FHWA Activities in GIS and Visualization

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FHWA Funded Peer Exchanges 2011

- GIS Applications for Climate Change Decision-Making
- GIS Applications for Livability Considerations
- GIS for Highway Safety Peer Exchange

FHWA - GIS in Transportation Website
http://www.gis.fhwa.dot.gov/

See Mark Sarmiento Session 3.4.1
Initial FHWA Efforts to Advance Visualization

- Websites: Federal lands Highway Division Design Visualization Guide
USDOT Websites:

- FTA Choosing Visualization in Transportation
  http://www.choosingviz.org/

- FHWA Buffalo Site
  – http://fhwa.ccr.buffalo.edu/

- FHWA Visualization in Planning
Initial FHWA Efforts to Advance Visualization

Office of Highway Policy GIS initiative: Highway Performance Monitoring System

See Ron Vaughn Session 5.3.1
FHWA Visualization Working Group

What is it?

- Provide leadership and advocacy for visualization and innovative data analysis
- Representatives from across the Agency
FHWA Visualization Working Group

Purpose

• Identify and inform FHWA on Agency visualization activities
• Begin to coordinate visualization efforts across FHWA
• Collaborate with TRB Visualization Committee and external partners
• Promote visualization activities within the community
• Collaborate on visualization initiatives to advance the application and practice
• Identify research, technology, and training needs
FHWA Visualization Working Group Activities

• **Inventory** the use of innovative data analysis and **visualization** within FHWA

• Conduct a synthesis of available methods, software, and tools that could meet FHWA needs

• **Investigate** methods and the types of data and research results that could benefit from innovative data analysis and visualization
Current Visualization Strategic Initiative Projects

1. Visualize NHTS Data through on-line GIS: A Demonstration


3. Identify Strategic Opportunities for the Use of Innovative Visualization Techniques

4. Best Practices in GIS-Based Transportation Asset Management
1. Visualizing the National Household Travel Survey Data through on-line GIS

- NHTS Data
  - Largest & only travel behavior data base in public domain
  - Far reaching audience
  - Travel demand modeling & policy
  - Program analysis & evaluations

- Project Objective: Develop & implement a GIS interface to NHTS data

- Outcome: Demonstrate leadership using visualization tools to increase accessibility
151,000 Household interviews and 320,000 person interviews
History

- Started in 1969 at Census as a Face to Face Interview
- Collected information on the American Public’s daily travel.
- 1977 switched to a telephone survey
- Periodically conducted as a telephone survey every 5 to 7 years
- Labeled the “Flagship” of US travel surveys.
Uses of NHTS

- Measure the amount, type and trends in travel for national policies and programs
- Determine vehicle or pedestrian exposure for safety measures (fatalities/million miles of travel)
- Provide or compare trip rates for local transportation planning and air-quality analysis
- Research the mobility of groups: elderly, immigrants, school children, low income
- Commuting trends and comparison to Journey-to-Work Census Data
What are some “Traffic” uses:

✓ **Congestion:** Trends in commute patterns and peak travel

✓ **Fleet mix and fuel use:** Hybrids, SUVs growth and use

✓ **Safety:** (drivers, passengers, and pedestrian)

✓ **Mobility Issues:** Older drivers and non-drivers

✓ **Trends in basic travel measures:**
  Changes in the components of VMT: Drivers, workers, vehicles, trip rates auto occupancy
2009 Add-On Participants

- California DOT
- Maricopa, AZ
- Pima, AZ
- Texas DOT
- South Dakota DOT
- Cedar Rapids, IA
- Iowa DOT
- Omaha, Nebraska
- Wisconsin DOT
- Indiana DOT
- Tennessee DOT
- Georgia DOT
- Vermont DOT
- Chittenden CO.
- New York State DOT
- Virginia DOT
- North Carolina DOT
- Greensboro, NC
- South Carolina DOT
- Florida DOT
2009 Non work trips add to Congestion

Number of Vehicle Trips by Start Time and Purpose

Start Hour

Vehicle Trips/Day (millions)

Midnight 1 2 3 4 5 6 7 8 9 10 Noon 1 2 3 4 5 6 7 8 9 10 11

Commuter
Fam/Pers (inc. Shop)
School/Ch
Soc/Rec
Total

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000 20,000

20,000 18,000 16,000 14,000 12,000 10,000 8,000 6,000 4,000 2,000 0
2009: The majority of peak vehicle trips are made by workers...both mandatory and flexible

43 percent of these workers go to work at another time
Data Extraction Tool (DET)

This data extraction tool allows users to obtain data from 1995, 2001, or 2009 National Household Travel Surveys (NHTS) to examine total travel (i.e., person trips, person miles traveled, vehicle trips, and vehicle miles traveled). This tool also allows users to extract data from all three surveys for trends analysis. The user can select one or more elements using selection criteria to generate a customized data set. This customized data set can be downloaded in CSV format for additional analyses.

For the add-ons, the user can extract data from a specific add-on. Note: the samples sizes used to generate area-specific travel can be extremely small. Users are advised to use these data with caution.

The customized data set will include the user-selected criteria (e.g., household income), total travel (i.e., person trips, person miles traveled, vehicle trips, and vehicle miles traveled), and the corresponding sample size used to estimate total travel.

