by

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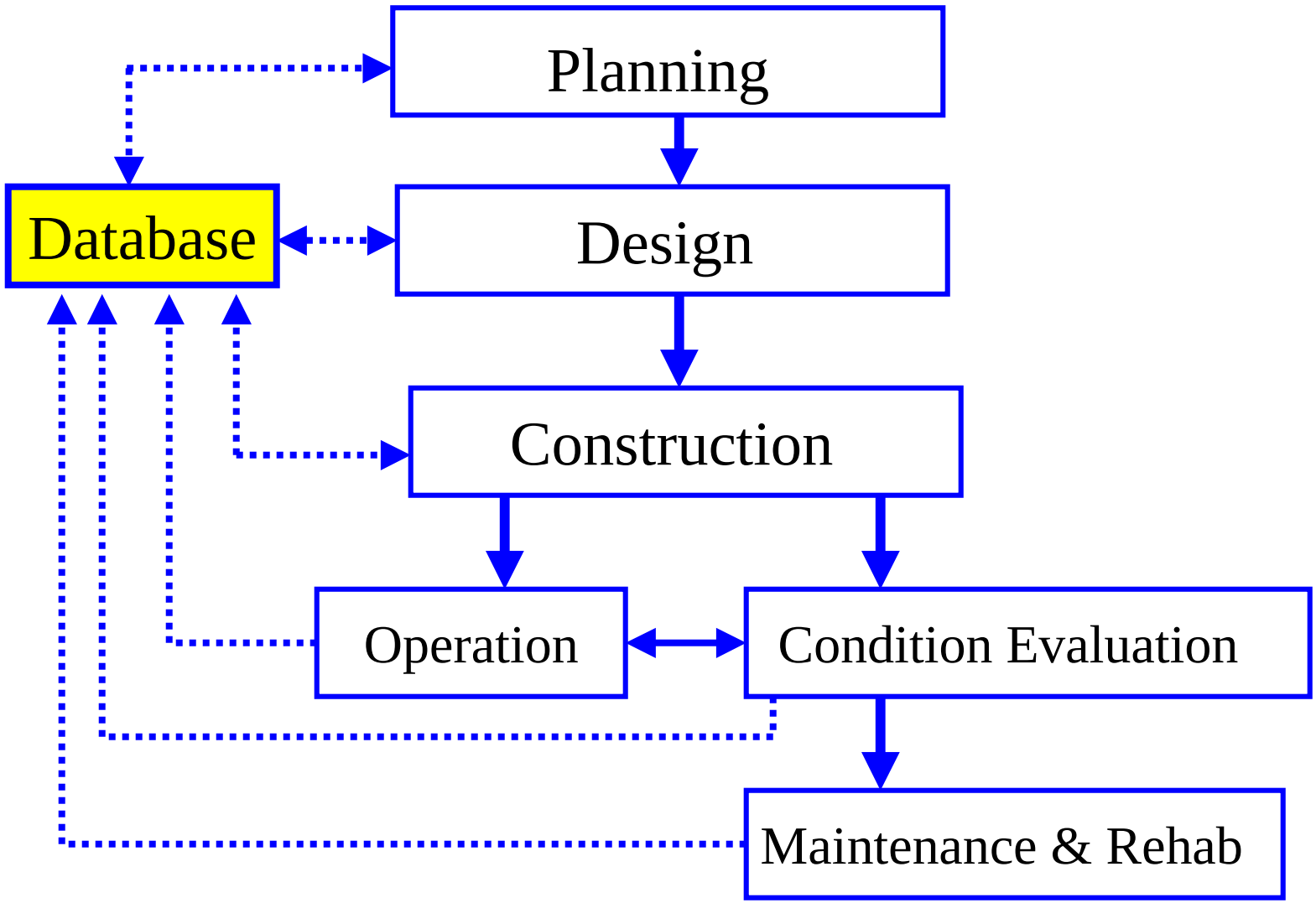
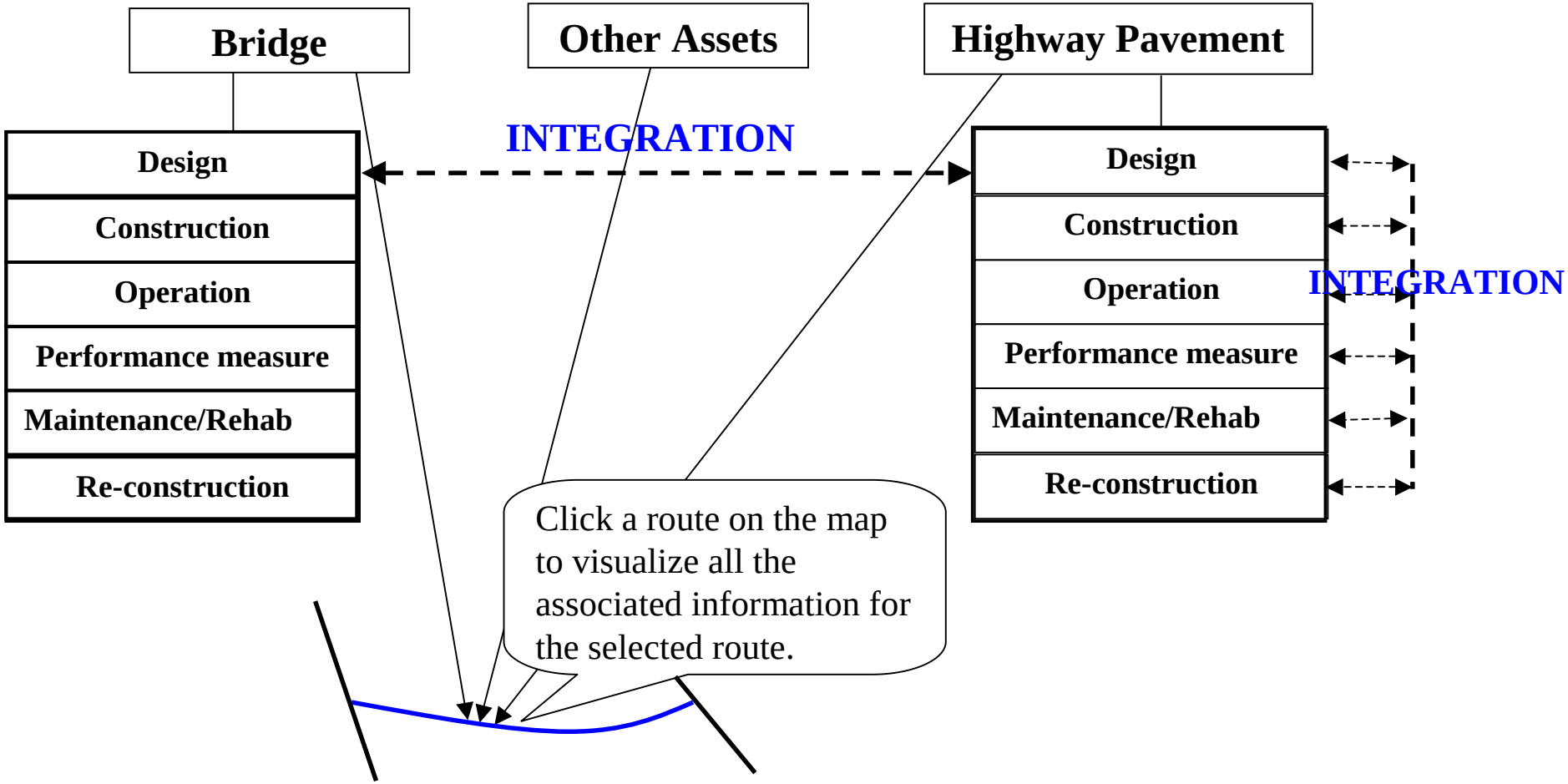
Outline

- Pavement Management
- Geographic Information System (GIS)
- Case Study
- Future Development/Challenges
- Demo

