

GIS DATA INTEGRATION PEER EXCHANGE

Olympia, Washington
November 14-15, 2018

Host agency:

Washington State Department of Transportation

Participating peer agencies:

Alabama Department of Transportation, CalTrans, Connecticut Department of Transportation, Florida Department of Transportation, Georgia Department of Transportation, Iowa Department of Transportation, North Carolina Department of Transportation, Ohio Department of Transportation, Southeast Michigan Council of Governments, Utah Department of Transportation, Oregon Department of Transportation, Washington Department of Transportation.



U.S. Department
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**Federal Highway
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Introduction

Purpose

The purpose of this peer exchange was to bring together practitioners of Geographic Information System (GIS) applications to discuss and learn about the implementation of data governance and data integration activities and policies at State Departments of Transportation (DOTs). There was a specific emphasis placed on explaining and aiding the efforts of the Washington State Department of Transportation (WSDOT), which has actively pursued a more developed data governance and integration project to improve the accuracy, usefulness, and structure of their data. The WSDOT hosted the peer exchange and presented their efforts to implement data governance and data management policies, while peer agencies contributed knowledge and expertise on topics within data integration. The ultimate goal of WSDOT is to create an enterprise-wide system that houses sound data, has clear protocols surrounding data governance, and appropriately informs decision making for leadership within WSDOT.

Background

There is much interest in data integration, enterprise systems, and data governance within the GIS and transportation community. A case study by the Federal Highway Administration (FHWA) GIS in Transportation program highlights recent State work on these issues and resources from outside the transportation field that are increasingly applied to the intelligent technology (IT), business, and financial questions involved in GIS.

Format

Held as a two-day seminar-style meeting, the event included presentations from subject matter experts on data integration and management from State DOTs and FHWA regional and Federal staff.

Day One Activities

Defining Data Management, Governance & Integration:

Bob Scopatz from Vanasse Hangen Brustlin (VHB) and Others

Defining terms related to data governance and integration is an important step in investigating and improving systems. Terms including data governance, data management, and data integration form a key part of our work. The following are some definitions, which initiated the discussion:

- **Data governance** is a formal process by which a group sets standards and policies that drive the action of data management, such as setting the format for metadata, prioritizing data sets, and establishing quality control measures. Implementing data governance strategies often includes setting up new policies, positions, and workflows to allow a centralized management of data-related decision making.
- **Data integration** involves multiple data sources combined or interoperable by design for the purpose of analysis and making data-driven decisions. An enterprise GIS system is the most developed expression of data integration, and involves having one authoritative and cross-functional data set accessible across departments within an agency.
- **Data management** is the foundational processes through which data is collected, cleaned, integrated into existing systems and data, used in applications, and catalogued. Data management involves many players (including data collectors, owners, users, and support staff) and is done for many purposes (such as needs assessment, planning, and maintenance).

Data integration, data governance, and enterprise data access save lives and money by creating a system that is proactive, resilient, and flexible. Enabling data-driven decision making means more efficient use of funds and improved overall asset conditions. These systems also allow for predictive analysis of historic safety data for prioritizing roadway improvements. Implementing these concepts takes time and an investment of funds, and rushing through it will not work. The process should be broken into smaller pieces, with each piece given a priority based on the organization’s needs and completed in a logical manner.

National Perspectives: Mark Sarmiento, Tom Roff, and Joe Hausman (FHWA)

The WSDOT is not alone in its quest to improve data standards and systems; many States are working on data governance and integration issues. Executive level buy-in and support are key to creating lasting initiatives across departments. Policy changes are effective in maintaining the efforts of data governance work. The FHWA is prepared to work with States to address these issues, and to offer support when possible. Third parties can be useful in the quest to integrate real-time data collection into a State DOT, including data formatting and data collection services. A [Highway Data Conference peer exchange and workshop](#) was held in March 2019 to work on these topics.

