

DIVISION HIGHLIGHTS: TRANSPORTATION PLANNING AND INFORMATION SYSTEMS

TRANSPORTATION PLANNING AND GIS

Sponsors: Federal Highway Administration, Iowa Department of Transportation

Note: The Federal Highway Administration and the Iowa Department of Transportation do not endorse any products or manufacturers. Trade and manufacturers' names appear in this article only because they are essential to a discussion of the project.

Planning: Background

Urban planners have long been using computerized transportation planning models to help them make decisions regarding transportation investments. Transportation modeling software helps planners forecast an urban area's future transportation needs (e.g., as a result of anticipated population growth or the arrival of a new business or shopping mall) and analyze alternative transportation scenarios (e.g., building either a two-lane or four-lane roadway through a particular neighborhood).

In recent years many transportation agencies have also begun to use geographic information systems (GIS) to graphically display roadway inventories and other data on maps. However, despite several studies suggesting GIS's potential usefulness for transportation forecasting and scenario analysis, most urban transportation agencies are not reaping the benefits of *integrating* GIS with their transportation planning modeling environments.

A few commercial products do incorporate both transportation modeling and GIS capabilities. TransCAD (Caliper Corpora-

tion) and UFOSNET (RST International Inc.) are GISs that contain transportation forecasting procedures. The developers of Tranplan and QRSII, two popular modeling programs, are currently beta testing or releasing GIS-capable interfaces. But most transportation agencies continue to use their stand-alone modeling packages and GIS packages independently of each other because of the significant investment already made in the separate technologies, both in initial cost and in training time and expense.

In (year) CTRE, in a project for the Iowa Department of Transportation (Iowa DOT), developed a user-friendly Windows program that integrates a transportation modeling program (Tranplan) with a desktop GIS package (MapInfo). The goal was to develop a simple program that would allow the department to use technologies it already had to reap the full benefits of GIS-based transportation modeling. The project was successful, and CTRE and the Iowa DOT believed the results were worth sharing with other Iowa transportation agencies.

Through its Priority Technology Program, the Federal Highway Administration (FHWA) then funded another project in which CTRE (1) extended the work to include additional GIS packages and (2) field-tested one integrated package in four Iowa urban agencies. With small urban areas as its primary audience, this project focused on keeping costs low and the learning curve short.

Planning: Developing Four Integrated Environments

CTRE's goal was to assist the largest number

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of potential users in the short run. The project team selected Tranplan, used by five of Iowa's eight metropolitan planning organizations (MPOs), as the modeling environment for the project, and the four most widely used desktop GIS packages (according to the 1997 GeoDirectory of Products and Services)—ArcView (ERSI), AtlasGIS (ERSI), MapInfo (MapInfo Corp.), and Maptitude (Caliper Corp.).

The end result was four separate products, or integrated environment interfaces: Tranplan/ArcView, Tranplan/AtlasGIS, Tranplan/MapInfo, and Tranplan/Mapitude. (The software versions tested with the interfaces were Tranplan 8.0 for Windows, ArcView 2.1a, AtlasGIS 3.03, MapInfo Professional 4.1, and Maptitude 3.0c.) The capabilities of the four interfaces could be extended to other modeling environments and GISs as well. All four interfaces operate on desktop personal computers with a minimum 486 processor, 66 megahertz, and 8 megabytes (MB) of RAM. Their operational characteristics were assessed and compared using a Pentium Pro operating at 150 megahertz with 16 MB of RAM and running Windows 95.

Each interface operates from within the appropriate GIS software. To develop each interface, CTRE staff first imported the Tranplan traffic network into the GIS environment. Then it was possible to modify the network, perform a Tranplan model run, determine traffic volumes for Tranplan links (or roadways) using sample network data, and incorporate the values into the GIS as new "link (roadway) attributes." In addition, capabilities for the integrated

environments were developed: turning movement diagrams and visualization plots; network infrastructure modifications and displays of the modifications' effects on traffic volume; and alternative scenarios.

Turning movement diagrams with directional arrows to display traffic turns can be created in all the GIS interfaces.

Visualization plots display links (roadways) labeled and buffered by traffic volume. Buffering refers to a visual representation of quantity (e.g., displaying proportionally thicker lines for heavier traffic). Buffers are developed through "themes" in AtlasGIS and through "dialog boxes" in MapInfo and Maptitude. ArcView cannot buffer elements, but several line styles and widths can be used to develop effectively buffered plots.

Network comparisons involve analyzing the effect of modifications to transportation infrastructure (e.g., enlarging a roadway from two lanes to four, or adding a new roadway where none previously existed) on traffic volume on roadways within a transportation network. The links on the resulting GIS displays are buffered and labeled according to the changes in traffic volume.

Tranplan's tools for **graphic scenario development** (the HNIS module) were imitated in each GIS environment. All four GIS environments can incorporate additional data sets—e.g., CAD (computer-aided design) files, aerial photographs, and TIGER (the Census Bureau's Topologically Integrated Geographic Encoding and Referencing) line work—to enhance the background display.

The four GIS interfaces function satisfactorily in each of the areas tested. Differences in time to perform these functions result, in part, from differences in the level of development of each environment. CTRE

hopes to improve all the environments, automating as many functions as possible.

Planning: Field Tests

CTRE conducted a six-month beta test of one interface (Tranplan/MapInfo) at three Iowa MPOs and one city traffic engineering department. These metropolitan areas range in population from 50,000 to 400,000, and each office was already using Tranplan (and some were also using MapInfo) prior to the test.