To start extracting NHTS data, please select one of the following options:

- Total Travel by Survey Year and Selected Household Characteristics
- Total Travel by Survey Year and Selected Person Attributes
- Total Travel by Survey Year and Selected Trip Characteristics
- PieBubbles
- Choropleth Map
- Dashboard

Prototype Systems

• **Data Extraction Tool (DET)**
  - Allow user to extract and download subsets of data on selected 2009 NHTS statistics (e.g., person trips)
  - User can extract compatible data from 1995 NPTS, 2001 NHTS, and 2009 NHTS for trend analysis

• **Choropleth map integrated with pie bubbles**
  - Display thematic maps and state level statistics in pie bubble charts

• **Dashboard design**
  - provide synchronized display of map, table, and chart on selected statistics and geography
Choropleth Map
Example on using PieBubbles in displaying mode share by trip purpose.
Sub-State Display & Statistics
(Add-on Locations only)
2. Visualizing Federal Lands Management System Data

Federal Lands Highway Transportation - GIS* for the NPS* (PILOT TEST WEBSITE)

The purpose of this PILOT Transportation-related Geographic Information System (GIS) website is to test how WEB technology can bring together the data from the National Park Service management systems (Roadway Inventory Program (RIP) and Pavement Management, Bridge Inspection Program, Traffic Data Collection, and Safety Management), and to put it into a system that is easy to use and can display the features at their spatial location. The Pilot GIS-T website will test how to use the WEB as the "window" into the data Federal Lands and the NPS collect, derive and use to manage National Park Service transportation assets.

This website contains the following applications:

Utilized to view ARAN photos and mapped positions where photos were taken. Graphs of pavement PCR, SCR and RCI can also be displayed.

* GIS - Geographical Information System
* NPS - National Park Service
Use of Pivot Tables to Sort Data

You can also filter by attributes and click which field contains to include in the filter.

Pick attribute to sort by, and select the column sort.
3. Advancing Strategic Opportunities for Data Visualization at FHWA

• Describe FHWA’s opportunities for visualization:
  – Perform analyses
  – Comprehend data bases
  – Plan, design & deliver complex surface transportation projects
  – Translate complex & data intense efforts into visual products for FHWA customers and stakeholders

• Propose approaches to acquire technologies & strategies to increase agency application of visualization techniques
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3. Identify Strategic Opportunities for the Use of Innovative Visualization Techniques

- Data visualization should be defined by requirements rather than available technology or current data bases
- Develop strategies for the systematic increase in the application of visualization techniques
- Provide a direction for FHWA & id high priority pilot efforts

Task: Conduct a requirements analysis
FHWA’s Current Uses of Visualization

1. Program and Operational Performance
   • Analyze and communication of safety, mobility, asset conditions, sustainability, etc.

2. Planning and Engineering/Project Delivery
   • Analyze and communicating the design and impact of transportation infrastructure projects

3. Professional Capacity Building
   • Communicate to state and regional partners and demonstrate best practices for training purposes.
Major FHWA Issues

- Data integration
- Data completeness & integrity
- Access to data
- National vs local perspective & the appropriate requests for data
- 508 Compliance
- Static vs Interactive Visualizations
- Organization capacity to produce visualizations
- Procurement & IT issues
Advancing Strategic Opportunities for Data Visualization at FHWA

Five Recommendations

1. Pilot transformative data visualization projects
2. Adopt and enforce open data policies
3. Enhance organization capacity through internal training
4. Increase organization efficiency through employee diversification and specialization
5. Improve future organization capacity through early education at university level
Federal Lands Highway Program
ARRA Project Database
2. Best Practices in GIS-Based Transportation Asset Management
Best Practices in GIS-Based
Transportation Asset Management

- Participants in the review:
  - Colorado DOT
  - Michigan DOT
  - Ohio DOT
  - Oregon DOT
  - St. Johns County, FL. Dept. of Public Works
  - Washington State DOT
2. Best Practices in GIS-Based Transportation Asset Management

- Institutional Perspective
  - Need a champion to promote the program
  - Leadership support to fund and use
  - Collaborative organization
  - Phased approach

source: St. Johns County
Best Practices in GIS-Based Transportation Asset Management

- Technical Perspective

DATA MANAGEMENT

COLLECTION
- Manual / Pen & Paper
- Traditional Surveying & GPS
- GPS-enabled Handheld Device
- Maintenance Vehicle
- Aircraft (manned or unmanned)
- Satellite Imagery
- Automated Road Analyser

STORAGE
- Paper Files
- Electronic Files (.xls)
- Custom Database

ANALYSIS
- Manual Analysis
- Custom Asset Management Analysis Tools
- Asset Management Database
- Geodatabase
- Geospatial Analysis Tools

INFORMATION DISSEMINATION
- Manual Reports
- Custom Reports
- Asset Management Data Reports
- GIS Maps and Data Layers
2. Best Practices in GIS-Based Transportation Asset Management

- Challenges
  - Stove piping
  - Garnering support from leadership
  - Cost of collecting data
  - Complex system architectures
  - Program ownership
  - Data standards
  - In-house versus commercial software