WSDOT: Practical Solutions and Performance-Based Practical Design

The WSDOT has struggled with developing practical solutions to integrate data-based decision making. A challenge here is understanding the quality of WSDOT’s data and determining whether it is useful for the management of programs and projects. Making data-driven decisions with high-quality data can ensure WSDOT is able to sustain its work with a limited maintenance budget. At the executive level, many of these decisions are driven by safety and financial considerations, but the importance and usefulness of higher quality data is not fully grasped.

Making data-driven decisions with high-quality data can ensure WSDOT is able to sustain its work with a limited maintenance budget.

At the local level, many transportation decisions revolve around economic vitality. The WSDOT questions how they evaluate the actions they take, and what performance measures ensure their decisions are made well. Evaluation depends on having good data, which does not always exist. Many competing needs exist across the agency, and there is not enough money to meet all the identified needs. Having high-quality data can prioritize these needs and direct funding more efficiently and effectively.

Goals for WSDOT’s GIS program include:

- Supporting integrated data-driven decision making.
- Supporting asset management improvements.
- Improving systems and modes integration.
- Aligning GIS-related investments, budgets, and policies with business needs.

Presentations by Peer States

Connecticut DOT (CTDOT): Collect Once and Use Many Times

The CTDOT’s approach to data governance focuses on breaking down silos and ensuring that data can be used across the entire agency. All data are stored in CTDOT’s data warehouse known as the Transportation Enterprise Database (TED) while being maintained in their original systems. This structure for the data means that data owners do not change their day-to-day processes. The agency’s approach has three implementation steps:

1. Identify data stewards who will collect and maintain data.

2. Create the appropriate data linkages within the system (from original systems to TED). This step addresses how the data links to the locational referencing system (LRS) and in what system will it be maintained.
3. Develop and implement tools to support data collection.

Florida DOT (FDOT): Authoritative Data Sources and Eliminating Redundancy through Communication

The FDOT identified their data stewards throughout the department and across the State. Given their district and headquarters structure, issues arise in duplicative data sources. The agency is making an effort to identify where definitive data sources are located and how to access them. Data is marked as a “definitive source” in ArcGIS Online to aid this process. FDOT is migrating toward a data warehouse solution for all entities to push their data toward and enable access to one unified, statewide data set.

The FDOT is currently eliminating redundancies by ensuring its districts know where to obtain definitive data sets created by FDOT’s Headquarters Office. The agency is working to integrate spatial data from other departments, including proprietary data sets. These data sets are integrated with geographic data sets for a number of purposes, including monitoring the impacts on ports from hurricanes and tariffs on Chinese imports and exports.

North Carolina DOT (NCDOT): Managed Data, Data Quality, Data Standards, and Enforced Rules

Data is an asset and it needs to be maintained like one. NCDOT undertook an enterprise data management initiative a few years ago that failed because the work was assigned to the IT department and the planning divisions did not participate. Without the participation of the planning division, the IT department could not fully capture the final business needs of the data users. The agency is trying again now with new management. The enforcement of data governance is critical to its success. After putting policies and structures in place, it is necessary to monitor how often standards are being met. Performance measures need to be tied to the goals of the data governance program in order to see results.

Analytics has been a challenge for NCDOT. There are so many different analysis tools available, but not enough that take into account the real nature and quality of the available data within their processes. This leads to analysis paralysis, which is cured by an iterative process of analysis—choosing a path and then improving as it progresses.

Ohio DOT (ODOT): Asset Management in Enterprise GIS

Asset management planning requirements helped ODOT organize and focus their data management activities. The ODOT implemented a leadership team for data governance issues to drive a shift in culture. According to ODOT staff, to manage the asset, you have to manage the data. The ODOT’s Asset Management Audit Group (TAMAG) is a cross-functional team that works across departments to ensure that the collection of data happens the right way the first time (e.g., has correct metadata, uses consistent field names, collection happens on a standard schedule, etc.). The TAMAG has district coordinators to organize the implementation and analysis of data standards, and follows a three-phase process that ensures that the agency is synchronizing its efforts to work toward effective asset management.