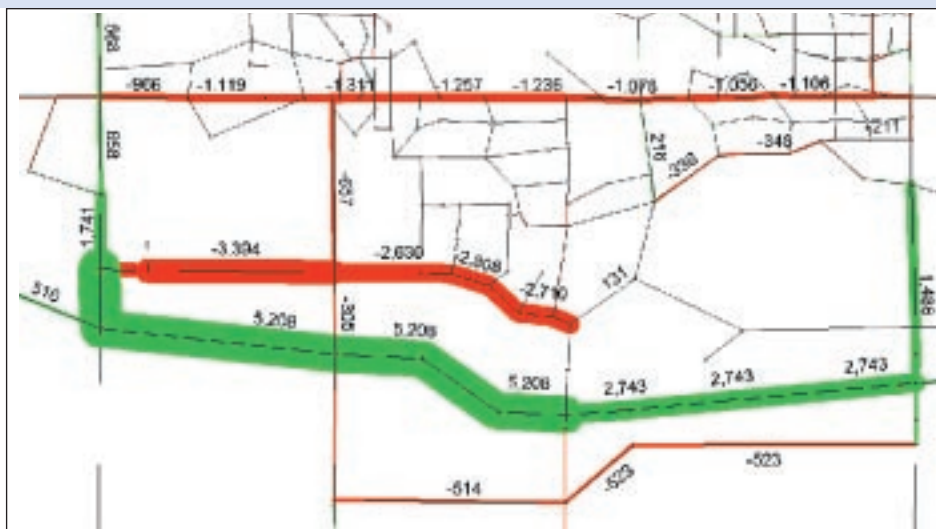
Overall response from the test sites was favorable. The graphical display of transportation models was "sharp, easy to read" and "presentation quality." One evaluator commented that the maps "not only grab the attention of policy makers and the public, but also illustrate useful traffic information and future transportation needs." While several evaluators found MapInfo's ability to zoom in, add text, and customize titles and labels to be a definite advantage, one agency found Tranplan alone to be superior in at least one aspect: ensuring that labels do not overlap.

Validation of the accuracy of visualization plotting in Tranplan involves double checking link by link. Testers of the beta version of Tranplan/MapInfo found the automatic color coding and labeling of percent traffic differences more efficient than Tranplan alone, offering the potential to save several hours validating new or updated models.

Two agencies found the ability to develop and display turning diagrams in Tranplan/MapInfo to be particularly useful; one agency cited requests from developers and city planners for such diagrams. Tranplan alone lacks such a mechanism. And users were pleased



Network Visualization



Advanced Buffering and Labeling

Scenario Analysis



Turning Movement Counts

with the interface's ability to develop graphics to support potential modifications in infrastructure.

The learning curve proved short, although users who had previous experience with Tranplan but not with MapInfo found the GIS interface a bit cumbersome to learn. Users with GIS experience generally preferred the Tranplan/MapInfo environment to Tranplan alone.

Planning: Improvements

The four interfaces developed are not problem free, but weaknesses have been

addressed and the interfaces modified according to the suggestions of the beta testers. These modifications include:

- removing common file management errors
- automating selected analytical calculations
- modifying formatting programs to automatically manage differences in network structures (e.g., the format of an agency's Tranplan network files are different from the format required by Tranplan/MapInfo)
- increasing the capability to customize

Field testers of the integrated GIS/Tranplan environment liked its sharp, easy-to-read maps and graphic displays that allow quick illustration of the effects of changes in the roadway system. The environment "expedites the plotting procedure (and) enhances the quality of output," reported the Quad City, Iowa, metropolitan planning organization.

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visualization plots and turning movement diagrams and adding dialog boxes that display customizing options

Planning: Shareware

Completed versions of the four interfaces developed by CTRE, along with documentation and the full project report, are available for downloading at CTRE's World Wide Web site: <http://www.ctre.iastate.edu/fhwa/>

The GIS interfaces have been structured to allow you to import your Tranplan traffic network, modify the network, perform model runs, determine traffic volumes for Tranplan links, and incorporate the values into the GIS as new link attributes. The interfaces also include special programs for developing turning movement diagrams and visualization plots; incorporating modifications to network infrastructure and displaying the modifications' effects on traffic volume; and developing alternative scenarios. The interfaces also include sample data for the City of Ames transportation network to use in experimenting with the capabilities of the interface.

Agencies without Internet access can receive the programs by contacting Michael Anderson at CTRE, 515-294-8103 (e-mail: mikea@ctre.iastate.edu). Information about the project is available from Anderson or from Becky Hiatt, Iowa Division, FHWA, 515-233-7321. **end**

CTRE and the Iowa Department of Transportation are planning their second biennial transportation research conference to be held May 14–15, 1998 in Ames, Iowa. This event will provide an opportunity for midwestern transportation professional who may not regularly attend national events like the annual Transportation Research Board conference to attend a high-level research conference .

Readers of *CTRE en route* will have the opportunity to participate. In a few weeks you will receive a flier inviting you to submit an abstract of a formal presentation to be made during the conference. Abstracts describing both basic and applied research projects in transportation will be solicited. Although the majority of conference attendees will be from the Midwest, we welcome presenters from all parts of the country.

The conference will cover a broad spectrum of transportation issues, ranging from infrastructure design to transportation policy. Papers covering any of the transportation modes are welcome. Possible topic categories include the following:

- transportation planning
- safety and traffic engineering
- commercial transportation
- transportation policy
- advanced transportation technologies
- transportation systems management
- passenger transportation
- transportation infrastructure

Abstracts will be reviewed by a committee of transportation professionals through a confidential review process. Authors of abstracts selected for presentation at the conference will then be invited to submit a brief paper on the topic of their presentation; the papers will be included in the conference proceedings. **end**