

Arizona Department of Transportation

The Data Supply Chain & AZGeo Data Hub

SAFETY DATA CASE STUDY

FHWA-SA-24-020

Federal Highway Administration Office of Safety

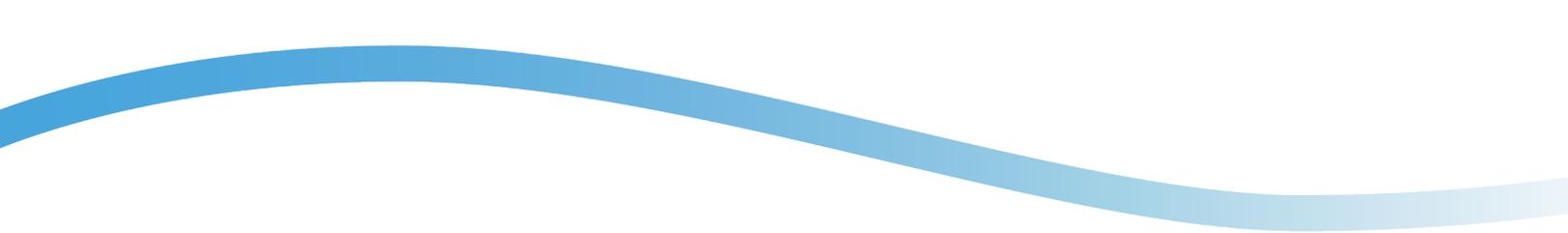
Roadway Safety Data Program

<https://highways.dot.gov/safety/data-analysis-tools/rsdp>



U.S. Department of Transportation
Federal Highway Administration

ADOT



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Acronyms

Acronym	Description
AGIC	Arizona Geographic Information Council
ADOT	Arizona Department of Transportation
ARNOLD	All Road Network of Linear Referenced Data
COG	Councils of Government
DOT	Department of Transportation
FAST	Field Office Automation System
FHWA	Federal Highway Administration
GIS	Geographic Information System
HPMS	Highway Performance Monitoring System
HSIP	Highway Safety Improvement Program
IT	Information Technology
LRS	Linear Referencing System
MAP-21	Moving Ahead for Progress in the 21st Century Act
MIRE FDE	Model Inventory of Roadway Elements Fundamental Data Elements
MPO	Metropolitan Planning Organization

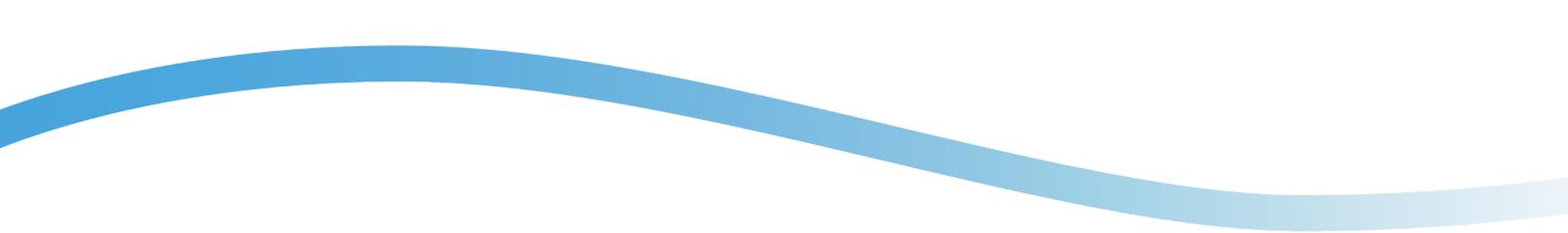


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Executive Summary

This case study reviews Arizona’s statewide geospatial data collaboration and its impact on the Arizona Department of Transportation (ADOT). The case study particularly focuses on the State’s AZGeo Data Hub. This includes the historic and administrative context around the development of AZGeo and ADOT’s data supply chain, as well as the impact of these tools on related ADOT safety data activities. What began for ADOT as the Centerline Unification Project has led to a statewide central geospatial repository, helping form a GIS data supply chain between different levels of government. While it was a significant effort, ADOT employed a variety of tools at their disposal, such as geographic information system (GIS), documentation, and user groups (i.e., Arizona Geographic Information Council) to develop a program that works. ADOT’s investments in relationships with other stakeholders have improved data quality and completeness and reduced the level of effort for ADOT analysts. Maintaining flexibility to different agencies’ needs and sizes has allowed them to move to satisfy several legislative and analysis needs.

