GIS IN TRANSPORTATION

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U.S. Department of Transportation Federal Highway Administration

A GIS Tool For All

Article by Andrew Breck, Environmental Protection Specialist, U.S. DOT Volpe National Transportation Systems Center

The next time someone asks you for a map, what if you could give them a tool instead?

Upcoming Events

GIS and Emergency Response Peer Exchange
September, 2019

A team at the U.S. DOT Volpe Center used Tableau software to create TransportSE, a prototype geospatial tool to help transportation agencies and partners integrate social equity considerations into transportation planning and operations. Social equity in transportation refers to the fair and equitable distribution of public services associated with implementation of transportation projects and public policy. The prototype is available to the public free of charge. For a faster experience, click "download workbook" at the upper right corner of the screen; then download and install the free reader to open the file.

Background

Transportation agencies and partners seek to analyze demographic information alongside transportation data to ensure that all residents have reliable, safe, and affordable ways to reach jobs, education, and other essential services.

However, not everyone has the same access to geospatial tools to inform these analyses. Small agencies and advocacy groups may lack sophisticated GIS expertise. Even within larger agencies, the expertise is often concentrated within the GIS department; other agency staff may have little ability to use mapping tools themselves and have to rely on GIS experts who often simply provide static outputs, such as maps. What if the experts could also empower them with interactive tools?

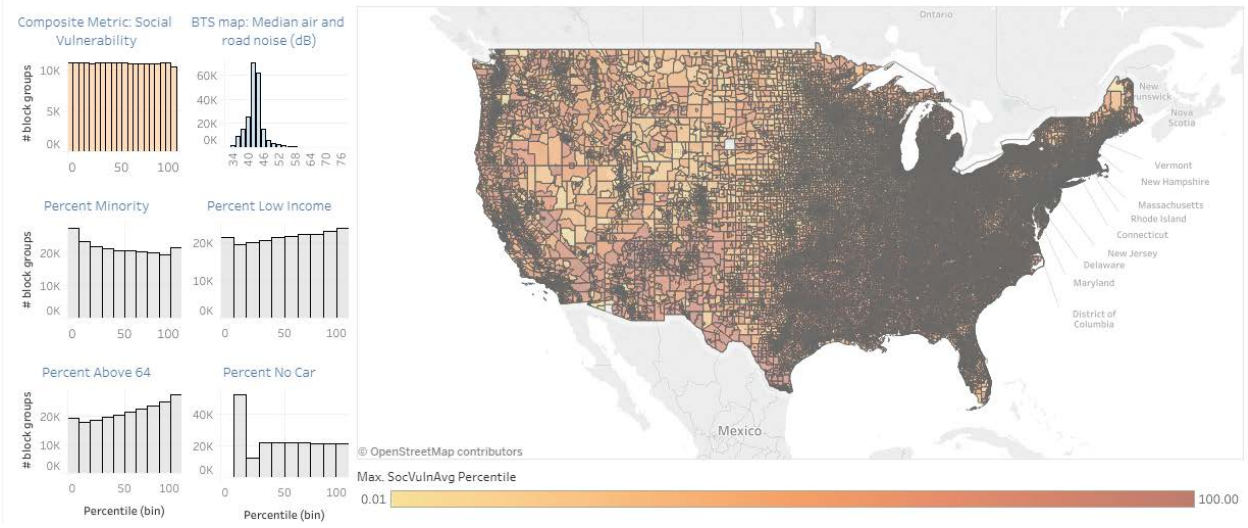

Figure 1. Illustration. Screenshot from TransportSE prototype.

TransportSE demonstrates how a geospatial tool can provide even novice users with the ability to easily interact with data. It generates a color-coded map that shows how different census block groups compare to one another on several key variables that indicate vulnerability. TransportSE calculates a composite vulnerability metric for each block group that combines the individual indicator variables into one simple score. Composite metrics can be a powerful way to make sense of multiple variables, but a common limitation is that the output may seem opaque; a composite score never tells the whole story. TransportSE addresses this by giving the user the ability to dig into the data, understanding and visualizing the drivers of the composite score for a block group or region.