Life-cycle Activities for Pavement Management



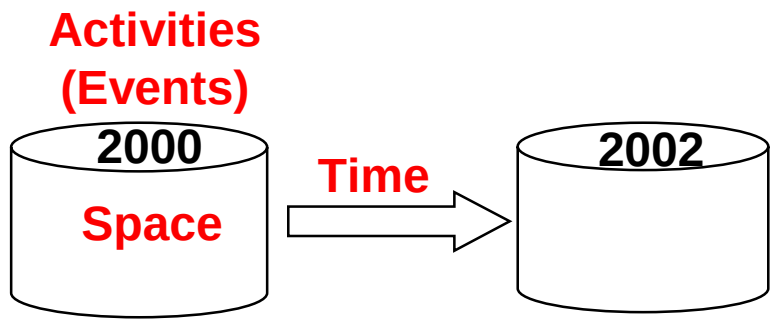
Location Reference-based Data Integration for Asset Management



Geographic Information System (GIS)

Characteristics and Strengths of GIS:

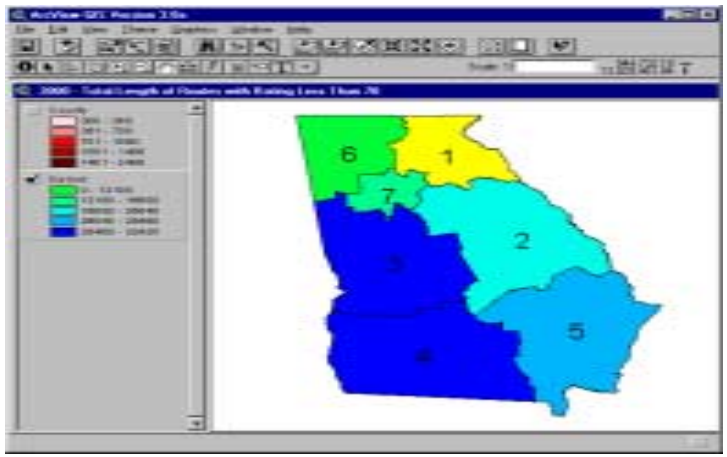
- Data Integration
- Spatial Analysis
- Information Visualization



Levels of GIS Implementation:

- Static GIS Application
- Dynamic GIS Application

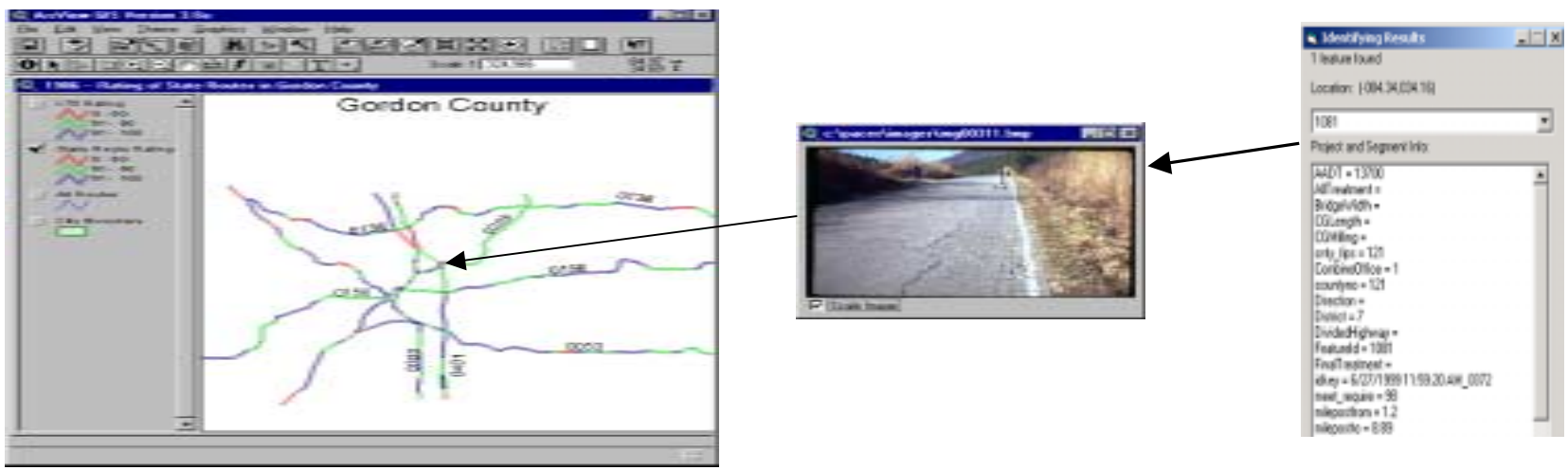
Pavement Management - Visualization and Quantification of Pavement Related Information



(a) Visualize and Quantify Spatial Distribution of Pavement Condition Information Based on Working District

DISTRICT	Total Length of Routes with Rating Less than 70 (ft)
1	14600
2	26040
3	30880
4	32420
5	28460
6	12100
7	16800

(b) Visualize Pavement Conditions for A Specified Segment



How GIS Can Help PM

- Support integration of different data based on their common location reference. This will lead to
  - Easier data access
  - Easier data correlation
  - More accurate performance forecasting
  - More reliable economic analysis
  - Prompter pavement management response
  - More effective cross-asset management

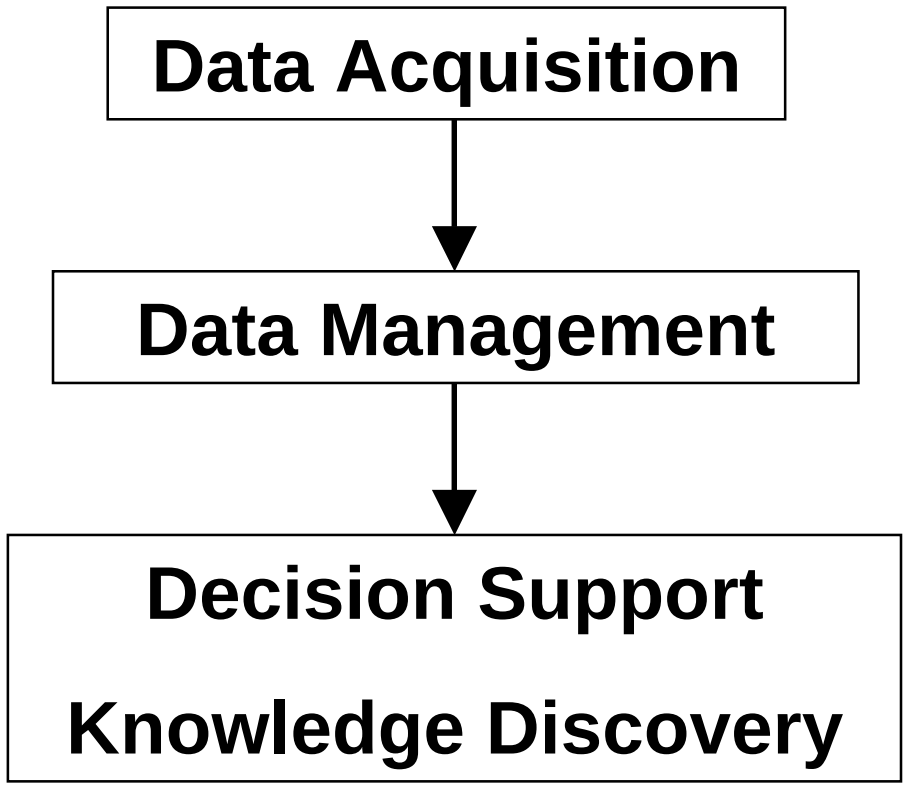
How GIS Can Help PM (cont.)