Introduction

In 2019, the Federal Highway Administration (FHWA) completed the second [U.S. Roadway Safety Data Capabilities Assessment](#) (FHWA, 2019). This nationwide effort documented the safety data processes, policies, and procedures of all 50 States plus Washington D.C. and Puerto Rico. This effort highlighted the current state of practice with respect to all phases of safety data collection, management, integration, and analysis. It also revealed that State departments of transportation (DOTs) were eager to improve their capacity for data management and integration.

The purpose of this case study is to highlight a noteworthy practice by the Arizona Department of Transportation (ADOT) as it coordinates geospatial data across agencies and develops its safety data capabilities. This case study focuses on the State's [AZGeo Data Hub](#) in particular. Key innovations associated with the maintenance of data on this platform include AZGeo's direct access between the State and local agencies, application of geographic information system (GIS) and spatial data aggregation, and its integration with ADOT's linear referencing system (LRS). The case study explores the historic and administrative context around the development of AZGeo and ADOT's data supply chain, as well as the impact of these tools on related ADOT safety data activities.

Purpose and Need

The AZGeo Data Hub is a multiagency collaboration that acts as a central geospatial repository for the State of Arizona. The platform is an initiative of the [Arizona Geographic Information Council \(AGIC\)](#) that provides access to online GIS applications, map services, data, and metadata. This approach aims to reduce redundant or contradictory data and relieve the need for State agencies to individually handle data requests.

AZGeo features a self-service mechanism that allows for data sharing between agencies, particularly data exchange between the State and local governments. Although ADOT is only one partner supporting the AZGeo mission, this feature services a critical need for the DOT. AZGeo provides a connection with local agencies and their data that have statewide significance. For example, it allows local agencies to report public roadway data that affect Federal funding and Highway Safety Improvement Program (HSIP) allocation.

Target Audience

- State DOT and local agency GIS staff.
- Information Technology (IT) staff.
- Data managers, analysts, and stewards.
- Transportation professionals in planning, engineering, and safety.

ADOT and the Data Supply Chain

AZGeo functions as a key component of a much larger ADOT concept, the data supply chain. The data supply chain is a conceptual understanding of how data migrate from siloed individual users, inside and outside the DOT, to formal ADOT custodianship. It is the way different entities share and deliver route network data to the State in order to have a complete spatial picture of the road network regardless of functional class. This process became essential as both Federal requirements and modern safety analysis needs required more comprehensive and reliable data.

Legislative Background

The Moving Ahead for Progress in the 21st Century Act (MAP-21) established several requirements to help States advance their roadway safety data capabilities. Two key requirements for States were to (MAP-21, 112-141):

1. Collect Model Inventory of Roadway Elements (MIRE) Fundamental Data Elements (FDE) data for all public roads.
2. Develop safety data management systems to support HSIP, the Strategic Highway Safety Plan, and data-driven safety analysis and evaluation.

FHWA introduced the MIRE policy in 2010 and updated it in 2017 (Lefler et al., 2017). MIRE is a list of roadway characteristic and traffic inventory data elements that can support agencies as they conduct data-driven safety management, analysis, and decision making. It includes 205 elements, 37 of which are FDEs on non-local¹ paved roads, 9 on local paved roads, and 5 on local unpaved roads. States are required to have access to the requisite FDEs for all public roads by September 30, 2026 (23 CFR § 924.11). States are encouraged to collect, maintain, and facilitate access to the full MIRE as applicable to specific locations.

The FHWA Office of Highway Policy Information and Office of Planning, Environment, and Realty issued the Memorandum on Geospatial Network for All Public Roads on August 7, 2012, requiring each State to update their LRS to include all public roadways (FHWA, 2012). FHWA refers to this requirement as the Highway Performance Monitoring System (HPMS) All Road Network of Linear Referenced Data (ARNOLD). The HPMS ARNOLD requirement expanded a State's obligation to include all public roads in its LRS base map. This LRS requirement provides at least one means to geospatially locate MIRE data elements and maintain these data elements for all public roads.

¹ Defined by functional classification.

ADOT's Journey

Prior to AZGeo, Arizona did not have a unified geospatial data network. ADOT lacked several key data elements, particularly roadway centerline and attribute data on local road networks. The State began its Centerline Unification Project in 2016, which served as one of several catalysts to a GIS supply chain. Arizona's involvement in the [National States Geographic Information Council](#) provided access to noteworthy practices from around the country and helped inform the supply chain concept.

The State started with an organic, ad-hoc approach. The Centerline Unification Project began as individual conversations with local governments, identifying available data and understanding how ADOT could provide effective data services to its constituents. This effort took several years, reaching major maturity in 2019. ADOT's move to ESRI's Roads & Highways opened more statewide possibilities as ADOT used this enterprise tool and improve LRS across the DOT and its external partners. AZGeo itself now serves as a key self-serve GIS data supply chain ingestion mechanism (figure 1).

