GIS in Transportation

GEOSPATIAL DATA-SHARING PEER EXCHANGE

Denver, Colorado
May 28-29, 2014

Host agency:
Colorado Department of Transportation

Participating peer agencies:
Arizona Department of Transportation
Connecticut Department of Transportation
Iowa Department of Transportation
Montana Department of Transportation
Nevada Department of Transportation
North Dakota Department of Transportation
Washington State Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

ACKNOWLEDGMENTS

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TABLE OF CONTENTS

INTRODUCTION

Background

This report provides highlights from a peer exchange held in Denver, Colorado, on May 28–29, 2014. The exchange was part of the Federal Highway Administration's (FHWA) Geospatial Data Collaboration (GDC) initiative. A companion report to this document—Geospatial Tools for Data-Sharing: Case Studies of Select Transportation Agencies—provides additional information on the GDC initiative and includes case studies from 23 State Departments of Transportation (DOTs) and others that are developing, using, and maintaining a variety of geospatial applications and tools to support GDC goals. Eight of these 23 agencies participated in the Denver peer exchange.

FHWA's Office of Planning (HEPP) sponsored the peer exchange, and the Colorado DOT (CDOT) hosted the event. FHWA HEPP also sponsored another GDC peer exchange on May 20–21, 2014 in Raleigh, North Carolina, hosted by the North Carolina DOT (NCDOT). The exchange at NCDOT convened a separate set of State DOTs to explore the same topics as the Denver event. Highlights from the Raleigh peer exchange are available here.

Goals

FHWA's GDC initiative encourages State DOTs and others to use geospatial tools to streamline transportation decision-making and improve data sharing within an agency and with external stakeholders. The Colorado peer exchange aimed to provide opportunities for State DOTs to share noteworthy practices, success factors, and challenges encountered in using, developing, and maintaining geospatial tools that support improved data-sharing: the core goal of GDC.

Format

The peer exchange was held at CDOT's offices in Denver. Participants included staff from CDOT as well as the Arizona DOT (ADOT), Connecticut DOT (CTDOT), Iowa DOT (IADOT), Montana DOT (MDT), Nevada DOT (NDOT), North Dakota DOT (NDDOT), and Washington DOT (WSDOT) (see Appendix A for a complete participant list).

This exchange followed a two-day format, which began with a brief round of introductions and information on FHWA's GDC activities, followed by peer presentations and demonstrations to highlight agencies' geospatial activities relevant to data-sharing. After the presentations/demonstrations, peers convened for a series of roundtable discussions that addressed pre-identified topics of interest. The peer exchange concluded with a discussion of next steps and final remarks from FHWA that summarized recurring themes (see Appendix A for the peer exchange agenda, including roundtable discussion topics).

Types of Data-Sharing Efforts

Participating agencies shared their experiences related to many different kinds of data-sharing efforts (see Table 1 below).[1] For the purposes of this report, these efforts were grouped into three categories:

- **Repositories** are compilations of geospatial data tailored to users with Geographic Information Systems (GIS) expertise or capabilities; examples include clearinghouses, libraries, warehouses, and inventories.

- **Gateways** offer users (including those without advanced GIS expertise) the ability to visualize geospatial data or share data; examples include data viewers, screening tools,[2] and portals. Gateways typically provide features that allow users to communicate with one another through the tool itself.

[1] Appendix D of the Geospatial Tools for Data-Sharing: Case Studies of Select Transportation Agencies companion report provides more detail on these agencies' efforts.

[2] Screening tools are specifically designed to support users in identifying a transportation project's potential impacts during project planning or development processes.

- **Coordination** efforts seek to harmonize information or processes; examples include developing data standards or templates to ensure a consistent data "look and feel" for information or participation in inter- and intra-agency groups to discuss common goals.

The agencies participating in the peer exchange had primarily focused on implementing or anticipated implementing gateways rather than repositories.

