DIVISION HIGHLIGHTS: TRANSPORTATION PLANNING AND INFORMATION SYSTEMS

MAPPING HIGHWAY CRASHES

Sponsor: Iowa Department of Transportation

Mapping: Background

Personal injuries, fatalities, and property damage from highway accidents are estimated to cost Americans billions of dollars a year in medical bills, repairs, and lost income; the emotional costs are, of course, beyond measure. A useful tool of highway agencies in the campaign to make roadways safer is an accident location and analysis system, a database query tool that provides a method for storing and analyzing information about accidents and, particularly, for identifying and analyzing high-accident locations and situations.

The Iowa Department of Transportation (Iowa DOT) has developed one of the best computerized accident location and analysis systems in the country, PC-ALAS. PC-ALAS is used by transportation agencies throughout Iowa—cities, counties, metropolitan planning organizations, and regional planning affiliations.

PC-ALAS is more portable than its mainframe predecessors and, with its pull-down menus, more user friendly. Searches (queries, inputs) can be narrowly defined. For example, users can query for accidents of specific types or at certain times or by drivers with certain characteristics. The results (outputs, statistics) can be viewed on the screen, saved to a file, or printed using predefined formats.

Still, PC-ALAS can be improved. Locations in the program are designated by node numbers; the actual locations must be identified by matching the numbers with location descriptions on cumbersome node tables or paper/CAD maps. Also, PC-ALAS is a text-based program. Users cannot see on-screen maps of accident sites or click on location nodes for more information. PC-ALAS could be improved by incorporating significant recent developments in the graphic display and query capabilities of geographic information systems (GIS).

Other ongoing projects at the Iowa DOT and elsewhere in the state are relevant to, and could be coordinated with, the department's accident location and analysis efforts. These projects include

- developing a program for assessing the potential benefits of safety improvements to roadways
- using software to develop collision diagrams for intersections or short sections of roadway
- analyzing the relationship of accidents to roadside features like guardrails
- developing statewide transportation management systems, especially safety and intermodal systems, but also maintenance, pavement, bridge, and congestion management systems
- automating reporting methods of law enforcement officers (e.g., the Mobile Accident Reporting System (MARS) being implemented across Iowa for accident reporting and accident data interfacing, which is pioneering the application of global positioning systems (GPS) and GIS technologies for such systems)

CONTINUED ON PAGE 6

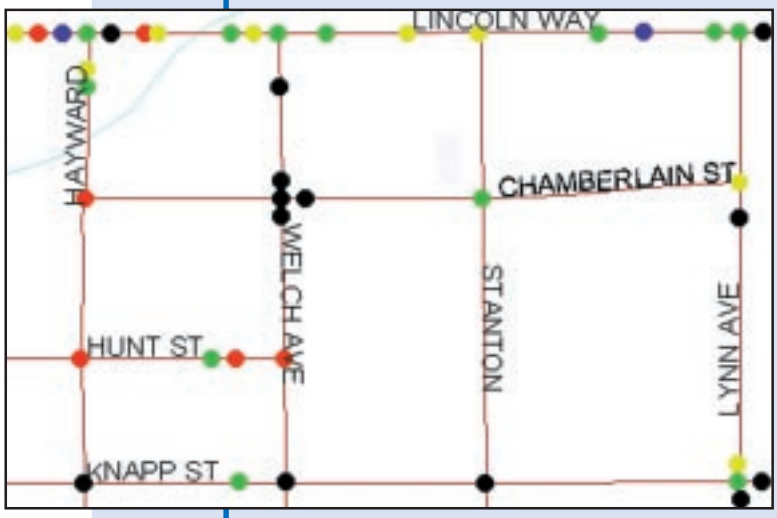
CONTINUED FROM PAGE 5

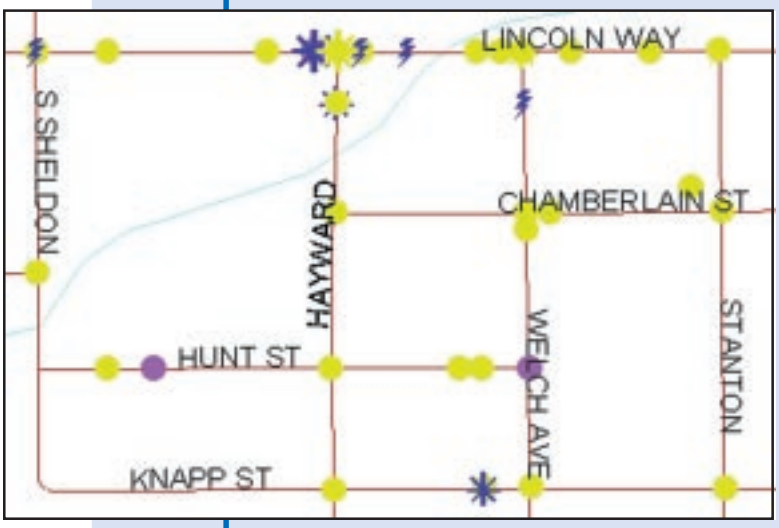
To enhance PC-ALAS's capabilities for the Iowa DOT, while making it compatible with related efforts in Iowa, CTRE is developing a GIS-based accident location and analysis system: GIS-ALAS.