- Visualize pavement condition such as historical and predicted pavement performance.
- Determine pavement performance at different jurisdiction levels using spatial analysis
- Determine logic project termini based on pavement condition and network connectivity

Case Study

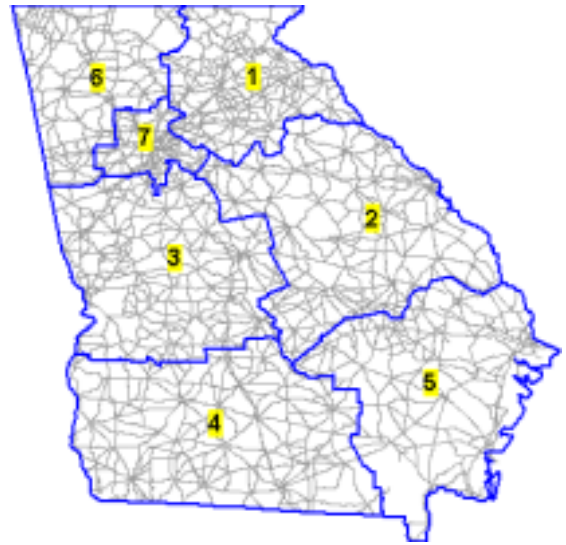
GDOT GIS-based Pavement Management

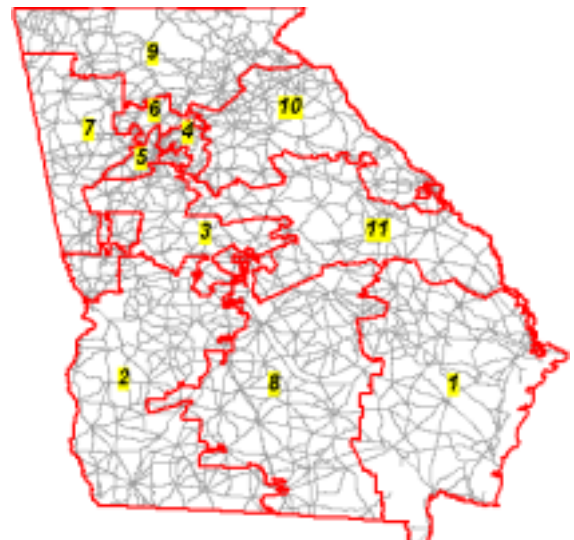
Components in Pavement Maintenance Management



PMM Practices in GDOT

- 18,000 mile centerline highway.
- 7 working districts.
- Pavement surveyed annually with about 60 engineers.
- 10 different types of distresses surveyed (i.g. load cracking)
- Project rating is between 0 and 100.
- More than 15 years of survey data (1986 – 2001)
- Survey data used to determine suitable maintenance and rehabilitation strategies.
- Annual total miles of projects to be treated are subject to funding availability.
- Activities/budget in Georgia congressional districts should be balanced.





Systems Development in Georgia

Phase I:

- A laptop-based on-site pavement condition evaluation system.
- A KBS for diagnosing causes of pavement distresses.

Phase II:

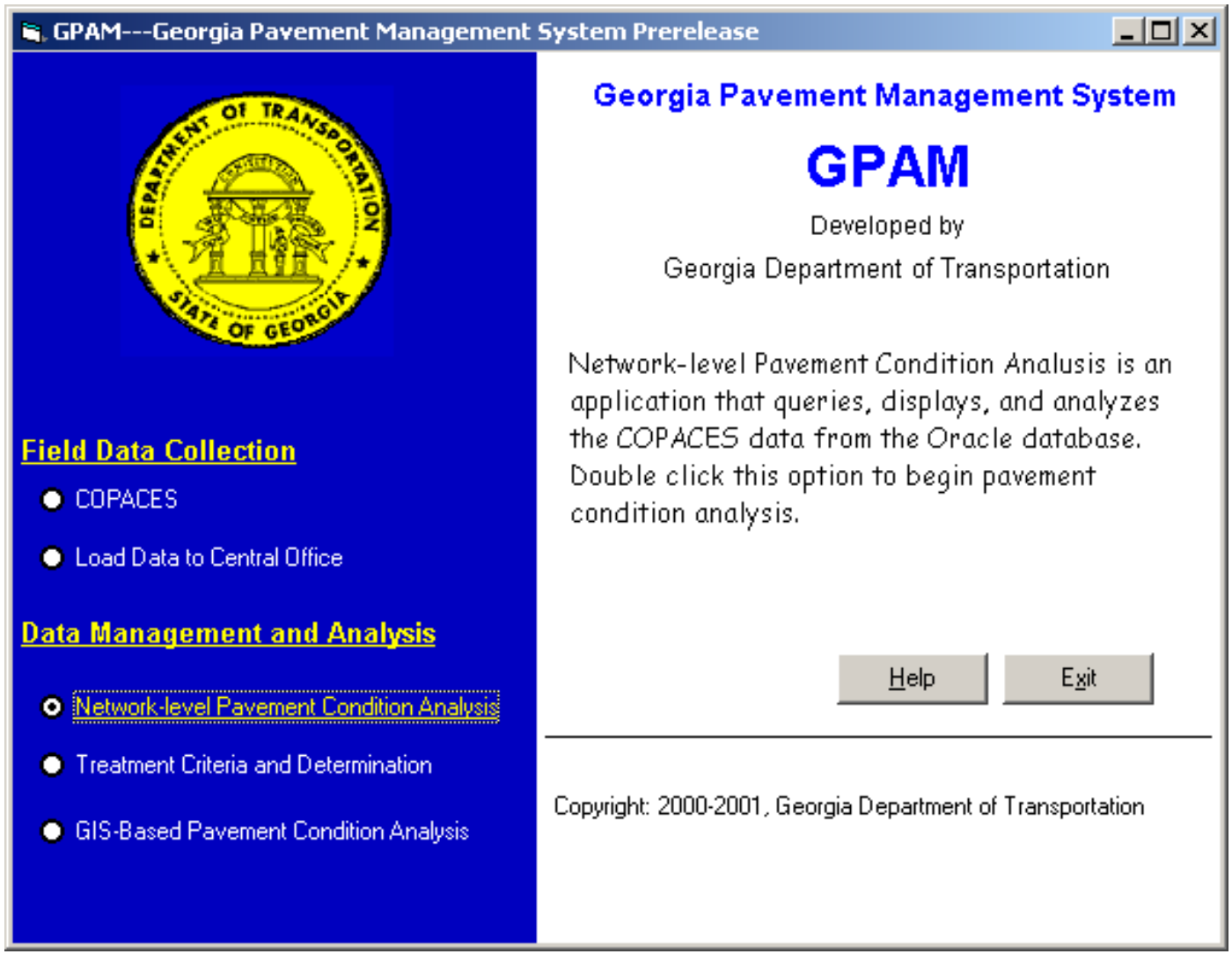
- Historical data filtering and conversion.
- An Oracle client/server GIS-based pavement information management and analysis system.
- Maintenance and rehabilitation determination.
- Deterioration models.

Systems Development in Georgia

Phase III:

- Pavement performance prediction.
- Rehabilitation project prioritization.
- Pavement performance simulation and optimization.
- Pavement profile information storage and management:
  - Pavement layer thickness and material properties.
  - Pavement maintenance and rehabilitation history.
  - Relate pavement section design to pavement performance.

Georgia Pavement Management (GPAM)