Table 1: Summary of data-sharing efforts reported by Denver peer exchange participants

Agency	Name of Data-Sharing Application/Effort[3]	Repository	Gateway	Coordination
ADOT	Historic Preservation Portal	■	■	
	Biology Portal	■	■	
	Arizona Cultural Resource Inventory	■	■	
	APLAN [ADOT ArcGIS Online (AGOL)[4]]		■	
	Feature Inventory System	■		
	AZGEO Clearinghouse	■	■	
	AZSITE	■		
CDOT	Online Transportation Information System (OTIS)	■	■	
	CPLAN (CDOT AGOL)		■	
CTDOT	GIS road network	■		
	Roadway inventory	■		
	Portal (anticipated)	■		
IADOT	Highway Division GIS Project Portal		■	■
MDT	MDT AGOL		■	■
NDOT	Planning and Needs System (PLANS)		■	
NDDOT	NDDOT AGOL		■	
WSDOT	WSDOT Online Map Center (WSDOT AGOL)		■	■
	Community Planning Portal (CPP)		■	■

[3] Efforts listed include both those that the State DOT initiated and those in which the State DOT is a participant or contributing partner.
[4] Esri's AGOL cloud-based platform permits users to aggregate and share a wide array of geospatial information including mapping application and data layers.

PEER EXCHANGE HIGHLIGHTS

This section presents a compilation of highlights and recurring themes that emerged from peers' presentations and subsequent roundtable discussions.

A. Motivating and Success Factors

Peers identified factors that motivated their agencies' data-sharing efforts or helped them successfully develop their related applications. Peers noted that a primary driver was an agency's belief that a centralized source of geospatial data was needed to simplify information management, access, and updates. Peers also noted the following factors:

Federal requirements. Many peers chose to develop data-sharing applications in response to Federal requirements. For example, United States Department of Transportation (USDOT) requires State DOTs to develop materials like the State Transportation Improvement Plan (STIP), the Transportation Asset Management Plan, and the Highway Performance Monitoring System (HPMS), to receive Federal aid for eligible transportation projects and programs. Peers noted that geospatial data are important components of many of these requirements. Many peers developed GIS applications to share relevant information and make developing these documents easier and more efficient. Using GIS applications to meet Federal requirements was particularly important for agencies that lacked executive support for geospatial innovation.

Peer example: Nevada's DOT, metropolitan planning organizations (MPOs), local agencies, and FHWA Division Office are working to develop an electronic Statewide Transportation Improvement Plan (e-STIP), which will be a database containing STIP project information. The e-STIP, part of NDOT's PLANS gateway, will help NDOT understand how project data are currently collected, managed, and shared within the agency and help it to improve the process. Federal requirements and encouragement to develop an e-STIP was essential to demonstrating the importance of the e-STIP project to DOT leadership.

Peer example: ADOT's Historic Preservation Portal is an important internal resource that can also be shared with the agency's consultants and contractors. The portal was initially designed to help the agency respond to Federal National Environmental Policy Act (NEPA) requirements, including assessing the environmental impacts of proposed transportation projects. The portal allows users to quickly identify historic cultural resources, their surroundings, and their spatial relationship to ADOT's existing and proposed transportation facilities.

User empowerment. Peers reported that gateways in particular can address the perceived need to aggregate a large amount of information in a relatively low-cost way, making information available to a broad set of users through a simple, intuitive interface. Gateways can also leverage data resources and eliminate duplicative datasets. Geospatial data have the potential to reach a wide audience due to their visual nature. Some GIS software is costly; however, making it difficult for some organizations to make the case for these investments. Furthermore, peers noted that not everyone has experience with desktop GIS software, although some applications require users to have a high level of technical expertise. Finally, the sheer amount of geospatial data being generated can be overwhelming.

Overall, gateways addressed a core need for many peers by giving users with little or no GIS expertise the ability to easily share, access, manipulate, and visualize information on demand, without requiring GIS staff support. Several peers also noted they are identifying training and marketing strategies to support users in using data-sharing applications.

Peer Example: CDOT launched OTIS in 2009 as the centerpiece of its effort to improve access to State geospatial information (see Figure 1). Before OTIS, CDOT's geospatial maps and the data underlying those maps were "housed" in various business units

across the organization in different formats and databases, and the information could be difficult to find. OTIS' user-friendly interface now provides both CDOT staff and the public a single framework through which they can access highway, environmental, project and traffic data, as well as statewide maps, reports, highway imagery, and a spatial and tabular data inventory.

Figure 1: Example of videolog available through CDOT's OTIS

Peer example: WSDOT developed its CPP to provide local government agencies with a "one-stop-shop" to access State transportation data and view their own local data to update local comprehensive plans. Prior to the CPP, local governments had to contact WSDOT to obtain data for these plans, and WSDOT had to respond to each data request. Now, regardless of their level of GIS expertise, local agencies can use the CPP to access relevant data, analyze the information using other local data sources, and visualize the transportation projects included in their comprehensive plans. The CPP allows users to download community fact sheets that provide an up-to-date snapshot of cities' transportation infrastructure. WSDOT also developed a series of online video tutorials to train CPP users.