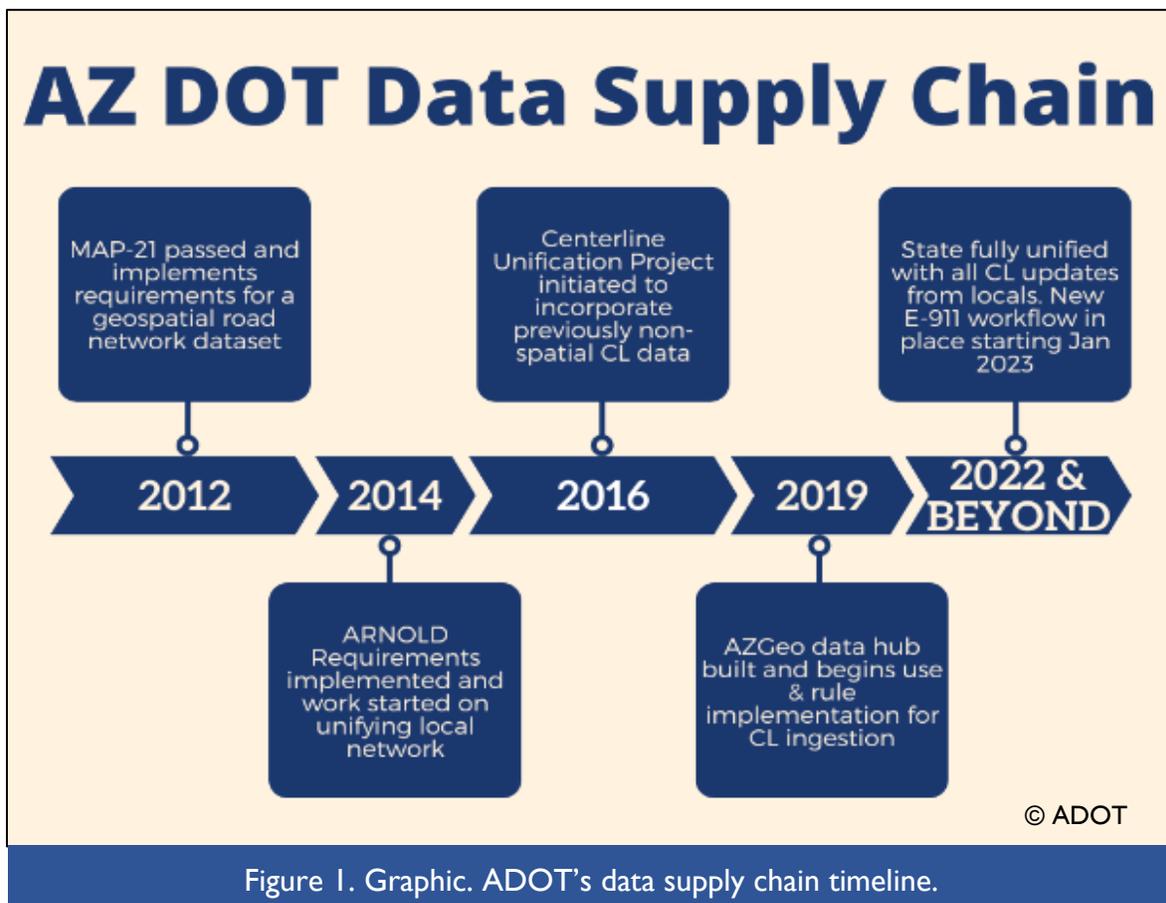


Figure 1. Graphic. ADOT's data supply chain timeline.

AZGeo and the Data Supply Chain

Outreach during the development process saw ADOT focus on building rapport with local agencies, introducing and reinforcing how they could mutually benefit from data sharing. Prior to the COVID-19 pandemic, representatives from ADOT's Data Analytics section regularly traveled to different councils of governments (COGs) and metropolitan planning organizations (MPOs). As ADOT further developed the system and continued to collaborate directly with local agencies, AZGeo helped formalize a continuous “supply chain” of local and other external data to the repository (figure 2).