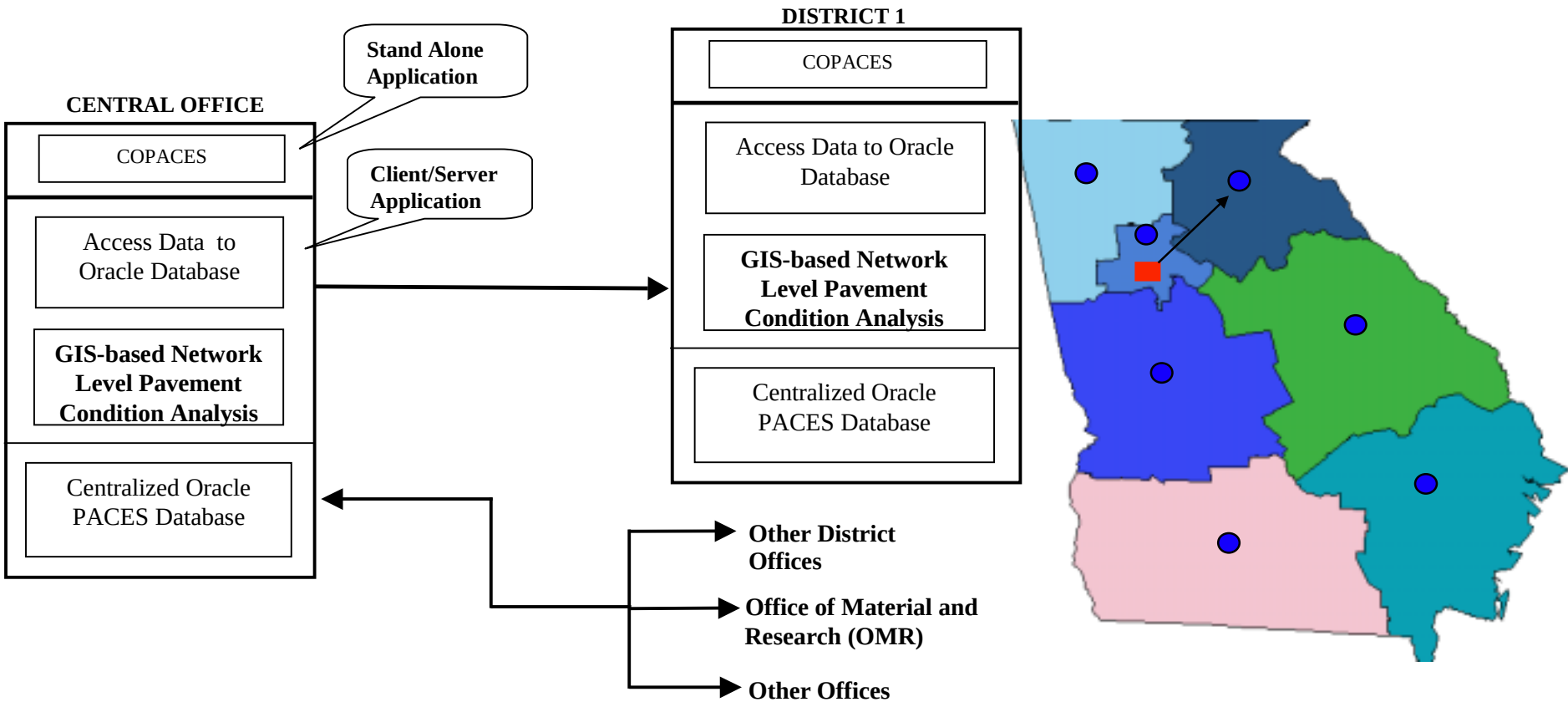


Field Data Acquisition

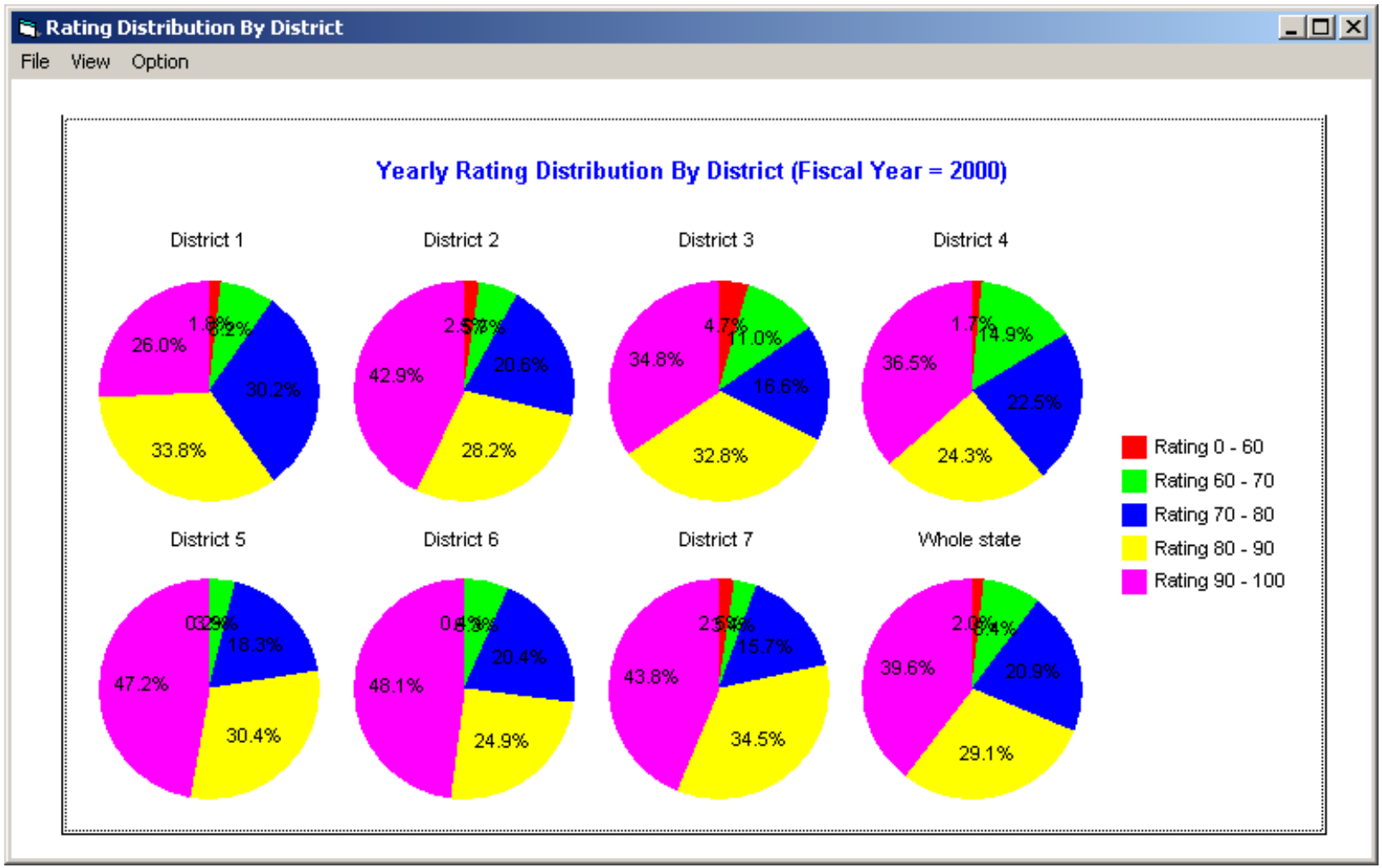
Field data acquisition is performed through the COPACES module in GPAM.