Peer example: MDT encourages individual business units to take responsibility for maintaining their own data and maps that are aggregated on the agency's AGOL site, which was developed to help staff share data between business units, with other agencies, and the public. MDT GIS staff members also train a few "power users" within each business unit to help co-workers navigate the tool. These trainings are tailored to each business unit's needs. MDT's GIS personnel report they have received significantly fewer requests for assistance since implementing the training, as users are able to share their own data with ease.

Identification of benefits. Peers noted that identifying benefits related to developing and implementing data-sharing applications or tools can them to help justify current and future investments of time and funding necessary to build more robust data repositories, gateways, and other applications. The following benefits were specifically noted:

- **Streamlined transportation project reviews.** Data-sharing applications help information flow more easily between planners, engineers, environmental scientists, construction contractors, and others. This increased communication is helping State DOTs more

easily identify potential project obstacles and any necessary mitigation strategies earlier in the transportation planning process.

Peer example: MDT collaborated with the State's Department of Fish, Wildlife, and Parks (FWP) to create an interactive GIS mapping platform on the MDT AGOL site that is tailored to FWP's needs. Using this platform, FWP environmental staff – regardless of their level of GIS expertise – can access MDT AGOL and create up-to-date maps of MDT construction projects. In a single meeting, FWP can make changes or provide comments specific to a construction project, and get real-time feedback from MDT. Issues can be addressed in a matter of hours rather than days, and environmentally sensitive projects can proceed normally.

Peer example: NDOT's PLANS is expected to help the agency better assess potential project impacts before they arise. For example, PLANS will allow stakeholders to identify potential right-of-way issues and project alternatives or mitigation options during the early design phase.

Improved data quality. Peers noted that increased data-sharing within an agency and with outside users often results in improved data quality. When data are openly accessible, agencies often place a greater emphasis on keeping information accurate and up-to-date. Typically, this also motivates internal agency business units to provide more accurate data up front. Sharing information broadly also encourages agencies to ensure that data standards are consistent across agency departments so that outside users are easily able to view and analyze data in a consistent, recognizable format.

Peer example: Arizona's AZGEO Clearinghouse is a repository that allows State agencies to share their authoritative data with each other, increasing efficiency and improving data quality. For example, local agencies will be able to view ADOT road data and suggest edits as necessary based on changing conditions, improving the road dataset and local emergency response.

Performance Measures. Despite a general consensus among peers that there are significant benefits related to using these tools, few had developed formal or quantitative performance measures to assess the tools' outcomes. Peers recognized this as a potential opportunity in the future.

B. Technologies and Platforms

Several of the peer exchange agencies (MDT, NDDOT, and WSDOT) use commercial off-the-shelf (COTS) software solutions, particularly AGOL, as a platform for their data-sharing applications. Peers noted they identified AGOL as an appropriate platform choice because it offered a user-friendly and intuitive interface while helping them take advantage of cloud capabilities for increased data storage and scalability. A few agencies, including CDOT, chose other platforms on which to develop geospatial tools. Other agencies, such as NDOT, are still in the process of exploring their options.

Peers agreed that most State DOT GIS departments are in the customer service business and need to be able to respond quickly to a large number of requests from other agency business units and State agencies. To improve their business practices, a GIS team needs to be able to integrate new technologies into existing systems. Several peers agreed that when an agency aligns itself completely with only one GIS software vendor, it is difficult to adapt to emerging technologies that may not be compatible with proprietary data formats. If an agency is able to develop a strong underlying infrastructure that functions with a variety of COTS and open-source GIS data formats, it will be easier to deploy new geospatial applications as technology changes.

C. Coordination

Peers noted that an agency's ability to coordinate and collaborate with internal and external partners is a key to managing and sharing geospatial data. Intra-agency coordination allows data users and administrators to design and implement new systems that fit into the agency's overall approach to information technology (IT). Interagency coordination provides opportunities for State DOTs to collaborate with other public and private organizations that frequently use geospatial data.