Utah DOT (UDOT): Benefits of Data Integration and User Feedback on Enterprise GIS

The UDOT believes it is important that users be able to access and rely upon UDOT’s data sets so that they become part of the driving force for keeping them well maintained, and can help identify any inconsistencies or errors in the data. The agency is trying to make data available throughout the organization, even to non-GIS experts, and has worked to increase data literacy across employees. The UDOT’s enterprise system data is updated automatically from component systems, avoiding lag time from storage of data on individual desktops. Having these data sets available across the agency also prevents data duplication from occurring. The State DOT

regularly performs outreach to subdivisions across the agency as part of its quality control plan, and is developing an official data governance standards policy.

Executive Engagement Report on Key Takeaways

The peer exchange featured a session curated to help gather input and provide context on WSDOT data integration efforts to top executives across branches within the agency. These executives described ways that enhanced data quality and availability would be beneficial to their business processes, and ‘consulted’ with the participants of the peer exchange for advice on how to improve their processes. The takeaways listed below resulted from the listening session:

Principles:

- **Data = dollars.** A benefit-cost analysis should be performed for data collection, data gaps, and data needs. These analyses should inform a budgeting process to fund creation of high-quality data sets that align with WSDOT priorities (safety, state of good repair, fiscal responsibility, etc.).
- **Data integration efforts need buy-in from everyone.**
 - A motivated executive leadership with a dedicated staff is needed to drive cultural change around data stewardship and leverage other disciplines within WSDOT.

The value of data integration is that a DOT can make the best decisions in an efficient, economic, and timely manner.

Objectives:

- Develop a 5-year vision and leverage information WSDOT already has.
- Establish a governance structure that will enforce data governance policies.
- Create an authoritative set of cross-functional, cross-departmental data that can be used multiple ways.

Strategies:

- The agency should focus on meeting its own internal needs for data (even if these needs are beyond the current regulatory requirements).
- Create a position of Chief Data Officer or Chief Information Officer and hire a strong candidate with a game plan (this step is necessary to assess where an agency’s current capabilities and what it needs and wants to have in the future).
- Establish a user group for GIS experts and non-GIS experts to disseminate tools and training.
- The WSDOT should obtain data from leading local jurisdictions, and work together on data standardization and reducing duplicate efforts.
- Use data management as a performance tool, and treat data as an asset in capital management programs.

The Value of Data Integration and Enterprise GIS for Asset Management

Marc Starnes—FHWA Office of Safety

Collaboration with States is an important part of getting work done on data integration. Resources are always a problem for State DOTs—there are unlimited priorities but limited resources. Safety information can help address these gaps, but what information is most important? It is difficult to determine how many fatalities are prevented

by safety policies, or from using appropriate data in decision making. Knowing the benefit-cost ratio of safety interventions is very important in order to know how cost-effective initiatives are and to understand what assets are contributing the most to safety. Data showing the number of lives saved per million dollars invested is needed, or the number of lives saved by treating 100 miles of roadways with an intervention. The FDOT performed this analysis on a project and determined that they made an enormous impact on high-traffic streets by diverting freight through a dedicated tunnel. The CTDOT has also been working with the University of Connecticut on this kind of benefit-cost analysis for safety solutions. Integrating safety and other geographic data sets to show the impact of improved assets in dollars will help to prioritize investments, efficiently target reductions in deaths and injuries, and justify increased safety budgets.

Mark Sarmiento—FHWA Office of Planning

State DOTs strive to make the best decisions in an efficient, economically informed manner. There are limited resources, time, and funding for transportation. Small budgets mean agencies need to identify overlaps, duplicate efforts, and opportunities to coordinate projects to save time, money, and work. The public also realizes benefits when work is coordinated.