Mapping: GIS Design

In addition to enhancing PC-ALAS, the new GIS-ALAS must satisfy other design requirements:

- Maintainability. The system must be easily updated to accommodate new and improved data and cartography and easily adjusted for changes in the format of the accident database.
- Compatibility. The system must have import/export options that are compatible with other systems (as described above) and interact with external programming languages (C, Java, etc.).
- Enhanced logical query capabilities. Users must be able to use standard queries or define their own queries based on any field(s) in the database.
- Spatial query capabilities. Users must be able to query by actual accident locations, while retaining the ability to use the old node system to reference non-accident information like roadside features.
- Maps and accident diagrams. The system must provide diagrams of specific accidents, maps of accidents in a given city or county, pie diagrams of accidents at nodes (e.g., by cause, number of vehicles, etc.), and intersection maps.
- Accessibility. The system must be accessible statewide; ideally, data will be accessible via the World Wide Web, queries will be possible via an interactive Web session, and the data and program will be accessible via CD-ROM.
- Performance. The system must respond quickly and efficiently to a large volume of simultaneous requests.
- User friendliness. The program must have a short, stress-free learning curve.
- Report generation. Users must be able to select predefined report formats or define their own.





GIS-ALAS displays query results graphically. Top: Result of a query showing accident locations color-coded by time of day. Bottom: Result of a query showing roadway surface conditions (icy/snowy, wet, or dry) at various accident locations.

Mapping: Progress to Date

The first phase of the project—developing a system that reproduces the functions of PC-ALAS and incorporates graphic display and query capabilities—is completed.

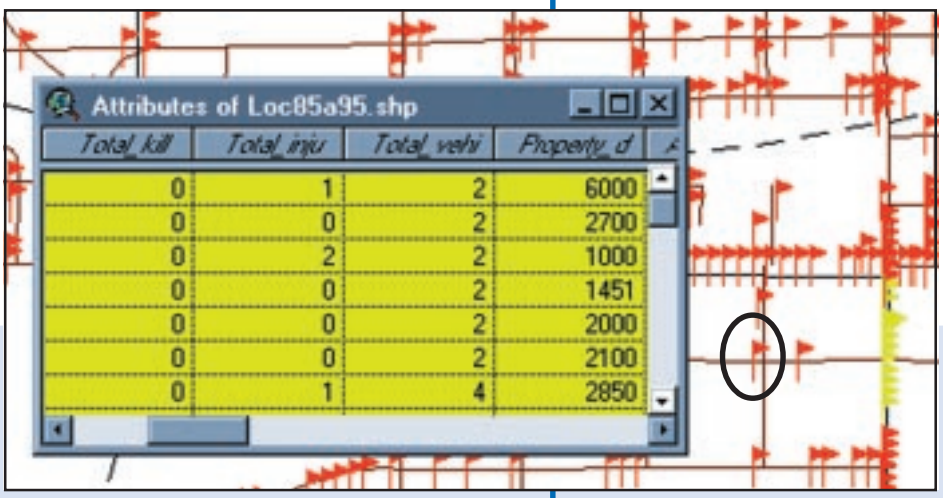
The project team selected and evaluated three GIS software packages—MapInfo, ArcView, and Maptitude. Accident reference node cartography for Dallas County, Iowa, was imported into the GIS packages, along with five years of ALAS location and attribute data. (The conversion process for the entire state of Iowa takes about one week.) If the Iowa DOT's cartography is enhanced in the future (e.g., the nodes realigned to more accurate locations), the process can easily be repeated to update the accident locations.