Intra-agency coordination. Many peers noted they face challenges related to coordinating IT and GIS activities. State DOT IT departments often lead agency-wide technological decision-making processes, including hardware/software procurement, development of policies and standards, and supporting technology users across the agency. While IT procedures are intended to benefit the entire agency, peers noted the outcomes of their work do not always support the progression of an agency's geospatial program. For example, some IT departments that encourage stricter data reviews are reluctant to allow other business units to freely share data, as the IT department would have less control over the way sensitive data are shared. Peers anticipated that as GIS technologies advance and agencies become more comfortable with open data-sharing, it might be difficult to implement new data-sharing applications within traditional IT parameters. There may be an opportunity to consider revising these parameters to more easily support new innovations.

Another challenge facing State DOTs is that business processes often occur without awareness of related activities occurring elsewhere in the agency. Because of these organizational "silos," agency staff such as planners, engineers, biologists, construction teams, and maintenance crews may only become aware of other geospatial efforts within their agency when a problem occurs. Organizational silos often lead to data silos, where data are stored and managed locally and are not shared across business units. By creating systems that make geospatial data more accessible throughout an agency, State DOTs can support cross-cutting geospatial analysis. Centralizing data can also help improve data quality and limit redundancies, as users are able to more easily identify errors and gaps.

Peer example: IADOT addressed its data silos by sharing georeferenced data stored and managed by individual data owners via its Highway Division GIS Project Portal (see Figure 2). If data do not already have a linear referencing mechanism, the IADOT GIS Unit can easily add the geometry in an extra field and link to it from the portal. This process leaves individual business units responsible for maintaining their own data, but at the same time leverages the Project Portal's ability to increase data accessibility.

Interagency coordination. Many participating agencies share data and coordinate informally with outside organizations, including other State agencies. However, USDOT and other agency staff might be reluctant to share data for fear that others will misinterpret the information. For example, one peer noted that his agency was concerned that the release of planned project data through a publically accessible GIS gateway might lead people to assume that a project plan was set in stone regardless of how the data are labeled. Other agencies restrict who can see certain types of data, such as location information on sensitive environmental or archeological resources.

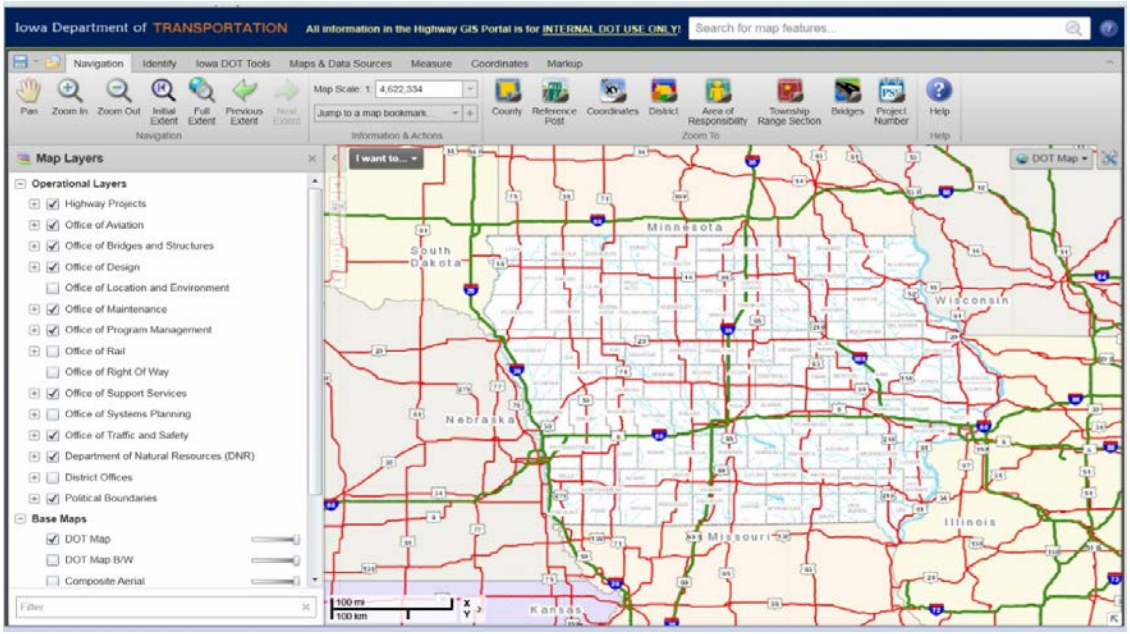

Figure 2: View of IADOT's portal shows layer options from many different State agencies

Peer example: In order to understand what types of data cities and towns would like to see in the CPP, WSDOT formed a planning workgroup of local agencies to create a detailed list of requirements for the tool. As part of this process, local communities were engaged directly in CPP development. WSDOT also coordinates with other State agencies to develop data standards that specify how information should be added to the agency's AGOL site. For example, an interagency AGOL workgroup is developing a template for AGOL thumbnails, a small graphic representation of a map's content viewable when searching for maps/data, so the State's mapping services are identifiable.

