Geographic Information Systems (GIS) in Transportation Safety

December 4-5, 2012

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TRB Data and Information Systems
University of Kentucky
What is GIS?

A computer system designed for Geographically Referenced Data:

- Capture
- Storing/Managing
- Integration
- Analyzing
- Interpreting
- Visualizing

- Relationships
- Patterns
- Trends

- Increase Productivity
- More Informed Decision Making
- Improved Communication
- Improved Record Keeping
- Managing Data Geographically

Source:
Free Android App Adds Collision Avoidance

by MATT BALL on NOVEMBER 1, 2011
GIS-T applications ...

**Aviation**
Use GIS for managing airport facilities, regulating use of airspace, and noise modeling.

**Michigan's Lane Mile Inventory**
GIS helps the Michigan Department of Transportation efficiently and accurately deliver annual maintenance and capital funds to various regions.

*GIS in Transportation, Winter 2012*

**Ports and Maritime**
GIS helps engineers build and manage port facilities and helps planners accommodate community and environmental constraints more easily.

**Railways**
Rail system operators use GIS to keep accurate inventories of facilities and report safety and performance statistics.

**Public Transit**
GIS is an excellent tool for analyzing ridership and service, as well as revenue, patterns, and usage, by select populations.

www.esri.com
GIS-TS applications...

**Disaster Response**

GIS for Public Safety

**AIMS**

**Airport and Transit Security**

**TransCAD**

Transportation GIS Software

**Computer-Aided Dispatch/E911**

Putting spatial intelligence at the fingertips of dispatchers and field personnel ensures proper response time. [Learn More](#)

**Fire/Rescue and EMS**

GIS helps fire/rescue and EMS protect life and property using information and analysis as a powerful tool. [Learn More](#)

**Law Enforcement**

Discover how to leverage data collected each day to create intelligence you can use and share. [Learn More](#)

**Emergency/Disaster Management**

GIS is essential for all phases: preparation, mitigation, response, and recovery. [Learn More](#)

**Homeland/National Security**

Federal, state, local, and tribal agencies use GIS to support the homeland/national security mission. [Learn More](#)

**Wildland Fire Management**

Access to information, increased safety and efficiency, and resource management are realized with GIS. [Learn More](#)

[www.esri.com](http://www.esri.com)

[www.intergraph.com](http://www.intergraph.com)
The Most Wanted List represents the NTSB's advocacy priorities. It is designed to increase awareness of, and support for, the most critical changes needed to reduce transportation accidents and save lives. Link for Most Wanted List Press Conference Video.
Evolution of GIS-TS

NASA

TOMTOM

Torrens, P.M.
Yucca Mountain - 1989
Evolution of GIS-TS applications ...

1998 GIS-ALAS

Basic analysis, data collection

1999 TraCS

User Interface Menu

Main Map Window

Coordinate Information
Evolution of GIS-TS applications ...

1999 Iowa Traffic Safety Data Service

Services, more sophisticated analysis

2001 High Crash Locations

Study Topics

1. Horizontal Curves
2. Four-lane, Rural Expressway Intersections
3. Fixed Objects
4. Head-on
5. Urban, Four-lane Undivided Corridors

Identify GIS segments proximate to "curve" crashes [ALAS]
Define Curves (bearing/alignment) [DQPS CL] [GIS Cartography] [Aerial Photos]
Join Crashes/Curves
Change Design
Field Personnel
Change Significance Tests/Causal Factors
Rank Locations (Freq, Ser, Rate)
Implement Mitigation

Derived from new horizontal curves GIS

1. Manual Definition
2. Change in bearing between road segments
2002 – Crash Mapping Analysis Tool/SAVER
2003 ERIS – Emergency Response Information System

Overlay data with free GIS on the ERIS CD

Emergency management agents and hazmat response areas

Carroll County - Demand vs. Capability
Today – usRAP – US Road Assessment Program

**Protocol 1. Risk Maps**

**Map 1 – Crash Density**
- Dark green (40% of roadway length) – lowest risk
- Green (25% of roadway length)
- Yellow (20% of roadway length)
- Red (10% of roadway length)
- Black (5% of roadway length) – highest risk

**Protocol 3. Star Ratings based on Road Protection Score**

**Protocol 2. Performance Tracking**

**Protocol 4. Safer Roads Investment Plans**

- RPS x traffic volume x calibration factor
- Deaths and serious injuries (before)
- Apply countermeasures → new RPS
- Deaths and serious injuries (after)
- Reduction in deaths and serious injuries and economic benefit
usRAP Kane County Illinois Safer Roads Investment Plan

MAP 2. Crash Rate (Fatal and Major Injury Crashes per 100M VMT)
Aggressive Driving Crashes

usRAP Kane County Illinois Predicted Casualty Savings Report

Kane County Illinois Fast Facts
- Population: 125,000
- GDP per Capita: $49,558
- Road Network: 403 miles
- Traffic Fatality: 70
TRB

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

About TRB  Annual Meeting  Calendar  Committees & Panels  Programs  Projects  Publications  Resources & Databases

Promoting Innovation and Progress in Transportation

Transportation practitioners, researchers, public officials, and other professionals need credible, high-quality information and research results to address the transportation challenges of the 21st century.