Framework of IT-based PMS

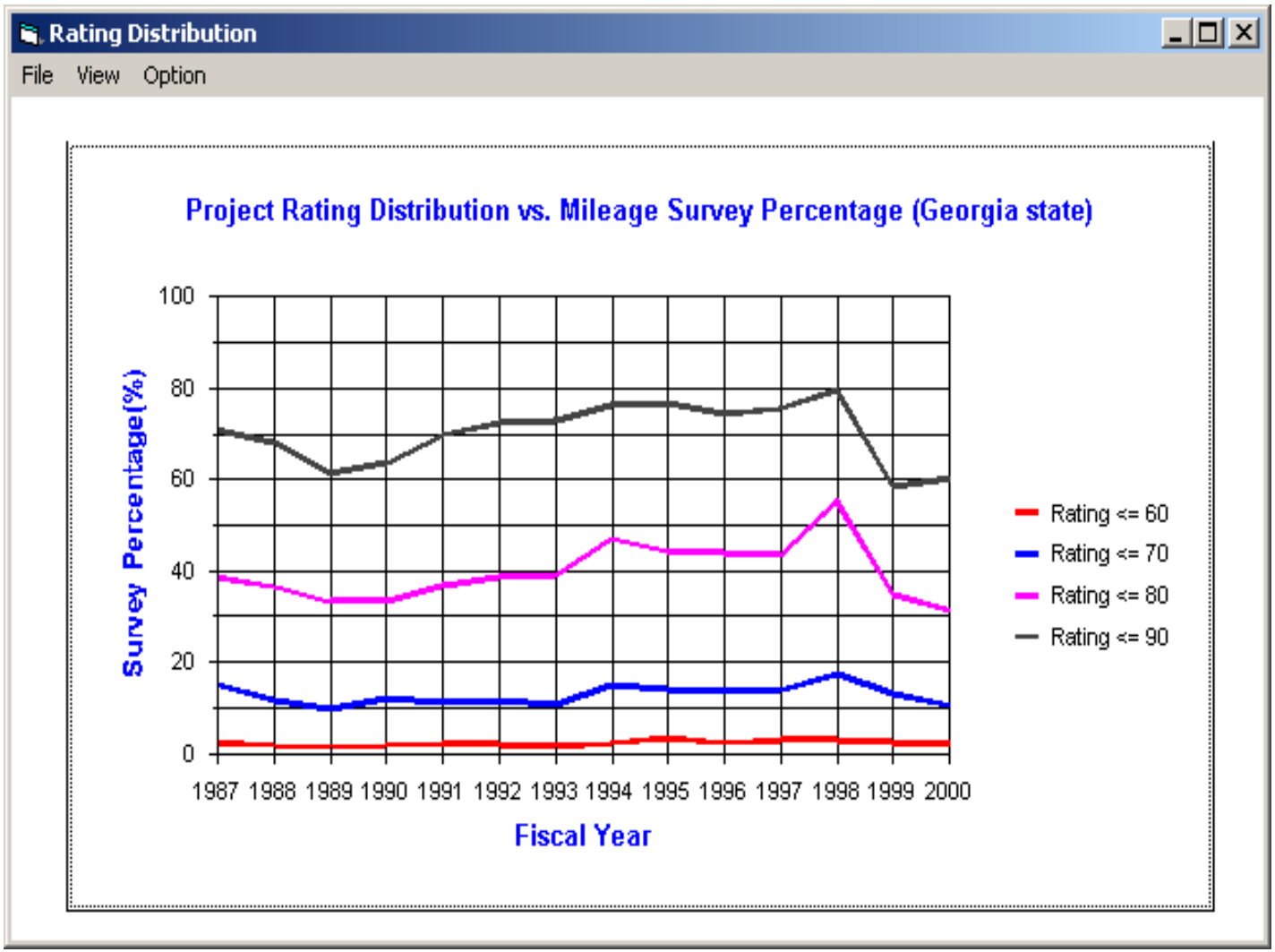
Client/Server Based System Architecture



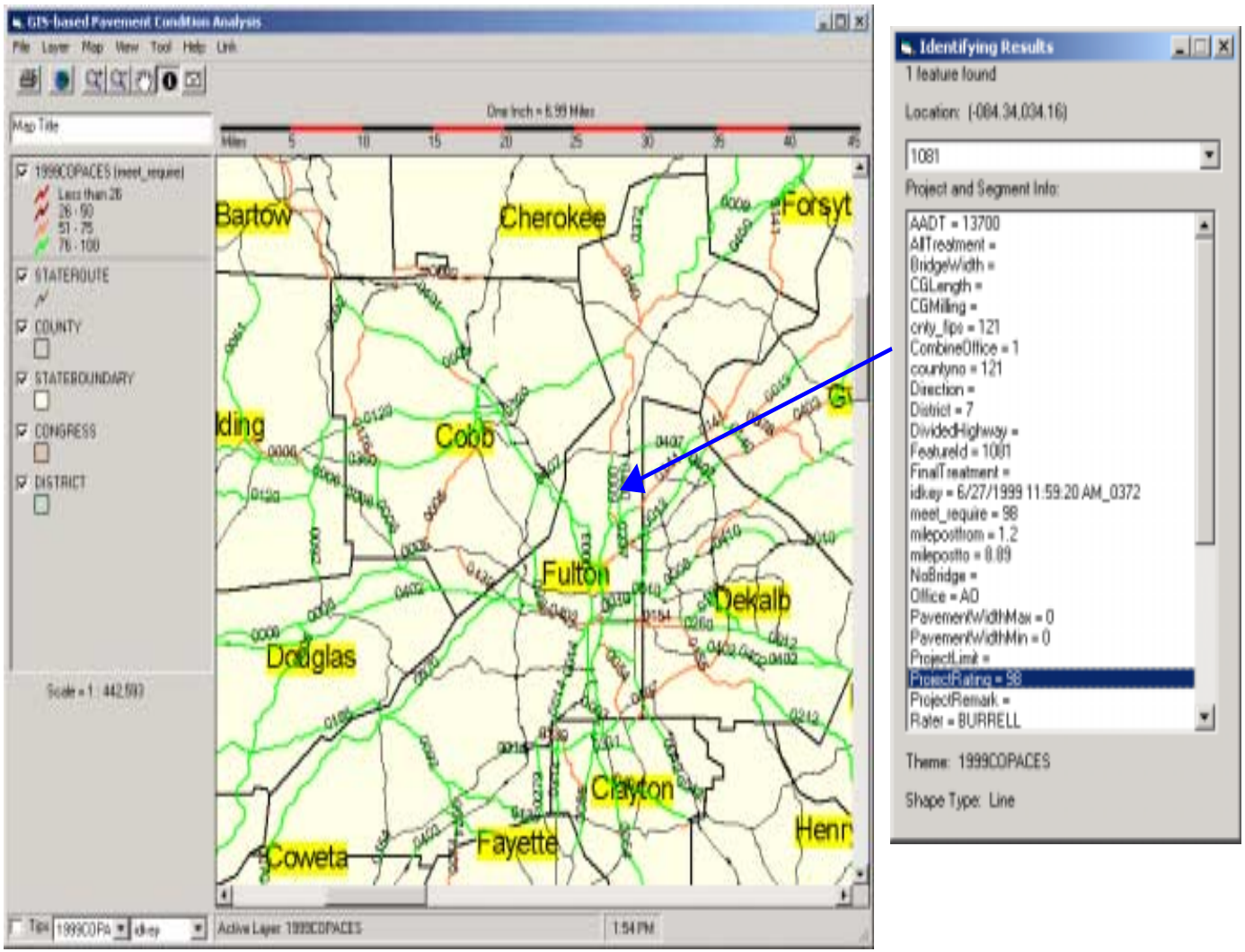
Rating Distribution By Districts



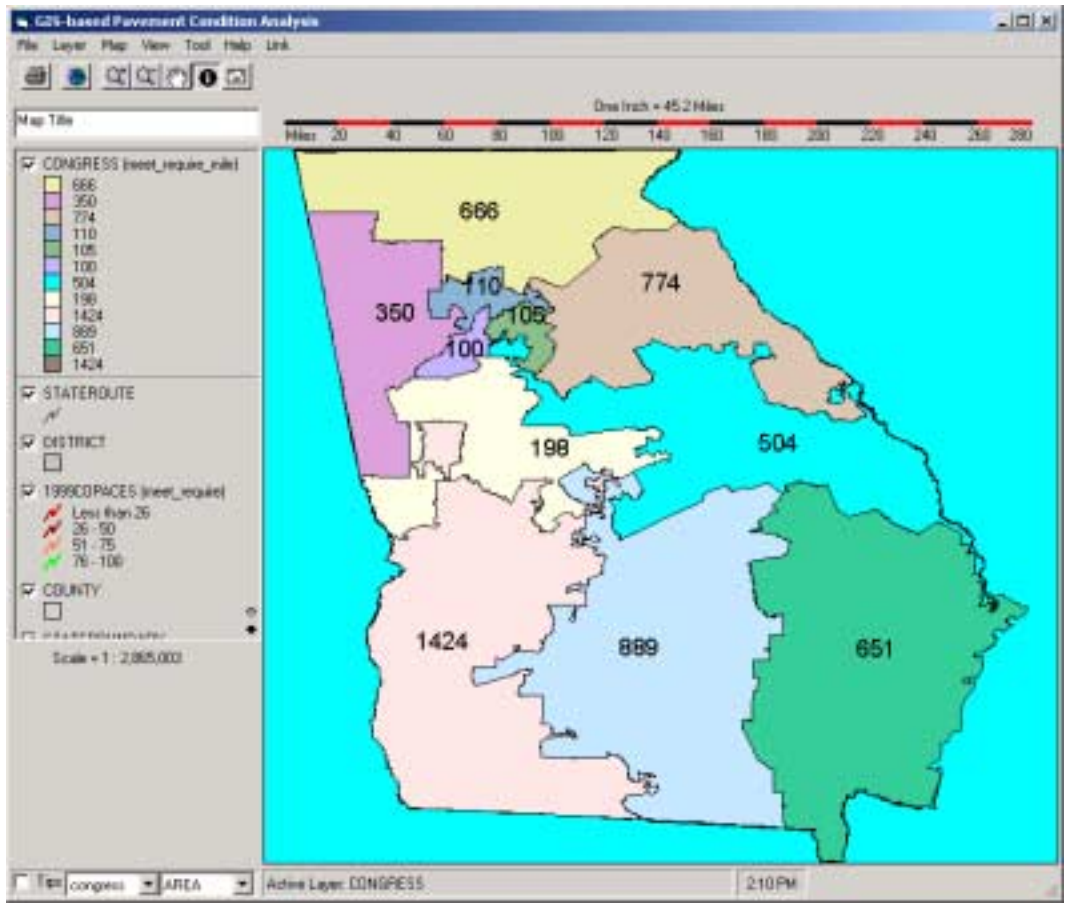
Historical Project Rating Distribution



Visualization and Identification of Project-level Pavement Information



Spatial Analysis for Visualizing and Quantifying Pavement Information for Different Jurisdictions