TransportSE is a flexible platform that can be adapted to specific user needs by changing the geographic coverage, modifying the indicator variables, and weighting the indicators differently for the composite score. The current prototype includes data processed from the National Transportation Noise Map, as well as various demographic variables from the U.S. Census.

If you are interested in adapting this framework for your use, or to share ideas or learn more, contact peter.herzig@dot.gov.

Using GIS to Examine Social Equity Impacts in Transportation Systems

Editorial by Alex Karner, PhD, The University of Texas at Austin

*Our first guest editorial writer is **Alex Karner, PhD, an assistant professor of community and regional planning at The University of Texas at Austin. His research addresses questions of justice and fairness in transportation planning.***

GIS can be a powerful tool for assessing how transportation system changes will affect different demographic groups. But different data sources and analytical approaches can provide different answers to the same questions. For this reason, multiple perspectives must be assessed simultaneously to determine what the true social equity impacts are likely to be.

Two examples are instructive. The first involves the common task of identifying “environmental justice” (EJ) communities or communities of concern. Agencies routinely use multiple overlapping indicators of disadvantage to create a single composite measure to identify places for inclusion. But composite indicators by their very nature obscure the conditions faced by individual groups. They also equate places with people. Any identification approach using spatial units will miss the fact that not all members of a protected group live in identified areas of concern. Employing different community definitions or calculating population-weighted means for groups of concern can be helpful alternative approaches.

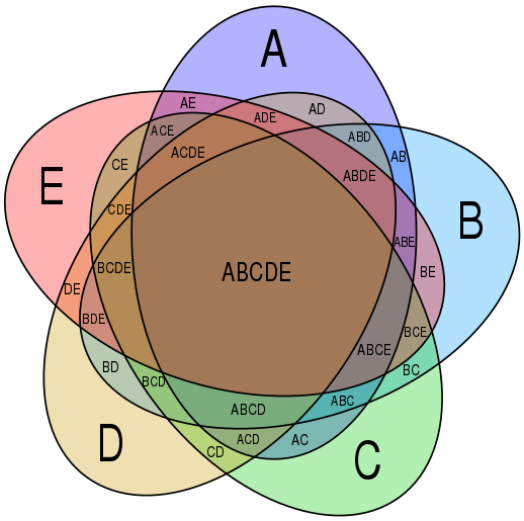

Figure 2. Illustration. Diagram depicting many sets of overlapping traits.[i]

The second example relates to data. Public transit agencies assess the equity impacts of service changes using either census information or ridership data gleaned from an on-board survey of transit riders. Available evidence suggests that the two data sources can result in different equity-related conclusions, yet both are widely accepted for use. An agency could conceivably conduct an analysis using one dataset or the other to generate the result that they desire.

Because of the limitations associated with any single transportation equity analysis, GIS analysts must become much more critical about data and methods. In general, analyses that use multiple indicators and approaches to triangulate information on equity issues, conditions, and, impacts are preferable to those that give a single yes/no answer on equity questions.

Equity Analysis and TIP Creation from the MPO Perspective

Editorial by Joseph Mueller, Senior Transportation Planner, St. Cloud APO

Our second guest editorial writer, Joseph Mueller, works for the St. Cloud APO in Minnesota. His job as senior transportation planner includes specialized work in GIS, and he brings experience from the U.S. Geological Survey, the U.S. Army Corps of Engineers, as well as the City of Minneapolis to his daily work.

Central Minnesota's St. Cloud Area Planning Organization (APO) is a federally designated metropolitan planning organization (MPO). Every year, the APO works with its member jurisdictions and the Minnesota Department of Transportation to develop its Transportation Improvement Program (TIP), a four-year program of surface transportation projects that are considered to be either regionally significant or are programmed to receive Federal funds. Use of GIS in the TIP process has grown to include social equity and demographic information, to help plan for a more inclusive transportation system and ensure equity of resource and risk distribution.

To ensure projects are not having a disproportionately adverse impact on vulnerable populations, the APO utilizes GIS in conjunction with census data and adds an overlay of local projects. As part of this analysis, the APO calculates the concentration threshold for different demographic values using block-group census data. The resulting data is mapped, with the proposed projects overlaid (see below). The APO's analyses are reviewed by our Technical Advisory Committee (TAC), which comprises local jurisdiction civil engineers and urban planners. Once reviewed and accepted by the TAC, the maps are then incorporated into our TIP.