Make a Business Case: Quantify how much money and time is spent under current conditions as staff work on flawed data...

Timely data is an important component to this kind of coordination. There are many questions to ask when discussing what “timely data” means. These include:

- Is the data current?
- How long do estimates and analyses take?
- How easy is it to access and/or use other people’s data?
- What is the best data, and how do we know it is the best?

An enterprise database is indispensable in answering these questions. The value of data integration is that a DOT can make the best decisions in an efficient, economic, and timely manner.

The benefits of an enterprise GIS system have been anecdotal so far, and the need to measure progress and clearly communicate value to stakeholders remains. The value of enterprise GIS can be measured through Capability Maturity Models (URISA, Puget Sound Regional Council, and the Slingim-T). A group of State DOTs developed the Slingim-T CMM based Iowa DOT’s model. These CMMs can help to effectively quantify the value of data governance, data integration, and enterprise GIS. Furthermore, evaluation must be integrated into every part of the enterprise GIS process; otherwise; it will always be superseded by other priorities.

Roundtable #1: Defining and Justifying the Value of Investments in Data Integration

- **Ohio DOT** started their data governance project with recommended actions from an in-depth assessment of their data capabilities. The ODOT’s leadership did not want to invest \$20 million into the suggested tasks. However, Ian Kidner quantified how much money and time the State DOT spends under current conditions as staff work on flawed data, to offer a comparison. The ODOT performed more research on how private companies leverage data governance and find efficiencies, and discovered that decision makers can lose 50% of their time through validating “bad data.” The agency then combined this estimate its own time spent on estimates to create an overall savings estimate specific to the agency.

The ODOT measures the current time spent on data cleaning activities so they will be able to measure time savings after implementation of data integration policies. The agency emphasized this process is not to be rushed; the key to success is to work incrementally and keep focused on the next small step to move in the right direction. Constantly explaining and validating to stakeholders the work that is being done will also prove valuable in developing consensus.

- **Iowa DOT** stressed that it is difficult to quantify cost savings from improvements in data, as “you don’t know what you don’t know about your data.” This sentiment recognizes the reality that flaws in data are often hard to identify, difficult to remedy, and can have a significant adverse effect on business processes and the agency as a whole. As the number of employees shrink at State DOTs and as more work is contracted out, operational emphasis will shift toward data, planning, and decision making. The danger of collecting too much data exists, given the number of data points easily accessible through automatic collection and third parties. Data is now the common currency at State DOTs, as opposed to physical infrastructure issues of the past. In the words of Eric Abrams, “data is the new asphalt.” Risks inherent in this move toward larger data sets include analysis paralysis, or not being able to effectively use data to make decisions in a timely manner.

A core part of what State DOTs do is provide services to the public, which is also inherently difficult to quantify. However, an agency can internally connect these services to its goals and accomplish mission objectives. Analytics software can be used to determine what data staff are using and how often they are using it, in order to prioritize data improvements. These analytics can also be used to show how much a State DOT is spending to create and maintain data, and if that investment is justified based on staff usage.

- **Utah DOT** identified advocates to report on the return-on-investment realized through data integration activities, specifically designed for an executive leadership audience. A multitude of small stories helped to make the case for investing in data. In an environment with high turn-over (especially as leaders retire and new staff come aboard), it is incredibly important to have these advocates within other departments able to speak up on behalf of data efforts. The UDOT also recommended linking these investments to saving lives when performing cost-benefit analyses; this added layer of benefit is difficult to argue against and provides a fuller picture of the economic impact of good data.
- **Connecticut DOT** emphasized that the value of data governance/integration/enterprise GIS is being able to use data effectively. New decision support tools (such as Decision Lens) help to use data effectively to make critical decisions at State DOTs. This software has been used at WSDOT and CTDOT, for multiple purposes. The tool identifies project priorities, but needs to have the best data to be able to work and evaluate the impacts of each potential priority. It’s difficult to summarize and advocate for the benefits of better decision making when it is unclear which decisions would be impacted and how they would benefit from using better data. There is a large impact yet to be felt from making decisions in a uniform, informed manner. However, we need to be mindful that these decisions are not all used to make simultaneous cuts to staffing (for instance, by improving three processes that will in theory free up staff time to take on more duties). Condensing staff roles beyond a reasonable limit leads to new problems, so some judgment must be made on the time savings impacts of data investments.
- **North Carolina DOT** has had success building a project selection application from scratch. The previous decision-making process was imprecise and not rooted in data, while the new system is entirely based on objective data. The application also incorporates local actors into decision making, and generates the State Transportation Improvement Program (STIP). In North Carolina, there was a controversy over earmarked projects that were passed at the end of an administration without a data driven decision