Total Miles for Projects with Rating Values Less Than and Equal to 80 in Each Congressional District

Benefits

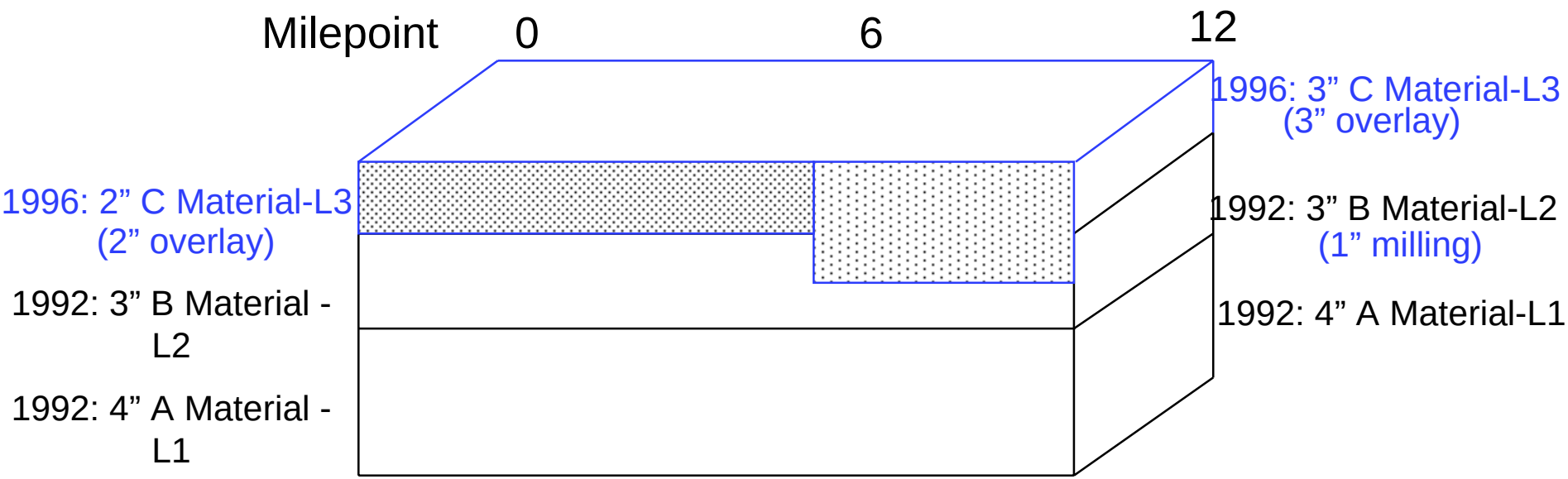
- Data acquisition efficiency was improved.
- Data quality was enhanced.
- Data can be utilized more often and more effectively.
- Treatment decisions were made more accurately and consistently.
- Provided the ability to more effectively manage the pavement preservation Program.
- Other benefits

Future Development/Challenges

Future Development

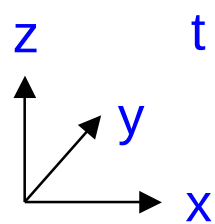
- Deterioration models for predicting pavement performance; optimization and prioritization modules to play what-if treatment strategies and funding levels; visualize future pavement performance.
- Relate pavement structural and material information to performance spatially.
- Spatial project termini termination.
- Integration of different source of info, such as data from infrared ray data, image processing for distress inspection, and satellite imagery and aerial photos.

A Linear Referencing System (LRS)-based and Temporal-enabled Pavement Profile Data Model



Pavement Profile Information

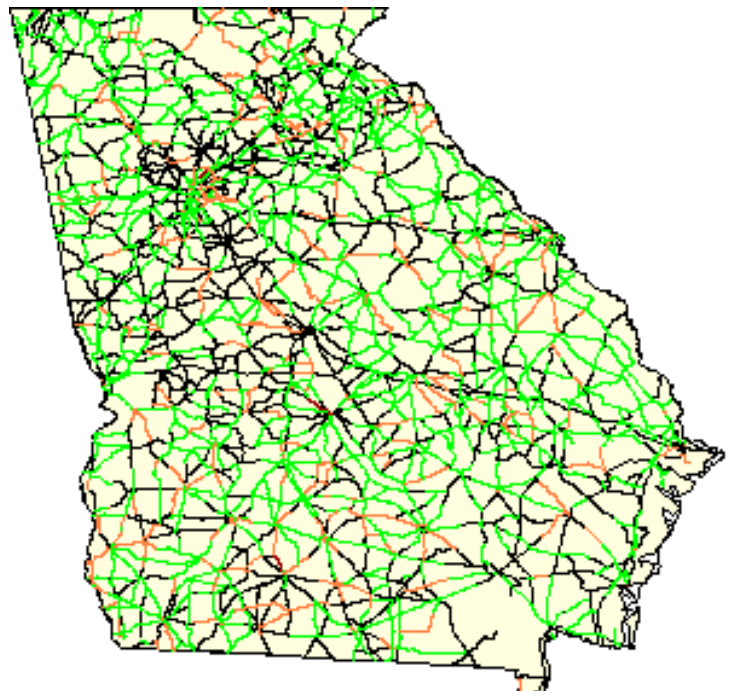
Milepoint	0 —— 6 —— 12	
Year	**Rating**	
1996	100	100
2000	92	97