The Transportation Research Board engages professionals worldwide in a broad range of interdisciplinary, multimodal activities to lay the foundation for innovative transportation solutions. Join us!

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Browse Information By Mode

Aviation  Highway  Marine Transportation  Motor Carriers  Pedestrians and Bicyclists  Pipelines  Public Transportation  Rail
### Standing Committees

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<td>Task Force on Highway Safety Workforce Development</td>
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<td>Research on the Health and Wellness of Commercial Truck and Bus Drivers: A Conference</td>
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<td>Simulation and Measurement of Vehicle and Operator Performance</td>
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### Policy Study Committees

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<td>Committee for the Study of Traffic Safety Lessons from Benchmark Nations</td>
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<td>Committee for Review of the Federal Railroad Administration Research and Development Program</td>
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<td>B0110</td>
<td>Commercial Truck and Bus Safety Synthesis Program</td>
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<td>B0113</td>
<td>Committee for a Review of the En Route Air Traffic Control Complexity and Workload Model</td>
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<td>Committee on Offshore Oil and Gas Platform Inspection Program of the Minerals Management Service: A</td>
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<td>Transportation Safety IDEA Program Committee</td>
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# TRB Committees Related to Data and Information Technology

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<td>ABJ00</td>
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<td>ABJ10</td>
<td><strong>National Transportation Data Requirements and Programs</strong></td>
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<td>ABJ15T</td>
<td><strong>Task Force for the Using Census Data for Transportation Applications</strong></td>
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<td><strong>Statewide Transportation Data and Information Systems</strong></td>
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<td><strong>Task Force on the Traffic Monitoring Conferences</strong></td>
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<td><strong>Task Force on Understanding New Directions for the National</strong></td>
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<td>ABJ95</td>
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<td>**Committee for Access to International Transportation Research Information:</td>
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<td>A Conference</td>
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<td>AFB80</td>
<td><strong>Geospatial Data Acquisition Technologies in Design and Construction</strong></td>
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<td>B0114</td>
<td><strong>Committee on Strategies for Improved Passenger and Freight Travel Data</strong></td>
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<td><strong>TRB Long-Term Pavement Performance (LTPP) Committee</strong></td>
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<td>E1002-B</td>
<td><strong>Expert Task Group on LTPP Special Activities</strong></td>
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<td>E1002-C</td>
<td><strong>Expert Task Group on LTPP Traffic Data Collection and Analysis</strong></td>
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<td>E1003</td>
<td><strong>Data Analysis Working Group (DAWG)</strong></td>
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## Search results for "GIS"

13 matches were found.

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<td>Task Force on the Logistics of Disaster Response and Business Continuity</td>
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<td>AT099C</td>
<td>Committee for EU-U.S. Transportation Research Symposium No. 1: Urban Freight Transport-The Last Mile</td>
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<td>B0125</td>
<td>Committee for Operating in the Ocean Environment: A Workshop on Offshore Renewable Energy Development</td>
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<td>D0887</td>
<td>NCHRP Project Panel on Best Practices in GIS-Based Asset Management</td>
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<td>DA0411</td>
<td>ACRP Project Panel on Integrating GIS into Emergency Management at Airports</td>
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<tr>
<td>DF040</td>
<td>NCFRP Project Panel on Improving Export Freight Logistics</td>
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TRB GIS/Safety Key Committees (DRAFT)

- ABJ10 National Data
- ABJ20 Statewide Data
- ABJ30 Urban Data
- ABJ35 Traffic Monitoring
- ABJ40 Survey Methods
- ANB20 Safety Data, Analysis and Evaluation
- ABJ50 IT
- ABJ60 GIS (GISA)
- ABJ70 Artificial Intelligence
- ABJ80 Statistics
- ABJ90 Freight Data
- ABJ95 Visualization

Data
Passive Data Collection
Volunteer Geodata
Smart maps
Software, Systems, Hardware
Spatial statistics
Example of Volunteer Geodata
Challenges

GRT Corp

MANAGEMENT ISSUES:
1. Education - How to get top management to understand the magnitude of GIS without getting them turned off before the system is completed:
   a. Training for executives and managers
   b. Training for legislators
   c. Good definition of GIS
   d. Define benefits of GIS
   e. Define needs
   f. How will quality be maintained
2. Organization - What changes should be made to organizational structure related to GIS:
   a. GIS / DBA ?
   b. Where/Who should control
3. External Coordination:
   a. FNI-NA role
   b. Standards
   c. Reporting
   d. Goals - FNI-NA/State/Local
DATA NEEDS and DATA ACQUISITION ISSUES:
40 issues received were reviewed and analysis reduced issues to the following 5 major categories:
1. Data Standardization
2. Data Accuracy
3. Data Sharing - Federal, State, Local governments
4. Create interface among separate data bases (created at different scales, resolutions, etc.)
5. Optimize data collection and maintenance techniques

TECHNOLOGY ISSUES:
1. Technology Transfer:
   a. General information of what's going on in GIS
   b. Dialogue between DOT's and Vendor Community
2. Integration Issues:
   a. Multiple hardware platforms
   b. Integrating - CAD, Image, Spatial Data, Workstations, Mainframe, Non-Spatial Data

1989 A.D.
Some not-so “simple” questions
Where are the roads? (Incorrect or incomplete cartography)
Where are the roads? (Improving cartography)

Alignment moves

Alignment stays put
Where are the crashes?