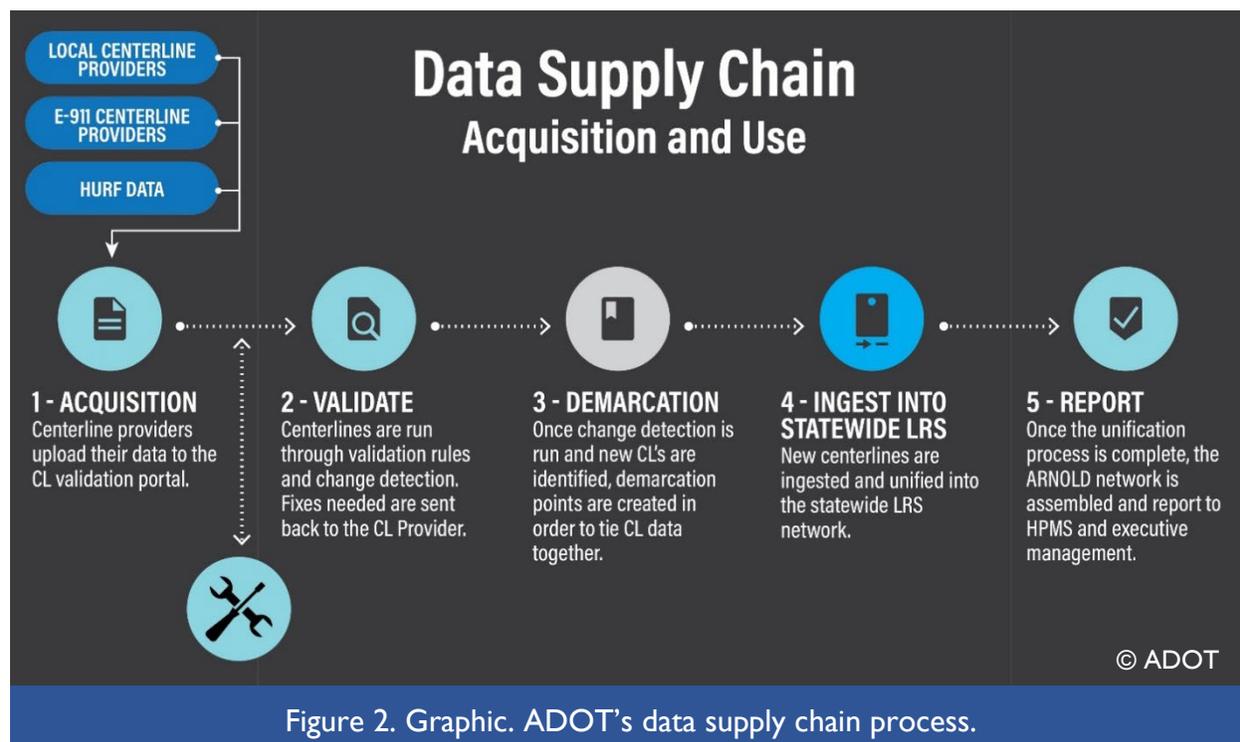


Figure 2. Graphic. ADOT's data supply chain process.

In promoting a system that permits data sharing and cross-verification, a cohesive dataset could be created from this cooperation. As ADOT incorporates local data into statewide systems, the DOT is able to share the integrated data back to the local agencies to support statewide initiatives. A practical example of this includes local roadway project sharing as local data custodians share changes on the network as a result of completed projects; this greatly improves the timeliness associated with local road data changes.

The reciprocal process furthers a relationship between ADOT and local agencies and continues to provide data access benefits to both parties. Since AZGeo uses Federal funding, data generated and shared through it must be publicly available (with appropriate disclaimers). This public accessibility helps satisfy public data requests without using DOT staff time and allows for public input on missing or erroneous data.

Managing Data in AZGeo

Federal funding support means the repository and its data must be publicly accessible, and Arizona's tools help support this mission. The Data Hub itself is based on ESRI's enterprise platform, developed by the AGIC in collaboration with the Arizona State Land Department and provided as a service for the public. Other tools also support data integration via AZGeo, including a spatial conflation engine where local agencies can provide their centerline data.

AGIC's management of AZGeo makes it cross-disciplinary. This well-established forum allows multiple agency stakeholders to be represented in technical and administrative decision-making. ADOT participates in this forum and holds a seat on the AGIC advisory council. Arizona State University also has a major role in facilitating AZGeo, and it is an example of how universities can contribute to these State data hub projects.

ADOT's methods to support local agencies vary with a key emphasis on flexibility. While some local agencies may have their own robust GIS teams that collect, analyze, and manage spatial data, others may lack the internal staff to support these efforts on their own. ADOT has taken the tact of allowing locals with the knowledge and ability to continue their work more independently while providing technical support for those that do not. Coordination between ADOT and local agencies is supported by the creation of [AZGeo Groups](#) within the data hub structure, which help contributors to streamline their activities and easily share data layers.