Peer example: Though it began primarily as an emergency response tool, Arizona's AZGEO Clearinghouse is growing into a statewide, multi-agency initiative. The purpose of the clearinghouse is to create an official repository for State geospatial data that facilitates data-sharing and eliminates duplicative datasets. Although the clearinghouse is still in a developmental phase, ADOT anticipates it being used especially for public safety initiatives. For example, local agencies may use the clearinghouse to review and edit ADOT's road data file to ensure accurate information for 911 use.

Peer example: In a unique data stewardship arrangement, MDT and other State agencies in Montana work closely with the Montana State Library, which keeps an official record of all State-produced geospatial data. As active data managers, Montana State Library staff provide guidance to all State agencies to ensure that all geospatial data are compatible with State library systems. This makes it easier to rely on geospatial data to support interagency collaborative efforts. While many States have developed geospatial clearinghouses, peers noted there are few, if any States that use the official State library as the sole statewide data center.

Operating agreements. Several of the peers noted they chose to develop formal data-sharing agreements with partner agencies that specified how partners should share data with the State DOT, and vice versa. Most State DOTs did not develop these formal agreements tied to one particular application, effort, or initiative; in the majority of cases these agreements were set up to address general data-sharing activities. However, several peers reported that their agencies do not have any formal agreements with other agencies. Instead, the agencies rely on informal processes and relationships to share and receive geospatial data.

Peer example: Currently, NDOT has multiple cooperative agreements with counties to outline formal guidelines for geospatial data-sharing, such as what standards should be used to generate county road data and raster or vector GIS data. These agreements cover periods of time from two to four years. NDOT is also developing a separate agreement with utility companies to obtain data for the location of utilities occupying the DOT's right-of-way. Until recently, developing formal data-sharing agreements has not been a major priority for NDOT.

D. Data Management and Governance

As the peer agencies continue to develop and refine their data-sharing applications, they increasingly struggle with the processes by which data are collected, integrated into agency systems, manipulated, and updated—also known as "data stewardship." Peers believe that agencies with successful stewardship practices are establishing data ownership and responsibilities and standards for collecting and recording data.

Data standards and governance. Developing a set of data standards is an important consideration for agencies seeking to improve a data management system, but most of the peers do not yet have formal standardization processes in place. Several agencies, however, recognize the advantages of having consistent data throughout agencies and across platforms, and have started to investigate next steps for better standardization.

Peers identified one effective approach to improving data stewardship: developing a thorough governance document that addresses common data management challenges and provides guidance for GIS practitioners. A strong governance document will likely include directions for file storage, naming conventions, data maintenance and upkeep, application development, and introduction of new software.

Peer example: WSDOT's GIS Branch developed guidelines for those sharing data with the public using the WSDOT AGOL site. For example, data shared with the public through the AGOL site must also be available for download on WSDOT's GeoData Distribution Catalog, which is a centralized distribution site for WSDOT's GIS data. The GIS Branch is realizing; however, its restrictions may be limiting business units from sharing useful data that does not conform to the agency's data quality standards.

Peer example: MDT developed a best practices guide for sharing data on its AGOL site. The guide provides advice on how to best share data but avoids being prescriptive so that State DOT staff have more flexibility in conducting their own job duties.

Peer example: IADOT developed a Geospatial Governance and Guidelines document, which lays out the responsibilities and structure of the IADOT GIS Council, metadata and projection standards, where to find certain types of data, and other topics.

Metadata. Metadata is an important component of ensuring data stewardship. Metadata provides data managers and users with accurate information about a datum point, including when it was created, how, by whom, and to what it refers. High-quality metadata tells a story about the data's history, limitations, and assumptions to help users answer underlying questions they may have about the data. Participating States reported they developed a variety of methods to keep track of metadata, but they find it challenging to keep metadata up to date when data changes frequently and data ownership is not clearly defined.