making process—and then the executive order tried to eliminate that type of issue. An executive order from the governor created the system, and it was very effective. It is important to get started with using data and improve as you go, continually refining a set of analyses and data that creates robust process each year. We had to create analysis that didn't exist—and as other DOTs have worked on the same process, we've tried to help. We definitely followed the 80/20 rule. Hurricane Florence—any major disaster—points out your flaws and deficiencies. During our 'lessons learned' we discussed data management. Use your disasters to point out why not having that information made it impossible to do our jobs.

Planning for Enterprise GIS: Enterprise GIS Capability Maturity Models (CMMs): Bob Scopatz—VHB

CMMs rank an agency across multiple categories of activity on a scale of 1-5. In order to perform a CMM effectively, agencies should know how they measure against the highest score of maturity in a given category and answer honestly. The CMM can then be used as an action plan to determine what the next steps are in pursuing a higher ranking. CMMs are subjective but valuable, as it is a direct comparison to a modern set of standards set by practitioners on what the state of the practice should be.

Roundtable #2: Capability Maturity Models

- **Iowa DOT** has used the Slimgim model for a few years and it effectively assesses where an agency's weaknesses are. The assessment also provides a list of actions to focus on in order to improve. This provides justification for contracting out work to elevate the quality of the work being performed.
- **Ohio DOT** utilized an internally developed CMM for data governance assessment. The assessment showed that ODOT needed to revisit the basics to create a "roadmap for operational maintenance" of the enterprise systems. The ODOT began using the IT Infrastructure Library (ITIL) in conjunction with their CMM, which provides a framework that breaks down processes and conceptualizes them as services. The ODOT advised WSDOT that a properly done CMM might take up to three years to effectively implement.
- **Washington State DOT** reported discrepancies between what gets reported to executives about the state of agency data, and operational working experience at the staff level. Agency executives are not getting a full understanding of the agency's data management deficiencies. The WSDOT is working to enable their business areas to report more comprehensively in order to reflect barriers to effective data use.
- **Connecticut DOT** worked through this problem by having as many staff members participate in the CMM as possible. The agency also had an assessment actually asking to submit items/data sets rather than simply asking if they exist. This was useful in showing the real state of the agency. The CDOT found that the ITS and transportation systems management and operations (TSMO) assessments were more robust than the Slimgim model. The CDOT also performed a series of stakeholder engagement questions to give feedback on each of the maturity scores, which helped create a more complete picture of the agency's capabilities.

MPOs and Linear Referencing in an Enterprise Approach: Sunil Dhuri—ICF and Maks Alam—Independent Consultant to ICF

One recurring issue with metropolitan planning organization (MPO) data collection and State DOT data collection is a lack of compatibility and interoperability. The two actors are not able to combine their data sources, and thus miss useful data sets or duplicate efforts. There needs to be an effort to determine how States and MPOs are working together to do Highway Performance Monitoring System (HPMS) data collection and how those processes can be improved. Encouraging MPOs to adopt an enterprise approach and helping them find their

place in the national data scene would be beneficial, but lacks an obvious proponent. Who is best positioned to integrate State and local work on these issues, and how would this integration help MPOs (who often have their own data requirements beyond State requirements)?

