An Integrated **GPS-based Mobile Data Collection** and **Web-based GIS Platform** for Supporting GDOT’s Pavement Rehabilitation and Design Processes

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• Other key persons
  – GDOT
    • Abdallah Jubran (AJ), State Pavement Engineer
    • James Turner, Pavement Test Engineer
    • Scott Gallman, Pavement Evaluation Engineer (retired)
    • Gregory Leggett, Pavement Evaluation Engineer
    • Timothy Poe, Enterprise GIS Team Leader
    • Sanjeev Devarapalli, Software Architect
    • Joshua Ross, (former) GIS Developer
    • Anand Matam, GIS Developer
• Other key persons
  – Georgia Tech
    • Yichang (James) Tsai, Associate Professor, CO-PI
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Outline

- GDOT IT development procedures
- Engineering background
- System architecture
- GPS-based mobile data collection
- A web-based GIS platform
  - Coring data management
  - Extraction and analysis of historical pavement conditions
- Recommendations for future enhancement
Development Procedures (cont’d)

- **Reviewed and Approved by OIT**
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- **GaTech performed refinement**
- **Reviewed and Approved by OIT and OMAT**

**Business Requirements**
- Discussed by OMAT & GaTech
- Reviewed and Approved by OIT

**Architecture Design**
- Existing data sources and requirements from OIT
- Reviewed and Approved by OIT

**Database Design**
- Discussed by OMAT & GaTech

**System Development**
- Development environment specified by OIT
- GaTech worked with OIT on Integration

**System Integration**
- OIT and OMAT performed testing

**System Testing & Q/A**

**Production**
Highway Maintenance in GDOT

• 18,000 centerline miles on the State Highway System
  – 46,000 Lane Miles
• 1,200 centerline Miles on Interstate
  – 6,000 Lane Miles on Interstate
• 10% Annual resurfacing/overlay
Pavement Evaluation for Rehab design

- Pavement evaluation for cost-effective rehab design
  - In-service and historical pavement surface distresses
  - Existing pavement structure
  - Material property and crack penetration

Existing pavement structure

Crack penetration

In-service pavement conditions

Historical pavement conditions

Coring

Pavement condition survey
Pavement Evaluation Processes

In the past...

Disadvantages

- Error-prone data recording
- Error-prone report compiling
- Inconsistent data quality
- Inaccurate location reference
- Tedious data utilization
- Difficult data reuse and data sharing
System Architecture/Solution

Field Data Collection

In-Office Data Transfer

Data Uploading

Other Maps
- GDOT base maps
- State routes
- Incomplete projects
- Completed projects
- Online base maps (e.g., Bing map, ESRI maps)

GIS-based Web Platforms

COPACES
GPS-based Mobile Data Collection

Accuracy is up to sub-foot.
In-Field Image Integration
Data Collected

Field-collected data has been uploaded to the central database:

107 projects since 2008
Including 731 cores and more than 4,000 pictures
Architecture of Web App

Online Sources

- ESRI Map Server
- Bing Map Server

GDOT Intranet

- Silverlight-Supported Client Browser
- ArcGIS Server
- Core Map
- GDOT Base Map
- Web Server (IIS)
- PE
- COPACES

Georgia Department of Transportation
### Core Locations

**Date:** 2/23/2010 8:52:49 AM
**Core ID:** 1  **PI NUM:** 0007062
**Department:** PDB  **County:** Fulton - 121  **Route:** COX
**Condition:** Poor  **Material:** Asphalt  **Underlying Material:** Graded Aggregate Base
**Lane Location:** Right Wheelpath  **Distress Type:** Load Cracking  **Distress Level:** 1
**Crack Depth:** 7  **Die:** 4  **Direction:** West
**Route Type:** 1  **Route No:** COX  **Route Suffix:**
**Sampler:** NA  **Comments:** Full depth

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**Date:** 2/23/2010 8:52:49 AM
**Core ID:** 2  **PI NUM:** 0007062
**Department:** PDB  **County:** Fulton - 121  **Route:** COX
**Condition:** Poor  **Material:** Asphalt  **Underlying Material:** Graded Aggregate Base
**Lane Location:** Right Wheelpath  **Distress Type:** Block Cracking  **Distress Level:** 1
**Crack Depth:** 9  **Die:** 4  **Direction:** East
**Route Type:** 1  **Route No:** COX  **Route Suffix:**
**Sampler:** NA  **Comments:** NA

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**Date:** 2/23/2010 10:56:05 AM
**Core ID:** 3  **PI NUM:** 0007062
**Department:** PDB  **County:** Fulton - 121  **Route:** COX
**Condition:** Good  **Material:** Asphalt  **Underlying Material:** Soil
**Lane Location:** Between Wheelpath  **Distress Type:** None  **Distress Level:** 0
**Crack Depth:** 0  **Die:** 4  **Direction:** Assumed S
**Route Type:** 1  **Route No:** COX  **Route Suffix:**
**Sampler:** NA  **Comments:** NA
Core Search

![Core Search Interface](image)

- **General Information in PEA system**
- **Pavement Evaluation Project Search**
- **Core Data Search**
  - **Search By**: PI Number
  - **Date From**: 5/2/2008
  - **To**: 5/3/2014
  - **Select**: 0007062
  - **Query**

- **PI Number**
- **Route**
- **County**
- **GDOT District**
- **ALL**
Online Core Data Input

Other than the data from PDB, other parties can contribute and easily share their data now.

Add core data using web (other offices/contractors)

GDOT designated engineer review and approve/reject new data
Historical Pavement Condition Data Extraction

- Define date range (when to when)
- Define project location (where to where) using GDOT LRS
  - RCLINK (10 digits: county, route type, route number, route suffix)
  - Milepoint from and to
Interactive tool was developed to visually locate projects without knowing RCLINK code
Historical Pavement Condition Data Analysis (cont’d)

Historical Pavement Conditions

County: Fulton-121  Route: 0401  MPt. From: 0.00  MPt. To: 5.30

Data Source: AO  DO  GO  Regression Type: Exponential Regression

Threshold Rating: 70  Starting Year: 2004

Start Rating for Analysis (Red Line): 93  End Rating for Analysis (Blue Line): 71
Year of End of Service Life: 2011  Change in Rating Per Year: -3.2
Equation: $100 - 5.47e-186 \cdot e^{0.214 \cdot t}$  R-squared: 86.19 %
Summary: New Pavement Evaluation Processes

From now on...

Advantages
- Consistent data format and data quality
- Accurate location reference (Lon. & Lat.)
- GIS-based web application for data management, report generation, and data analysis
- Other end users can also share their own data
- Other data sources (e.g. COPACES) are integrated
Benefits

• Increase the return on investment (ROI)
  – Better managing the valuable and scarce data (coring data)
  – Better utilizing the existing data (COPACES and map services)
  – Easier data sharing (other than PDB, other users and contributors: Office of Maintenance, Office of Roadway Design, District & Area Offices, and Contractors & Consultants)

• Directly support GDOT’s engineering decision making on pavement rehabilitation and design
  – Improved data accuracy
  – Comprehensive data integration
  – Efficient data retrieval
  – Effective data analysis tools
Suggestions on Future Applications

- The GPS-based field data collection procedures and GIS-based web platform for data management, sharing and reporting can be extended to
  - Soil surveys
  - Testing management activities
  - Bridge foundation investigations
  - Construction audit activities
Suggestions on Future Enhancement

• Use new tablet computers and cloud computing for seamless synchronization between data acquisition and data utilization)
Thanks!

Q/A