

Collecting and Disseminating Transportation Data between Government Agencies in Arizona

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INTRODUCTION

In 1997, a business area analysis of Arizona DOT's transportation planning databases and their collection methods resulted in an in-depth list of recommendations for improving the outcome of the data collection and maintenance effort. With the support of the Federal Highway Administration, Arizona DOT is currently in the advanced stages of implementing the most progressive statewide transportation planning data program in the country. It is based upon the concept of empowering local governments with the responsibility for the accuracy and completeness of their own roadway inventory.

An open geographic information system framework allows all agencies to report their system in the same map-based reference. A group of customized applications enable any ArcView-equipped agency in Arizona to use the information contained in the Highway Performance Monitoring System (HPMS) database. Other databases that are available through the same interface are bridges, motor vehicle crashes, traffic counts, national highway system roads, functionally classified roads, at-grade rail crossings, and feature inventory databases.

This paper outlines the capabilities of Arizona's statewide transportation data framework, as exemplified by an application called HPMStools for ArcView. The application includes six component tools that offer the following functions.

- \$ Generating map views of any particular area of Arizona
- \$ Painting databases onto the particular area or view
- \$ Making changes to the attribute values
- \$ Making changes to the extent of the record
- \$ Updating the centerlines with new or realigned roadways
- \$ Generating customized spatial databases

GENERATING VIEWS

HPMStools provides a wealth of custom GIS views of specific areas within Arizona. The basic views delivered in the first release show the entire state, each county, and each incorporated city. Future releases will include other special areas that may be larger than a county, such as federal land agencies (Forest Service or Park Service) or tribal lands (e.g. Navajo Nation). The shapefile components of these views can be generated from master ADOT databases for distributed consumption via CD or network in short order, depending upon the extent of the areas. These

“cookie-cutter” snippets of ADOT’s Arizona Transportation Information System (ATIS) are complete with ADOT’s versatile linear referencing technology. This enables tabular databases anywhere in Arizona to become registered to ATIS so that they can be “painted” into spatial map formats.

DATABASES THAT PAINT ONTO MAPS

ADOT’s versatile linear referencing technology provides that any database that contains records with an ONroad attribute and ATroad attribute(s) can be linearly referenced (i.e. geocoded) to the centerline GIS coverages/shapefiles of ATIS. The ONroad can be ATIS nomenclature an alias name. The ATroad can be another ATIS roadway nomenclature, but it can also be a milepost reference, an urbanized area or corporate boundary, a hydrographic feature, or virtually anything else. Databases can become linearly referenced to ATIS by using ArcView utilities or Microsoft Access utilities developed by ADOT. Once geocoded, they are “painted” from their tabular format in to a spatial map format. This allows that database to become “visual” as each record becomes a point or a linear segment on a map. These points and lines can be symbolized to represent any attribute that is contained within the record. Attribute values inspected in map form are comparatively easy to scrutinize for accuracy. They can be updated, as necessary, using the Attribute Editor.

CHANGING ATTRIBUTE VALUES

When geocoded databases are painted, the original database is used to generate a shapefile that contains its own copy of the attributes. HPMSStools for ArcView provides an Attribute Editor to operate on this shapefile database, giving the data reviewers/maintainers the ability to immediately change the value of any of the HPMS attributes. However, each and every change to the shapefile database is recorded as a transaction. ADOT uses these transaction files to efficiently update the master HPMS files, while allowing the shapefile database to remain in custody of the maintaining agency.

CHANGING THE SPATIAL RECORDS

While attributes of a HPMS segment are anticipated to change often, the linear segment itself is also expected to change due to partial capital improvements, development growth, and other reasons. Therefore, the government agencies needed a mechanism to specify the subdivision of existing segments, the combination of previously different segments, and the adjustment of the termini of other adjoining segments. HPMSStools for ArcView provides a Segment Editor that easily accomplishes the end-user needs. Once again, a transaction file is generated and passed onto ADOT to efficiently update the master database, and the changes made to the local database are retained until following the subsequent HPMS submittal, when ADOT reissues the updated database to the supporting agencies for future year updates.

UPDATING THE CENTERLINE FILE

HPMStools provides a means for the local agency to tag their roadways with ownership, pavement surface, and traffic volume information. This information can be assimilated into a public mileage accounting system and a vehicle-miles-traveled (VMT) estimate. Invariably, the amount of roadway in most agencies changes from one year to the next, and the ATIS centerline coverage is almost never up-to-date when it is reviewed for public mileage and VMT. Therefore, HPMStools contains the facility to allow local agencies to append new centerlines to the database prior to the mileage and VMT determination. The centerlines can come from other GIS files such as TIGER files or local agency centerline GIS files. They can also come from CAD drawings for new subdivisions, or they can be digitized from aerial photography. Finally, the local agency can add the new centerlines by freehand drawing in absence of any better source. All added files are appended to the local agency shapefile created by HPMStools, and a transaction file is created in parallel so that ADOT can update the master centerline file with the input from the local agency. This methodology allows the ATIS centerline coverage to be updated using the responsive input of local agencies all over the state, thereby increasing the reliability of the database while minimizing the cost of collecting new centerlines

GENERATING CUSTOM SPATIAL DATABASES

ADOT's effort to develop a framework for statewide transportation databases includes a feature intended to attract other government agencies to use HPMStools, regardless of whether they intend to use it for HPMS reporting purposes. ADOT's robust linear referencing system is deployed (through HPMStools) for any agency to create their own spatial database to their own choosing. This feature is most obviously useful for transforming established tabular legacy databases (e.g. pavement management systems, traffic signal inventories, and capital improvement histories) into shapefiles, as well as generating new spatial datasets. This can be done by graphically linking any record to the ONroad/FROMroad/TOrad or ONroad/ATroad reference. This act of "geocoding" a database record is completed by tagging each spatial record with a unique primary key value. Once each spatial segment/point is attributed with the record identifier, the existing legacy database can be joined to the shapefile. This capability, provided free-of-charge by ADOT, is extremely helpful to agencies that can't afford to establish a GIS for their everyday business functions. As it turns out, it is also a significant to agencies with established GIS capabilities because most of them have not yet exploited dynamic segmentation for its intended value, as ADOT has.

SUMMARY

The entire HPMStools program is based upon a distributed mechanism for database review and update. This mechanism is not dependent upon networks. It offers GIS technology to all government agencies in Arizona. It adds significant value to the existing GIS technology in even the most advanced transportation planning agencies.

The application, first previewed in February 1998 was exposed to nearly 150 employees representing 62 agencies between October 1998 and February 1999. It has a solid foundation of support at all levels of government. With continued support and development, the framework established in Arizona will mature into a robust support concept for better transportation system information and planning.

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ENDNOTES

1. Breyer, J.P., Pike, R.E., and M. Catchpole. *A Statewide Transportation Database for Arizona*. Proceedings of the 1996 GIS-Transportation Symposium, Kansas City, March 1996.
2. Guo, B., Breyer, J., et al. *From Map-based to GIS-based, A Technical Review of ALISS Migration*. Proceedings of the 1996 GIS-Transportation Symposium, Kansas City, March 1996.