All projects involve data integration, and the integration functions performed are constantly evolving with data sets and analyses. One example of integration processes was when FHWA was trying to integrate truck volumes into a GIS map to show truck regulations across the country and provide more accurate freight route modeling abilities. This project cycled through multiple rounds of data integration and troubleshooting as the available data sets changed. You'll never have perfect data—so you need to define what you really want from the database and what standards your outputs must meet.

MPOs can be an actor within the All Road Network of Linear Referenced Data (ARNOLD) design structure, contributing data they gather for their own uses to national data sets. There are challenges to absorbing this information into national data sets, which include technical issues (conflation of LRS to centerlines, mismatch between LRS and block group data, version control, etc.) and communication issues (knowledge of the system, acronyms, staff time, etc.). Justifying investment in learning this new system may not be comfortable for MPOs, and a fear of using LRS may hamper the effort. However, using LRS may improve travel demand modeling and transportation improvement program (TIP) creation, which ultimately benefit the MPO.

Roundtable #3: State LRS and Value for Data Integration

- Iowa DOT reported that using an application program interface (API) is important for LRS. The IDOT uses Skyfire— a program that returns a requested data set in XML or JSON format—for their Roads and Highways LRS. The API is not just for IT and the agency's partners, but for all types of requests and allows better access to data. They are able to retrieve a mile marker and return the geometry and the data that comes back with it. This system helps navigate their Roads and Highways system.
- An LRS allows for the visualization of data sets over time and allows agencies to control how data is published to the rest of the organization and when it is published. Determining these “data publishing schedules” is difficult as they change every year due to competing priorities and reporting deadlines. With an LRS, temporality is integrated right into the data, which enables agencies to match data sets based on time. An LRS is dynamic, but a regular GPS is not.
- Florida DOT meets customer demand for weekly LRS publishing by implementing an automated process that creates maintenance event data layers and shape files, and then publishes this data to AGOL. This process is done through FDOT's districts, who syncs their data across the system by Friday afternoon, so the automated update that is run on Saturdays can pull that data.
- Integrating data governance with the Maintenance Department is a major pain-point for some agencies, as maintenance staff often operate on a different set of priorities for work. The problem is that maintenance often does not document their work despite the need for this documentation. Without this documentation, there can be no understanding of what has or has not been done on an asset and what its condition is.

Data governance has to happen, and requires a champion *and* executive buy-in.

Define standards: You'll never have perfect data—so you need to define what you really want from the database and what standards your outputs must meet.

Day One Key Takeaways

- Executives are ready to take action, and are committed to working across departments.

- Data governance has to happen, and requires champion *and* executive buy-in.
- Enforcement of data governance standards is necessary.
- Calculating the value of data governance and conveying that message to leadership and staff is critical.
- CMMs are a useful tool for creating action plans. Agencies should strive to have as many staff participate as possible to ensure a true reflection of the agency’s current state.
- LRS and enterprise GIS systems must deal with the temporality of data instead of solely the spatial component of it.
- LRS can be used to create a platform of “platform agnostic data,” which allows the data to be used across multiple software platforms so staff can work on their own preferred platforms.

There are no longer “Microsoft Excel specialists”; when software is embedded into the culture of nearly every office and nearly everyone can use it, it becomes universal.

Day Two Activities

Roundtable #1: Enterprise GIS for Data Integration

Implementing an Enterprise System

Solidifying a GIS team foundation should be the first priority when implementing an enterprise GIS system. Once this is complete, the team should ensure that all staff are on the same page. Only then should data assignments be given out. Delegating data collection and maintenance to the most appropriate department(s) should be done after data governance policies are in place.

Integrating the external system connections to your data can be a challenge. Iowa DOT relies on APIs to check their data references, and discourages using milepost signs as a reference because they are frequently moved. This is important because funding for assets can be tied to an inaccurate milepost. A solution for this is to assign a random identification number to an asset.