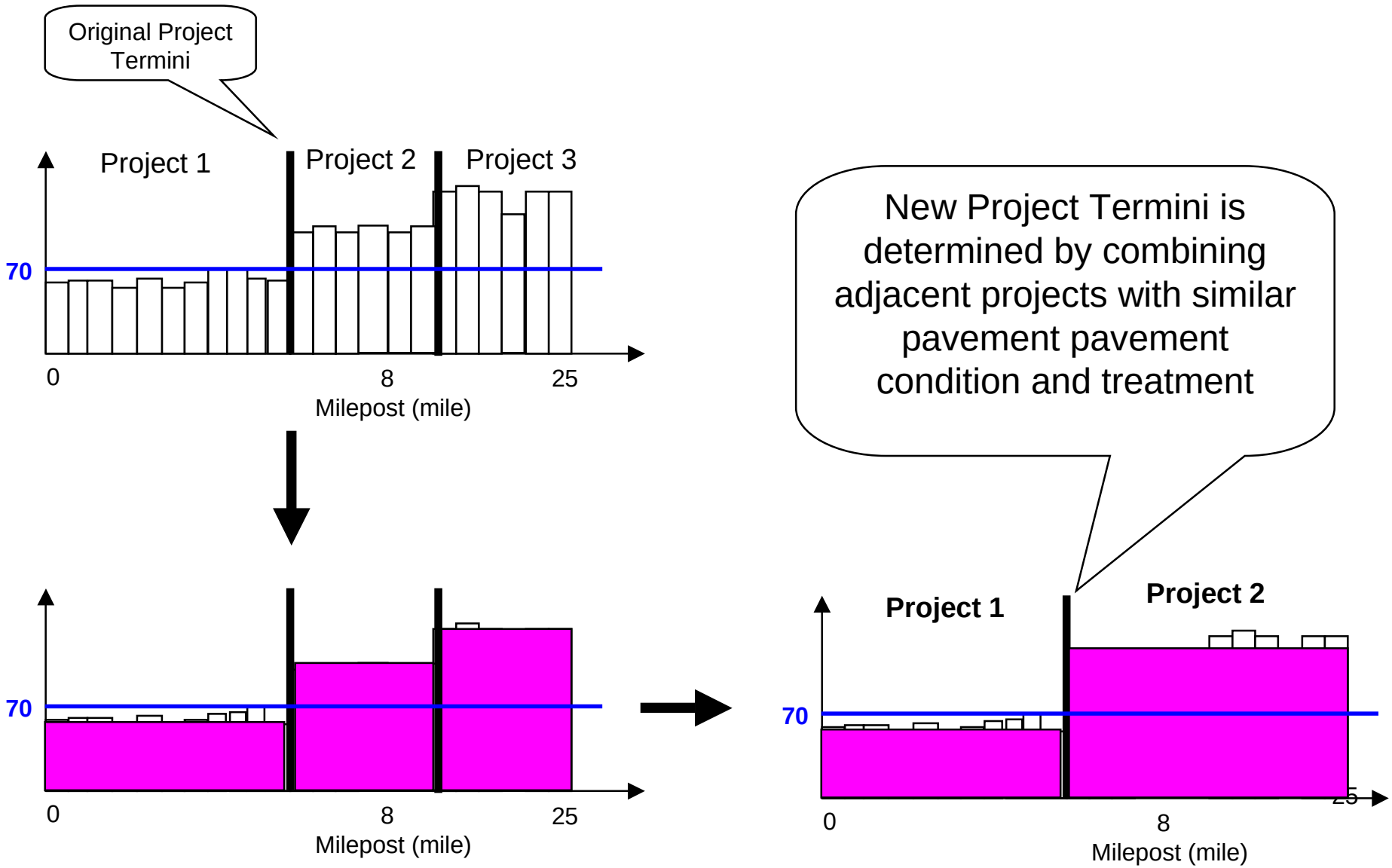
Pavement Performance

Factors Influencing Logic Project Termini Determination

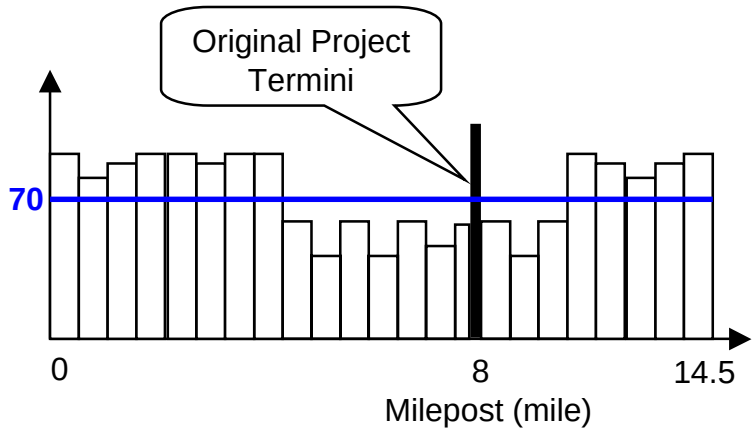
- Natural barriers such as bridges.
- Proximity.
- Pavement performance.
- Traffic congestion and safety concern.
- Management concern.
- Economic concern.



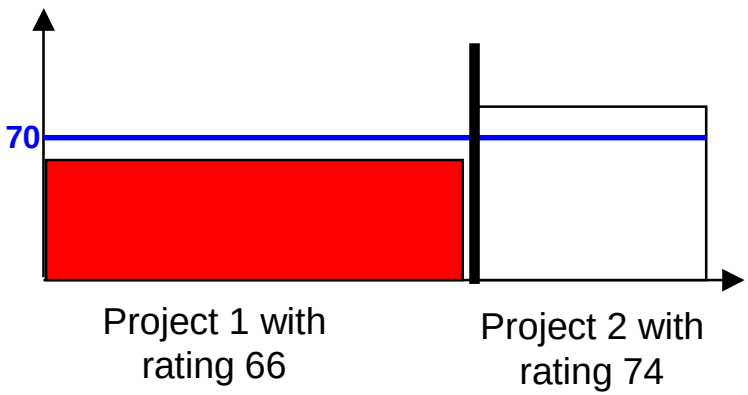
New Treatment Project Termini Determined by Combining Adjacent Projects



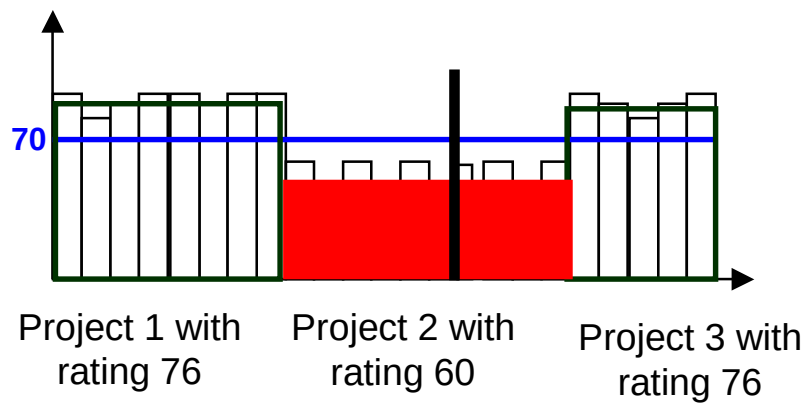
Determine Project Treatment Termini Based on Pavement Segment Performance



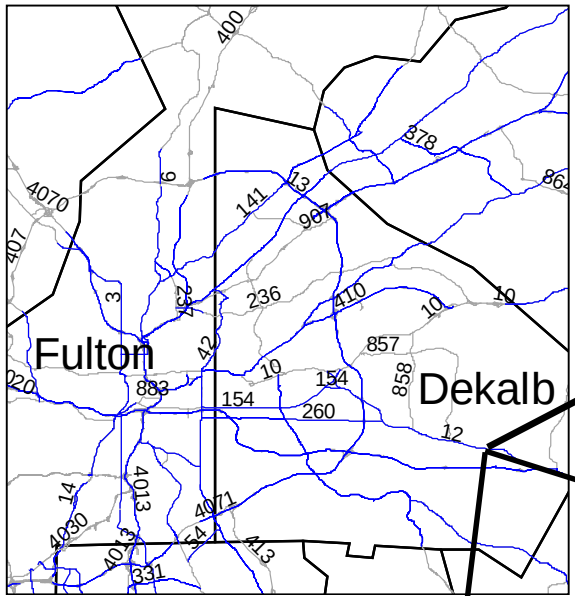
A typical treatment project termini deterination