Peer examples: In the future, CDOT intends to use a data harvester to replace the need to manually update metadata in its OTIS tool. From each AGOL data layer, WSDOT links directly to metadata from the enterprise database where the agency's data is housed. ADOT maintains a data dictionary, which describes what data fields mean and how the data were generated.

CONCLUSION

Based on discussions held during the Colorado peer exchange, it is clear that it is becoming easier for State DOTs to share GIS data both internally and externally. New geospatial platforms and technologies have emerged that allow data to be more efficiently stored, accessed, and shared with a broad array of stakeholders. Because many of these technologies are specifically designed to be intuitive and user-friendly, they are also reducing the amount of formal training required to work with or manipulate GIS data. Along with these developments, however, have come unique challenges, such as the need to develop improved data standards and governance and metadata processes; as well as the need to address concerns about properly managing access to lesser-quality or sensitive data.

This peer exchange provided important opportunities for State DOTs to share noteworthy practices, lessons learned, and challenges related to geospatial data-sharing. Peers agreed the exchanges helped provide momentum for developing a community of practice in this area. Peers also agreed GIS personnel—who often serve various offices within an agency—are essential for developing these solutions as State DOTs continue to strive to shorten project delivery, enhance safety, protect the environment, and meet the needs of the traveling public.

To conclude the peer exchange, peers identified recurring themes that surfaced from the presentations and roundtable discussions. They also discussed success factors and areas of opportunity for improving data-sharing. Finally, the discussion revealed some actionable strategies FHWA could take to help to support State DOT data-sharing activities. Highlights from these discussions are presented below:

Champions within leadership.
Peers agreed that having a strong champion at the agency executive level is essential for developing a sustained GIS program and data-sharing initiatives. An executive-level GIS champion should have a firm understanding of geospatial concepts and their many potential applications to the transportation field. Peers believed that agencies with executive-level GIS champions may be able to more easily develop and maintain innovative data-sharing tools.

A GIS champion also recognizes the value of sharing data both internally and beyond the agency. Some peers have found that agency leaders are concerned that opening access to data will expose poor performance or lead to misinterpretation of data. A champion may be able to address this concern. Peers also believed that any champion should trust the agency's GIS practitioners to focus on technical details and develop new tools that improve the agency's geospatial services.

Guidance on planning for and coordinating natural disaster response.
Peers discussed the challenges they encountered while sharing relevant data during natural disaster response. Without interagency data-sharing plans in place before these events, mapping data for emergency response can be difficult. A lack of data consistency and an inability to quickly exchange data can impede GIS specialists' abilities to respond quickly to mapping or analysis requests. Peers believed better guidance on how to develop data-sharing response plans would be very useful.

Clarification on Federal data collection requirements.
Peers noted that while Federal data requirements are important in encouraging data collection and sharing, varying and sometimes overlapping data requirements can lead to confusion and duplication of effort. Peers believed that it would be beneficial to have increased coordination between agencies on the type and format of data collected, as well as improved guidance on how and what to collect.

Training.
In the past, FHWA offered GIS training for mid-level management through the National Highway Institute. Peers believed that FHWA should reinstitute a similar training with a greater emphasis on data-sharing, collaboration, and the value of making data available to the public. Peers also believed the training should focus on demonstrating the power of geospatial data as it relates to State DOT programs and its ability to improve agency business practices, interagency relations, and public communications.

APPENDIX A: PEER EXCHANGE AGENDA

Federal Highway Administration (FHWA)
Geospatial Data-Sharing Peer Exchange
Colorado Department of Transportation (CDOT)
4201 Arkansas Avenue, Room 225
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May 28-29, 2014

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Wednesday, May 28

8:15 – 8:30 **Welcome –** *Colorado Department of Transportation (CDOT)*

8:30 – 9:00 **Overview of FHWA Geospatial Data Collaboration (GDC) Activities –** *FHWA*

9:00 – 9:30 **Introductions and Discussion of Peer Exchange Goals** – *All Participants*

9:30 – 10:45 **Demonstrations/Presentations 1**

- CDOT: Online Transportation Information System (OTIS) and CPLAN
- IADOT: Highway Division GIS Portal