Enterprise GIS takes a long time to be truly implemented, and is facilitated best by having a designated leader who has the authority to take action. The IDOT recounted the importance of having an executive level position within its own GIS department. When IDOT changed its organizational structures and shifted the responsibility of database management back to its IT department, IT managers were asked to embed two IT staff into the GIS team to better understand the GIS database. This move eased the migration of the database management to IT. To be successful, Iowa needed the authority and vision of an executive level staff member to bring concepts and business processes together, and ensure they were implemented across departments. If an enterprise system is built correctly, data is interchangeable between GIS and IT.

An enterprise GIS system can circumvent the need for a certain level of data literacy. In an enterprise system, data sets are authoritative and different levels of access can be granted based on a user’s technical skill level. This enables effective gatekeeping of data creation. Disseminating access to tools like Survey123 and Esri Collector is also an important component. The benefits to having good data accessible to many staff members outweighs the danger of staff misusing the data, which is relatively rare. For example, there are no longer “Microsoft Excel specialists”; when software is embedded into the culture of nearly every office and nearly everyone can use it, it becomes universal. Iowa DOT said they would rather deal with the chaos of providing all the tools to people than not letting staff experiment and be challenged.

The California Department of Transportation (Caltrans) has found that managing its large number of users and servers is difficult, and getting in front of a problem is critical to making the necessary changes early—before dissemination of incorrect data. Caltrans had success in building an enterprise GIS at the district level that crossed departments. This system had ready access for different business units built into it.

Regular meetings where the business managers meet to discuss data issues can lead to conflict, but this is where progress is made. Barriers fall quickly when every asset manager is in the same room. The WSDOT will be attempting to do this during the process of modernizing their LRS. The agency foresees difficulty in getting its business groups to participate in this activity, and keeping focus on business needs rather than “business wants.” The WSDOT hopes these meetings will help staff to understand how interconnected its business objectives are, and the scale at which data is used throughout the organization.

Other Key Takeaways

- The “enterprise GIS implementation triangle” used at Iowa DOT consists of “Vision, Infrastructure, and Authority.”
- Build the enterprise system to match the agency’s data needs and business processes, not the other way around.
- All the agencies that seem like they are doing great were not always so successful. They had to start somewhere.
- It is important to have one person who can get everything together, a “data champion” who has the ear of executives.
- Talk to users and find out their data needs. This will drive the rest of the process.
- “Useless” data is still data—use an iterative process for improvements.

Roundtable #2: Institutionalizing Data Governance and System Maintenance

The recommendations for WSDOT to begin institutionalizing data governance began with determining what is needed to perform business functions, and then determining the needs of business managers. Defining what WSDOT needs should be the first primary focus, and staff should not worry about selecting a technology platform until those needs are defined. Forcing workflows based on what software can do instead of what is needed will destroy any efforts to institutionalize data governance.

If WSDOT begins to think of data as a process, and begins to figure out what the product needs to be and why it is needed, data governance will eventually work.

Communication is not occurring between business units at WSDOT, and the agency does not currently regard its work as a “conveyor belt of information.” The agency is encountering issues with staff having too much work to see where their work fits on this conveyor belt, and their performance is evaluated based on taking care of their core responsibilities. If WSDOT begins to think of data as a process, and begins to figure out what the product needs to be and why it is needed, data governance will eventually work.

The NCDOT reported it is also struggling with this problem, but has started assessing agency performance as a whole rather than looking at individual business unit performance. Management has to make this a priority to ensure that all staff are striving to work together rather than only doing a great job within an individual group. However, the need to look at the downstream effects should not paralyze action. Years can be spent analyzing the agency and result in not moving forward at all.

Another school of thought proposes that if silos need to exist, then they need to be connected. One model is a ‘perforated silo,’ or groups of specialists who are interconnected and able to reach through silo walls. This is of crucial importance in implementing effective data governance. Otherwise, data governance simply becomes an IT process.

