Framework for Integrated Spatially-Referenced Driver-Crash Databases

tech transfer summary

Integrating various transportation safety-related databases can help improve the analysis of transportation safety issues.

Objective

This project was designed to evaluate the potential benefits and limitations of integrating transportation safety-related databases in a spatially-referenced geographic information systems (GIS) environment. The project focus was the analysis of crash records and driver records.

Problem Statement

Information on crashes and crash characteristics is collected using various methods, for various purposes, and across several separately developed and managed databases. As a result, key relationships spanning different databases may go undiscovered, and transportation safety analyses may not be sufficiently comprehensive and informative. Moreover, many database attributes, such as crash locations, vehicle owner addresses, and medical facility locations, can be more useful if the data are spatially referenced. Linking the spatially-referenced data among several transportation safety-related databases can ultimately improve the analysis of transportation safety issues.

Integrated Safety-Related Databases

The National Highway Traffic Safety Administration (NHTSA) outlines six database types that are related to motor vehicle crashes and that are typically included in transportation safety information systems:

Six database types typically included in transportation safety information systems

Database Type	Data Attributes
Crash information	Crash time/location, drivers involved, vehicles involved, injuries, crash circumstances
Driver information	Name, address, date of birth, license number, driving restrictions, traffic violations, previous crashes, etc.
Vehicle information	Vehicle ownership, registration, make/model/year, VIN
Citation/adjudication information	Driver citations, convictions, sentencing information
Roadway information	Structure, classification, geometry, pavement type, traffic volume, roadside features, etc.
Statewide injury surveillance information	EMS data, hospital ER data, hospital stays, outpatient services, death certificates

In addition, transportation safety information systems may include insurance, land use, topography, and U.S. census data.

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RESEARCH PROJECT TITLE
Evaluation Framework for the Creation and Analysis of Integrated Spatially-Referenced Driver-Crash Databases

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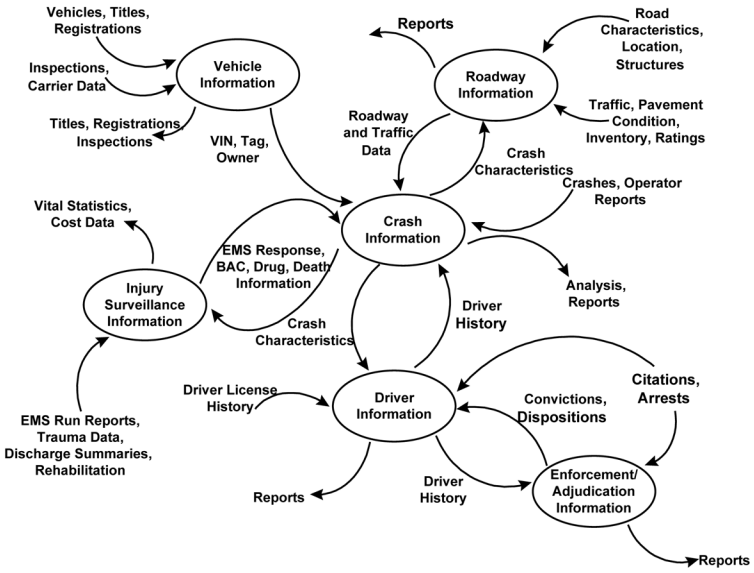
To help integrate and analyze spatially referenced crash-related data, GIS software can work with different location referencing systems across multiple information sources. Data elements may include, for example, the location of the crash, the location of the nearest hospital to the crash, and the addresses of the drivers involved.

The figure below, from the NHTSA's 1998 *Traffic Records Advisory* but updated regularly, illustrates the ways data from various sources are linked to crash data.



Six database types used in a traffic records system and the linkages among them

Applications of Integrated Data

Various integrated transportation safety databases, using both spatial and non-spatial data, are possible.

For non-spatial data, linked crash and driver records have been used to help researchers analyze driver characteristics in relation to a driver's tendency to be involved in crashes. Other uses of non-spatial data integration may include crash-injury or crash-citation linkages.

For spatially-referenced data, a potential application may be to link crash location and driver address data to analyze crashes involving the residents of a specific county. In addition, spatial data can be used to examine spatial relationships among sets of objects, e.g., the spatial pattern of injury severity and the locations of emergency response services.

Key Benefits

The integration of spatially-referenced data can help improve transportation safety analysis:

- Spatially-referenced data are useful for displaying spatial patterns, integrating data from different sources, and generating new research questions.
- Linking spatially-referenced GIS safety data can improve information about crash types and frequencies and about the locations associated with drivers and crashes.
    - Spatially-referenced data collected and stored for non-transportation purposes, such as demographic or land use data, can be used to explore causal relationships in crash patterns.

Implementation Issues

Before implmentation, any integrated spatially-referenced database will need to contend with four main issues:

Technical issues

These include concerns about the accuracy, completeness, or format of spatial data. Most issues may be resolved by making spatial data GIS-compatible and by accurately recording crash position and other locations (e.g., citations or hospitals) using geospatial coordinates.

Methodological issues

These include the types of conclusions that can fairly be drawn from spatial data. Methodological issues can be addressed primarily through an understanding of the constraints of spatial data and through the use of newer statistical methods.

Administrative issues

These include ways to integrate data that have been collected and managed by agencies with multiple and varying objectives. Administrative issues may be mitigated through intra-and inter-agency cooperation on data collection and sharing standards.

Legal/Ethical Concerns

These include confidentiality issues raised by using legal records, medical data, or other information that may idenify individuals. Legal/ethical issues may be resolved by "masking" individual data points, e.g., aggregating individual driver data into larger units (e.g., zip codes) or randomizing the data. Additionally, a "tiers of risk" approach can grant researchers access to different levels of confidential data for different research needs.