Break

11:00 – 12:00 **Roundtable 1: Process & Structure -** *All Participants*

Lunch

1:00 – 2:45 **Demonstrations/Presentations 2**

- MDT: MDT ArcGIS Online (AGOL) Site
- NDOT: Planning and Needs System (PLANS)
- CTDOT: Digital Highway Network, Roadway Inventory Expansion & Connecticut Open Data Portal

Break

3:00 – 4:00 **Roundtable 2: Technology & Data -** *All Participants*

4:00 – 4:15 **Day 1 Wrap-Up -** *FHWA*

6:00 **Informal Dinner** (Hacienda Colorado)

Thursday, May 29

8:00 – 8:10 **Day Overview –** *FHWA*

8:10 – 10:00 **Demonstrations/Presentations 3**

- WSDOT: Community Planning Portal and WSDOT AGOL platform
- ADOT: ADOT AGOL Site, Historic Preservation Team (HPT) and Biological Portals, AZGEO Clearinghouse, AZSITE
- NDDOT: NDDOT AGOL Site

Break

10:15 – 11:15 **Roundtable 3: Benefits, Challenges, & Lessons Learned -** *All Participants*

11:15 – 12:00 **Roundtable 4: Future Directions & Next Steps -** *All Participants*

12:00 – 12:15 **Wrap-Up -** *FHWA*

12:15 **Adjourn**

Roundtable Discussion Questions

Roundtable 1: Process & Structure - *All Participants*

- What are some common needs that State DOTs identified which led the DOT to develop/build a geospatial data-sharing application/system/effort (e.g., data library, portal, inventory) or engaging in a data-sharing initiative?

- What are examples of different processes that State DOTs took to develop these applications/systems or initiatives?
    - How have State DOTs coordinated with both internal and external stakeholders (e.g., State GIS offices, resource agencies, local government agencies) for data-sharing efforts? What factors have helped make this coordination successful?
    - Was agency leadership involved in data-sharing efforts or initiatives? If so, how?

- Have State DOTs formally structured applications/systems/initiatives through any of the following:
    - Data-sharing agreements/memoranda of understanding or operating agreements
    - User documentation (e.g., user guide, best practices manual)
    - Governance or data maintenance guidelines
    - Other materials?

- Who is responsible for developing and maintaining data?

- How are end users using these application/systems in their workflows? Do you have any examples of unexpected or unanticipated uses?

- What does "success" for data-sharing efforts look like or will look like? How do you know?
    - Has the State DOT developed or would it consider developing performance metrics to assess the application/system? If so, what are some examples of these metrics and how have they been used?

Roundtable 2: Technology & Data - *All Participants*

- Who are the main customers/consumers of State DOT data as shared through these applications, systems, or initiatives?
    - What have State DOTs found to be the most effective methods for developing or making metadata available to these customers/consumers?

- It appears that many State DOTs are using ArcGIS Online (AGOL) as a platform for developing geospatial portals that make data "discoverable" by a broad range of users. Why have State DOTs identified AGOL as the appropriate platform for these portals? What other kinds of platforms or technologies are State DOTs using to share geospatial data, and why?

- How are State DOTs addressing the issue of sharing or storing sensitive data?

- What are State DOTs doing to facilitate interagency geospatial data-sharing during non-recurring emergency events such as major storms, earthquakes, etc.?

Roundtable 3: Benefits, Challenges, & Lessons Learned - *All Participants*

- What specific benefits and challenges have State DOTs encountered in terms of any of the following topics?
    - Developing, managing, or maintaining data-sharing applications, systems, or initiatives
    - Compiling, storing, and sharing data; developing metadata, including sensitive datasets
    - Database design
    - Using various types of GIS-based platforms or technologies

- How do these benefits support FHWA's GDC goals of increased collaboration, time/cost savings, improved information accessibility, and overall improved transportation decision-making?

- How have State DOTs successfully addressed any challenges?
    - What are overall key success factors and lessons learned?

Roundtable 4: Future Directions & Next Steps - *All Participants*

- Are State DOTs identifying their data-sharing efforts as part of FHWA's Every Day Counts or Geospatial Data Collaboration initiatives?
    - If so, how? If not, why not?
    - What are the benefits of making these connections more explicit?

- What future plans does your State DOT have for data-sharing applications, systems, or initiatives?

- What can FHWA do to help either now or in the future?

- What do State DOTs see as some of the key current or future trends that are likely to influence data-sharing applications, systems, or initiatives in the future?