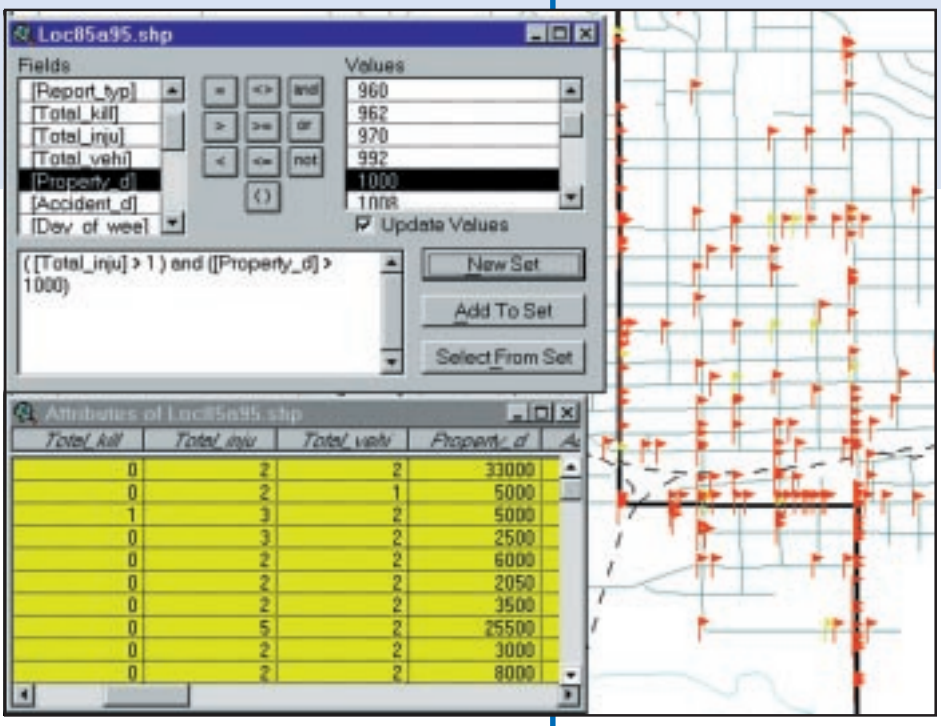
Each of the resulting GIS-ALAS systems provides an immediate enhancement to PC-ALAS: users can see accident sites on a map. With a click of a mouse on a location, users have access to more detailed information. Each system also provides a potential tool for finding discrepancies, such as missing roads in the cartography of recently developed areas, or incorrect coding in the accident file. Such discrepancies might display, for example, an accident where there is no roadway in the GIS system.

The three software packages were evaluated according to their capacity to fulfill the requirements listed above (accessibility, user friendliness, etc.). ArcView was selected for further development. ArcView GIS-ALAS was then customized to mimic the query functions of PC-ALAS while providing robust GIS capabilities like mapping and spatial queries.

CONTINUED ON PAGE 8

GIS-ALAS contains several layers of information.
Top: Information for crash locations selected on a map can be displayed in tabular form.
Bottom: Results of a database query can be shown in both tabular form and graphically.





CONTINUED FROM PAGE 7

ArcView GIS-ALAS is being designed to work with a commercial collision diagram software already selected for use by the Iowa DOT through another CTRE-managed project. Care was taken to avoid inefficient file structures, duplicate and orphan databases, etc., because ultimately the GIS-ALAS may be integrated with MARS and other law enforcement applications, as well as other safety and engineering applications outside the current scope of ALAS. Throughout the programming process, compatibility with the World Wide Web has been considered.

CTRE has also developed a freeware version of the system, Explorer ALAS. This system allows users to simultaneously view crash data and background layers of information but does not have the mapping and spatial query functions of the ArcView-based system.

Mapping: Current Efforts

The second and third phases of this project will address many issues.

A usability study is being conducted to evaluate the GIS-ALAS menus and toolbars, query and report options, and online documentation and to test for bugs or potential technical problems. After improvements suggested by the usability study have been incorporated, both the ArcView and Explorer versions will be distributed to transportation agencies throughout Iowa via CD-ROM and via secure World Wide Web access.

Using Black Hawk County as a pilot area, the research team is working with the University of Northern Iowa to experiment with incorporating additional kinds of information: road features, health care facilities, geographic borders (e.g., counties, census tracts), emergency response service districts, highway/rail grade crossings, aerial photos/digital ortho quads/digital elevation models, and maintenance and emergency facilities.

The team will also develop a two-way conversion process between node-specified locations and latitude/longitude addresses, as well as links to weather and other real-time information. Questions will be considered regarding security and proprietary information, providing outputs for service jurisdictions, classifying accidents by type of intersection and/or turning movements, and analyzing the relationships of various factors (traffic volume, road and weather conditions, lighting, etc.) in causing accidents.

VisualBasic and MapObjects are being explored to see if a fully functional, freeware GIS-ALAS can be developed. In addition, the data from ArcView GIS-ALAS will be ported to GeoMedia, which is compatible with the Iowa DOT's enterprise GIS implementation strategy.

System distribution and training is beginning across the state of Iowa. For more information, contact Tim Strauss, transportation research specialist, 515-294-8103, strauss@ctre.iastate.edu. end