Economic spatial treatment project termini determination

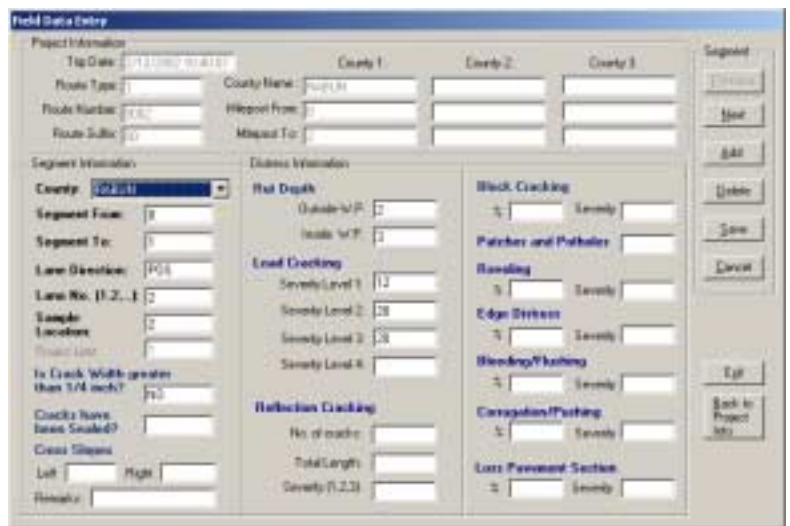


Integrate Exiting and Future Pavement Performance in a GIS Environment

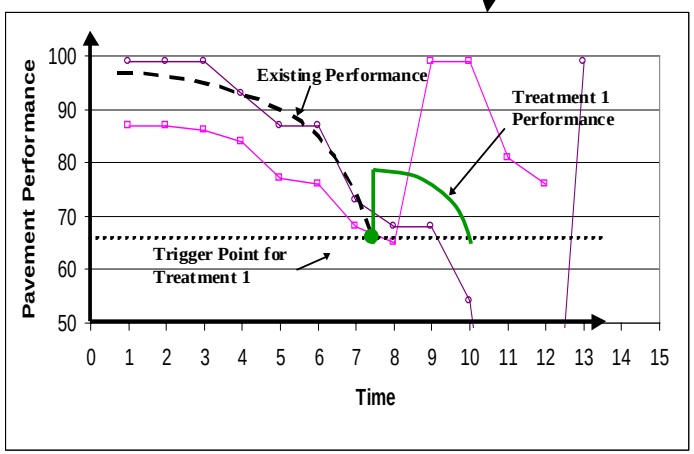


Performance

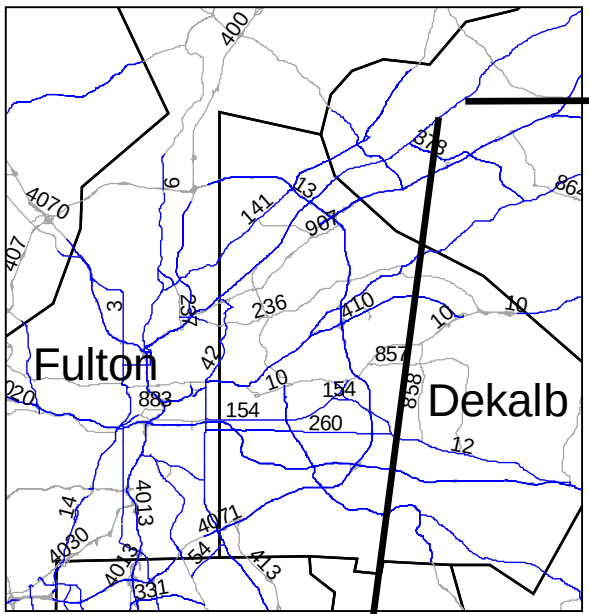
Detailed distress info

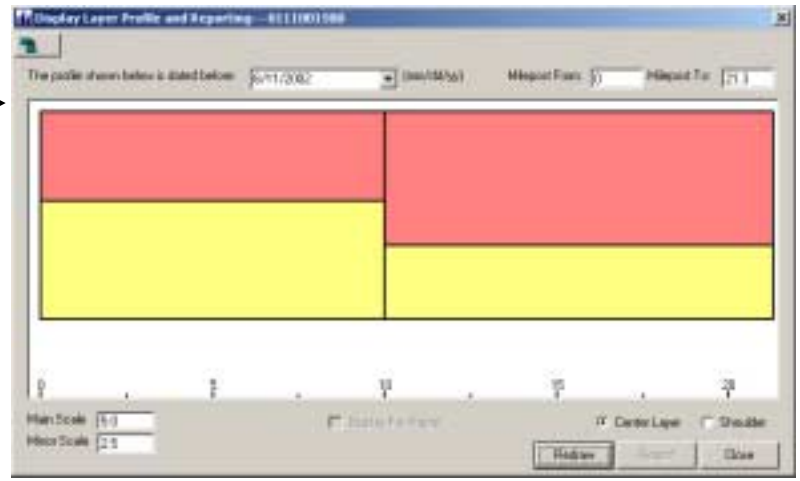


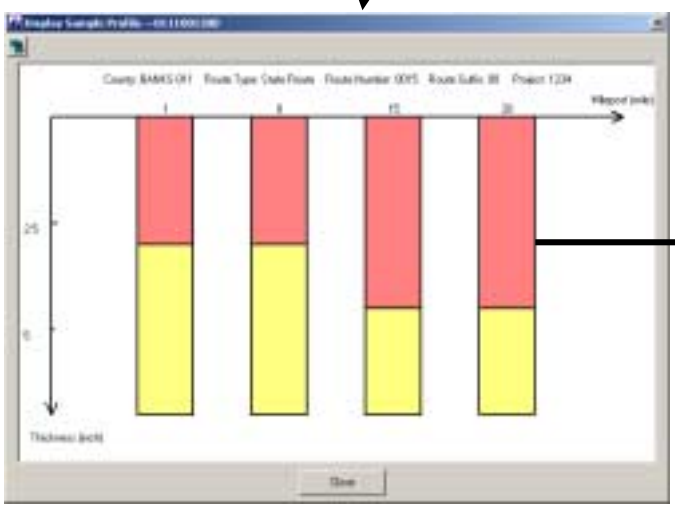
Project Level Pavement Performance Trend



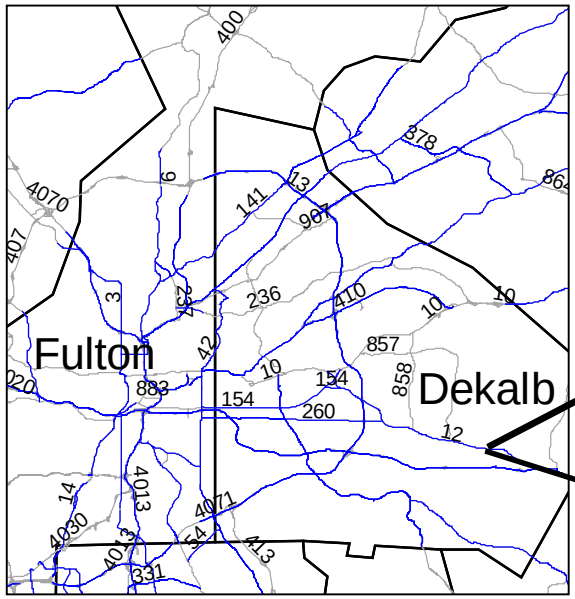
Integrate Pavement Section Design and Coring Info in A GIS Environment





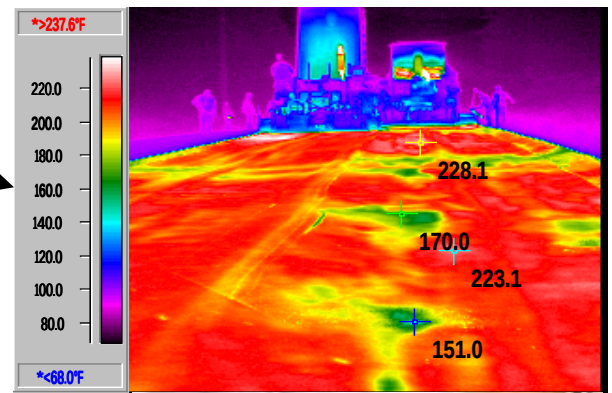


Integrate Construction QA/QC Info in A GIS Environment



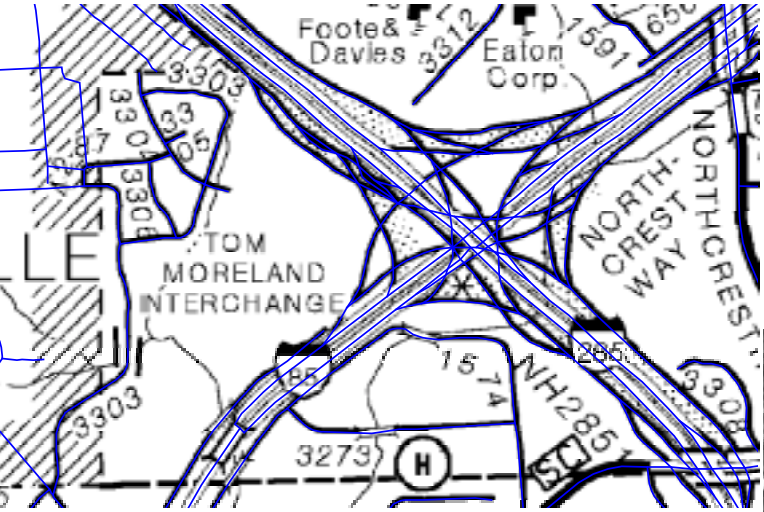
Performance

Construction



Detailed Construction QA/QC Info

Road Map and Aerial Photo



Challenges

Technical:

- Data fusion for data with different location references (e.g. milepost and milepoint)
- Temporal-based GIS model to meet the future need
- Legacy data conversion.
- Strategies and architecture for integrating different database server
- Data integration from different units in one agency or among different agencies need to reconcile and consider:
  - Data quality
  - Data collection spatial frequency
  - Data collection temporal frequency

Challenges (cont.)

Non-Technical:

- It's not just introducing new tools, such as GIS and Information Technology (IT). It requires new thinking about business process re-engineering to gain the utmost benefit.
- It requires the coordination of different business units and agencies to really "DRAW A LINE ONCE."
- It involves revealing and sharing information in the territory of each business unit.

Demo

Contact Info

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