Geographic Information Systems (GIS)

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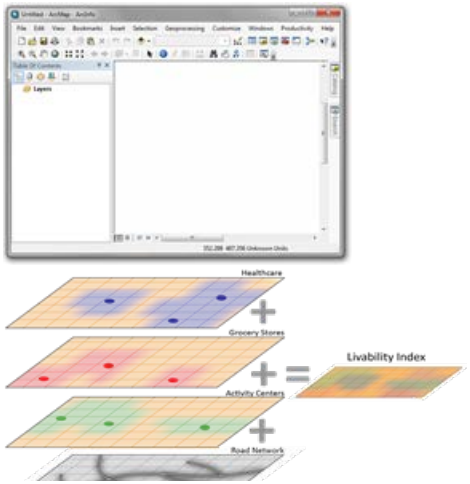

Photo: Courtesy of Neil Hetherington, WTI

Description: A Geographic Information System (GIS) is a computer-based tool that allows a user to visualize, analyze, interpret, and process data that has a geographic component to understand relationships, patterns, and trends. At its most basic use, GIS is a tool for cartography, but the real power of GIS is in its ability to integrate common database operations such as queries and locational and statistical analysis with visualization and geographic analysis offered by maps. GIS can be adapted to a wide array of transportation needs including decision support for planning and analysis, fleet management, route planning and analysis, trip planning, and real-time traffic monitoring.

Cloud-based GIS solutions (versus desktop) are a new trend. This allows for data access from anywhere via an internet connection, data capture in real time, real-time collaboration, improved efficiency/workflow as if can be done utilizing smartphones and tablets in the field, and ease of sharing data for public use. Cloud-based GIS solutions also tend to be less costly than the desktop versions.

Rural Transportation Critical Needs

- ☐ Crash Countermeasures
- ☑ Emergency Services
- ☑ Operations & Maintenance
- ☑ Rural Transit & Mobility
- ☐ Surface Transportation & Weather
- ☐ Tourism & Travel Information
- ☑ Traffic Management

Issues Addressed

- ☑ Congestion and Delays
- ☐ Inefficient Signal Operations
- ☐ Parking Challenges
- ☐ Vehicle Detection
- ☐ Road Closures
- ☐ Travel Time
- ☐ Speed
- ☑ Alternate Routes
- ☑ Dynamic Traffic Control/Operations
- ☐ Special Event Management
- ☑ Inefficient Use of Road Network

Strategies Achieved

- ☐ Road User
- ☐ Road
- ☐ Vehicle
- ☐ Safety Culture
- ☑ Engineering
- ☑ Emergency Response
- ☐ Enforcement
- ☑ Education

Applicability	Partnerships	Key Components
•GIS can be used in a wide variety of engineering applications, including mapping resources, cost benefit analysis, and transit planning. In order to reduce costs, free or open source software options are available for an agency to use.	•Applications benefit from collaboration among numerous agencies, which may include: •Departments of Transportation (Federal, State, Local) •State and Local Government •Metropolitan/Rural Planning Organizations •Transit Agencies •Emergency Services	•Computer/tablet/smartphone •Handheld Receiver •Software – ArcMap, QGIS, etc. •Data – Raster and Vector Data •Trained Personnel

Examples of Implementation

- **GIS Mapping to Match Workers with Transit and Jobs (Maryland)**

St. Mary's County in rural Maryland used GIS to connect people to jobs and make stable work available to welfare recipients. The St. Mary's County Department of Social Services (DSS) partnered with KFH Group to use GIS mapping to view where jobs were in comparison to where people lived and to available transit services. Through the creation of these maps St. Mary's County could identify where transit services should be expanded in order to serve the needs of welfare recipients and facilitate their access to jobs.

- **Alabama Department of Transportation (ALDOT), Rural Transit Asset Management System**

ALDOT created an interactive GIS based asset management system to manage its vehicles. A GIS database was created for over 1,900 vehicles that were being operated within the state that were purchased with Section 5310/5311 funds. This GIS database allowed users to access the information in a way that allowed advanced statistical analysis using spatial characteristics. A prediction model was created to determine future needs and fleet quality.

- **Effects of Roadway Characteristics on Farm Equipment Crashes: A GIS Approach**

The University of Iowa looked at the effects that roadway characteristics like traffic density, speed limit, road type, surface type, road width, and shoulder width had on farm equipment traveling on public roads. Crash data from the Iowa Department of Transportation was merged with Iowa roadway data using GIS. Through the use of GIS, both statistical and spatial analysis was conducted to determine the roadway characteristics that were commonly associated with farm equipment collisions.

- **Delaware Valley Regional Planning Commission, GIS Incorporated Safety Assessment**

The Delaware Valley Regional Planning Commission is used GIS-based safety analysis to improve the transportation planning process and provide data-driven safety decision making, for example GIS has provided a visual way to identify and prioritize high-crash locations.

- **Idaho Transportation Department's (ITD) IPLAN platform**

ITD created a cloud-based, public platform called IPLAN to allow access to ITD's GIS datasets in a user-friendly web browser. The goal is for IPLAN to enhance the planning process, improve coordination amongst their districts and the public, and support the goals of FHWA's Every Day Counts (EDC) initiative.

Implementation Considerations (Pro)	Implementation Considerations (Con)
•Improves communication capabilities. •Can make data visually understandable to people with a range of backgrounds. •Improves analysis tools for prioritizing funding for specific areas. •Facilitates coordinated fleet management. •Can be used for a wide array of purposes. •Provides real-time information. •Open source software options are available (Quantum GIS or QGIS, GRASS GIS). •Allows for mobile data collection by maintenance personnel – eliminating the need for paper reports.	•Requires trained personnel. •Data tends to be in silos. •Varying data standards exist. •Requires large amounts of data.

Opportunities for Future Expansion

- GIS can be combined with automatic vehicle location (AVL) to visually track vehicles, plan their routes, and signal an alert if drivers go off of schedule. GIS can also be integrated into 911 for address verification and incident mapping.

Additional Resources

- *ESRI*, found here: http://www.esri.com/
- *GISCorp Free and Open Source GIS Software*, found here: http://www.giscorps.org/index.php?option=com_content&task=view&id=13&Itemid=48
- Federal Highway Administration's (FHWA), *GIS in Transportation*, found here: https://www.gis.fhwa.dot.gov/default.asp
- Federal Highway Administration's (FHWA), *Uses of Cloud Technologies for Geospatial Applications: Case Studies of Select Transportation Agencies*, found here: https://www.gis.fhwa.dot.gov/documents/Cloud_Technologies_for_GIS.htm

Useful Tips

There are free and open source GIS software options available. For options, click here. Also, moving to a cloud-based GIS system allows for ease of sharing your data publicly, allowing others to create new web and mobile applications using this data.

Cost Range

(Cost/financial information, where noted, is based on 2016 dollars (unless otherwise specified). Cost/financial information is estimated, and will vary based on size and scope of project, number of units, etc. In general, capital costs include initial purchase costs of hardware, software, and other required equipment. Maintenance and operations costs include staff time to operate, monitor and maintain systems; data collection; system upgrades; evaluation; etc.)

Capital Costs: The total capital costs for this tool are low (less than $50,000). The cost to purchase a perpetual license for ESRI's ArcMap ranges from $1,000 for the basic version of the software to $7,000 for the standard version. An annual license can be purchased for $800 (basic) to $3,000 (standard). There are also free and open source software options available.

Operations Costs: The operations and maintenance costs for this tool are anticipated to be low (less than $50,000). There will be a need to maintain the GIS data, purchase a license, and keep staff trained to use the program.

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