Many of the features of AZGeo's capacity management also tie into the associated data management. A feedback service, the "[Centerline Data Validation System](#)" tool is part of the system. The crowdsourcing mechanism provides the opportunity for both public and stakeholder input and feedback. Trust between stakeholders has been a critical piece of quality data management and has been an ongoing effort throughout the process. ADOT has built trust based on fostering connections with local agencies alongside the development of AZGeo. This promotes data sustainability and feedback reduces redundancy across State agencies.

Results and Impact on Safety Data

Although ADOT has not formally quantified the return on investment for AZGeo, ADOT has observed tangible benefits. Analysts require less time on associated data integration and refresh tasks correlating with a substantial reduction in their level of effort. There is interest from ADOT to study and eventually quantify these benefits. Beyond staff time, ADOT has also noted improved ease associated with ingesting and integrating the local data updates received compared to previous workflows. For instance, email notifications alert staff when data are uploaded, further contributing to the automated, institutionalized structure.

Safety Data Enhancements

ADOT's focus has been to improve the data quality and quantity, especially off the State-owned system, to support MIRE and safety analysis. ADOT has a [story map](#) highlighting the data supply chain and its setup alongside the State's ARNOLD basemap. AZGeo builds upon several key transportation and safety data related initiatives (FHWA, 2022). The platform will support several near-term safety data efforts and MIRE enhancements:

- The State now has roughly 50 percent coverage of surface type data, pavement coverage, and characteristics, for its non-State road network. While the data are more generic (i.e., paved as opposed to unpaved), the supply chain is improving MIRE completeness. On the local agency side, improved access to data has resulted in better data quality for use in their analyses.
- ADOT incorporated the Field Office Automation System (FAST) and developed a spreadsheet of ongoing construction plans for State system construction. Details of local construction plans can be verified in supporting data systems. Though not all cities and local agencies may participate in this workflow, AZGeo is one of many avenues at ADOT's disposal in creating their data supply chain for local system data.
- AZGeo supports ADOT as the State develops its MIRE data for intersection and intersection leg databases. Local partners can submit intersection-related characteristics, and ADOT can incorporate these elements in their databases.

Recommendations for Other States

While the introduction of AZGeo and the data supply chain reduced the level of effort for State and local agency analysts, ingesting these data is still a significant process. ADOT still requires fully trained GIS and LRS staff to handle the effort. This process takes time and resources; however, ADOT noted that they have advanced beyond key initial challenges and are refining the agency's process.

Accessible documentation is essential. This supports both internal and external collaboration, such as with COGs, MPOs, and different units within ADOT. Documentation helps establish the business needs, identify existing data gaps, increase efficiency in data collection, and share data, procedures, and standards (FHWA, 2022).

A State or organization attempting to build something similar to AZGeo would benefit by having a strategic plan for the effort. ADOT developed its own strategic plan, and key insights from ADOT's experience with the Data Hub include:

- Have a clear picture of where the data should be housed to accommodate all stewards and users.
- Understand the desired goals, as well as the objectives to accomplish those goals, and then develop individual steps from those ends.
- Find and leverage existing structures that work as a means to coordinate these activities (i.e., AGIC in Arizona). Multidisciplinary groups like AGIC have representatives already invested in data, as well as a ready-made forum to discuss these issues. These efforts do not have to be started from scratch. Local universities, like Arizona State University in this example, provide another practical partner with the capability to assist ADOT and State DOTs.

Building a geospatial data hub is a steady, iterative process – taking several years to complete in Arizona's example. Alongside appropriate preparation, utilizing structures and documentation that already work within the State, even if not perfect, can be effective means to reach the desired outcome.

Conclusion

The AZGeo Data Hub is the culmination of a multi-year effort by the ADOT, other State government agencies, and several local governments and stakeholders. What began for ADOT as the Centerline Unification Project has led to a statewide central geospatial repository, helping form a GIS data supply chain between different levels of government. While it was a significant process, ADOT employed a variety of tools at their disposal, such as GIS, documentation, and user groups (i.e., AGIC) to develop a program that works.

ADOT's management style has provided a notable example of how a State DOT can facilitate collaboration between groups, working to build trust with other agencies, streamline public access, and improve the comprehensiveness and timeliness of datasets. These investments in relationships with other stakeholders have improved data quality and completeness, as well as reduced the level of effort for ADOT analysts. Maintaining flexibility to account for varying agency capabilities has allowed ADOT to make major advancements in its data and analysis capabilities.

Acknowledgements

FHWA would like to express appreciation to ADOT for providing information used in developing this case study. For more information or clarification on the concepts in this case study, practitioners should contact ADOT and carefully consider the applicability of these approaches in their own agency.

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