- Crashes are not necessarily point events
- Some crashes may be located using different methods and degree of accuracy
  - Temporal (e.g., link node to lat long)
  - Spatial (e.g., state police v. local)
  - Techno (GPS v. smart map)
What’s “the” traffic volume on “the” road?

- Need traffic level for the year the crash happened
- Requires multiple files – in Iowa, working on going back past 1998 – difficult to do
- Was the road even there then? Is the road still there?
How to segment the road system?

• Requirements
  – Logical breaks (engineering and public)
  – Relationship to inventory data
  – Long enough for manageability and presentation
  – Short enough to reflect important changes
  – Clear and understandable to use

• Facility location and type
  – What is rural/urban? Character is important ...
What is an intersection crash?

Can use attributes and/or proximity...
Red: probable, Yellow: spatial @ 75’, Blue: possible + spatial
Some events, like birthdays, weddings, and graduations, are easy to mark on the calendar. Others, like the beginning of a social movement or a language—or the invention of GIS—are harder to pinpoint. However, the confluence of three pivotal events in 1962 and 1963 makes this as good a time as any to celebrate a half-century of GIS.

The first event was the establishment of the Canada Land Inventory (CLI) in 1962. CLI set out to produce about 1,500 maps of land use and land capabilities at 150,000 scales. Though the maps were drawn by hand, Tomlinson and his colleagues at the Laboratory for Computer Graphics at Harvard, by using computer mapping and charting, the evolution of computer mapping into GIS.

Whether we choose these milestones or others as the origins of GIS, the fact remains that GIS has come a long way, baby, in a relatively short period of time. Its impact extends far beyond the hundreds of thousands of GIS professionals at work around the world. The recent Penn State-Public Broadcasting video series Geospatial Revolution (geospatialrevolution.psu.edu) dramatizes the far-reaching impacts of GIS and related technologies on how we think, act, and interact. At its 50th anniversary, GIS has itself become a kind of movement and and federal resource policy and regional planning, will generate an estimated 30,000 map sheets, at various scales. The Inventory has currently produce 6000 map series, of which 200 have been prepared for computer input. The maps contain an average of 500 distinct areas in each sheet, and have been found to contain as many as 6000. Additionally, other types of maps covering waterbodies, climate, geology, administrative boundaries, and land titles are generated by other agencies.

The idea for a computer-based system, whereby map related data can be stored in a form suitable for rapid measurement and comparison, is apparent as soon as the magnitude of the problem is recognized. This, of course, is what GIS is all about. This, and the potential for enhanced decision making, is the reason mapping information is vital.

“A situation can be reached where the amount of data precludes its use.”

- Tomlinson, 1962

The first known published use of the term Geographic Inform August 1968.

For more information contact David Billings

Tomlinson, Roger

1962
Big data: Sensors

TranStar Traffic Uses Bluetooth for Real-Time Monitoring

by MATT BALL on AUGUST 22, 2011
Big Data: SHRP2

Charles Fey, TRB
Motorway crash closures to be cut by 3D laser scanners

New technology is to be employed to cut down the time that motorways are closed after crashes, the government says.

A £2.7m deal will allow 27 police forces across England to get 3D laser scanning technology.

This quickly makes a 3D image of the crash site, instead of investigators surveying multiple sections of a scene.

Roads Minister Mike Penning said the technology will benefit drivers "by reducing incident clear up times by 39 minutes on average".
wikipedia
Portion of First Railway in West Is Kept on University Grounds

Tracks of Old Lexington and Ohio Railroad Are Embedded in Concrete on Lawn in Front of Mechanical Hall; Dedication of Historical Monument Was Held on May 30, 1916

Unknown to a large number of students of the summer session there is a group a charter from the legislature for a railroad from Lexington to O. The work was started last summer.

1831 to 2012
Sometimes, the cure is worse that the disease …

NGAC Meeting Addresses Transportation and Laser Regulation

by MATT BALL on JUNE 20, 2011

The National Geospatial Advisory Committee (NGAC) met June 8-9, in Washington, D.C. On the agenda were discussions on transportation for the nation, Census address and road features and parcels, and parcel data on tribal lands. There was also concern about the impact on lidar mapping technologies from new Federal Aviation Administration regulations that ban the pointing of lasers at aircraft.
Challenges, or Opportunities?
Thank you

Accomplishments
• Technology
• Applications
• Innovation

Challenges
• Making sense of big data
• Supporting decisions
• Privacy
• Finance data programs
• Coordination