The APO has learned that GIS is a valuable asset for demographic analysis in the TIP and other planning efforts. Multiple demographic factors (age, race, income, access to a vehicle, etc.) need to be examined for the APO to accurately view our community, examine impacts in more depth, and prepare better plans.

Moving forward, the APO is now using this method when updating the long-range Metropolitan Transportation Plan. GIS is also used with census data to view other impacts transportation may have on our population, such as public health mapping (i.e., diabetes, obesity, and heart disease rates in relation to multimodal projects) and protected natural environment concerns. By looking deeper into the data with GIS, the APO finds better options, and can evaluate the possible positive and negative impacts that may result from planned projects.

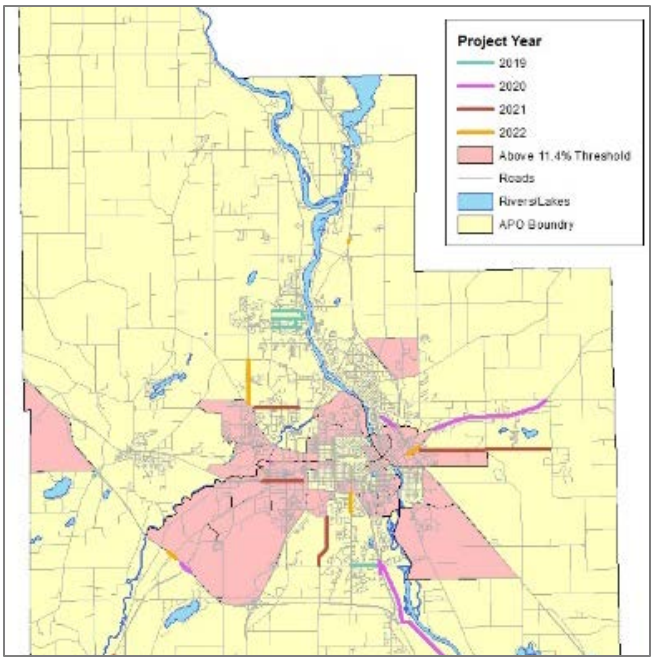

Figure 3. TIP projects (2019-2022) by percent (%) of minority population by block group. (Map produced by Joseph Mueller, St. Cloud APO).

Other News

Reports Available

Data Governance & Data Management: Case Studies of Select Transportation Agencies

This new case study report explores how State Departments of Transportation (DOTs) currently define and apply data governance and data management concepts. Four State DOTs were interviewed for this effort (Arizona, Arkansas, Ohio, and Texas) to ascertain the current and planned levels of implementation, and to obtain feedback on what the Federal Highway Administration (FHWA) can do to facilitate the development of these processes.

Geospatial Information System Capability Maturity Models: Case Studies of Select Transportation Agencies

A new case study report highlighting four State DOTs and how they use the URISA Capability Maturity Model to assess their organizational maturity is now available on the Federal Highway Administration website.

Past Events

On January 9th, the Geospatial Online Transportation User Group (GOTUG) hosted a webinar on GIS and Capability Maturity Models (CMM). Mark Sarmiento of the FHWA presented on the results of recent peer exchanges and case study reports focused on CMMs and their use by several State DOTs. He provided background on CMMs and summarized the benefits, challenges, and observations of the State DOTs that tried them. To view the webinar archive for GOTUG and sign up for the email list, please visit their website.

Coming Soon

Peer Exchange on Enterprise Data Systems
In November, Washington DOT hosted a peer exchange organized by FHWA's offices of Transportation Safety and GIS in Transportation Program. The exchange focused on ways to create enterprise data systems within State DOTs, with a focus on data integrity, the outcomes of data systems, and practical steps to creating enterprise GIS for an agency. A summary of this peer exchange will be made available.

For more information about this newsletter, please contact Mark Sarmiento, FHWA Office of Planning, at Mark.Sarmiento@dot.gov.

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[i] https://en.m.wikipedia.org/wiki/File:Symmetrical_5-set_Venn_diagram.svg