In data work, keep focus on business needs rather than “business wants.”

Structuring Data Governance

Ohio DOT has an asset management team whose work includes data governance. The group meets monthly, developed a routine, and can run through an agenda too quickly sometimes. Ohio DOT wants to change this dynamic to be able to connect with people and really explore what is working and what is not in terms of data governance. Agency leadership needs the emotional intelligence to determine how well the job is being done, and effective in-person meetings are essential to moving data governance forward.

The CTDOT has a TED group and data governance council that both work on enterprise data issues. The data governance council consists of higher-level staff but the TED group is open to any staff member using or maintaining data. One of the purposes of such a group is getting staff to not see their data as “their data,” while also providing a forum for specific problems.

Cultural Shifts

Determining what drives agency data culture and capitalizing on this information can yield powerful changes in an agency. These drivers include: mission and values, customs and traditions, social organization, economy, symbols, and language.

Agencies should be cognizant of inherent biases in the usual method of doing work (e.g., planners vs engineers vs IT). The data governance process needs to be more than one person or office dictating how business will be conducted; adopt a “don’t do this **to** us; do this **with** us” approach. The WSDOT’s Open Data Committee is taking this approach. Agencies should also empower staff members by asking them to problem-solve and think of ways to perform their jobs more effectively. Collaboration can be difficult, and can also be new for some individuals, but it is worth doing. Getting staff in the same room and talking is half the battle.

Adopt a “don’t do this **to** us; do this **with** us” approach.

Training Needs

Iowa DOT carried out Metadata requirement trainings by having a GIS staff member host trainings to explain the requirements, why they were being imposed, and gather feedback on metadata. Enforcing these metadata requirements involved taking content down (if it didn’t meet IDOT standards) to make staff understand that there are consequences for not following the new metadata requirements.

Supervisors can create and view curriculum and assign courses and training tasks in learning platforms like the Saba Learning Portal created by PeopleSoft. Utah DOT has some open links for training and a learning portal for new employees that has short videos on GIS topics. They have also extended their remote learning program, and a communications team that writes features on the teams to share information across the organization and create connections and name recognition. Tools like these are useful for promoting agency-wide data knowledge.

Care should be taken to avoid offering too many trainings, as there is such a massive amount of training content that it can be overwhelming. The NCDOT manages this by having an on-staff trainer for “GIS 101 and 102,” and then develops custom in-house training plans based on individual needs. Training all staff might be counter-productive and unfeasible. Therefore, understanding and targeting the needs of staff and the organization is necessary. Ohio DOT recommended connecting training seminars to job functions. Webinars can be recorded and referenced for future trainings. Caltrans recommended contracting with universities for cost-effective production of training videos.

LRS training as a basic requirement for new DOT staff is a good idea for State DOTs to build a general body of knowledge and ensure all their staff understand the concepts behind linear referencing and why it is so useful. Non-formal training and learning opportunities can be an important part of the curriculum. After-action reviews are useful and effective in fostering growth, as are mentorships and developing an “expert staff directory” for new staff to contact with questions.

The WSDOT reported that while the agency has a GIS trainer, there is limited training time available for staff. As such, there is a conflict between focusing on basic “GIS 101” type courses, or more advanced or conceptual content. Ohio DOT recommended identifying knowledge gaps and focus on them. Are staff performing complex analyses or are they making a basic map? Create training tiers and assign staff to those education plans based on their needs.

Funding for Data Governance

State Planning and Research (SPR) funds can be used to perform data governance activities. Division Offices do not typically tell States what to do with these funds (unless something has gone wrong). Other sources of funding that could be useful include Highway Safety Improvement Programs (HSIP), the National Highway Traffic Safety Administration (NHTSA), State Transportation Improvement Programs (STIP), Every Day Counts (EDC), Traffic Records Coordinating Committees, and gas tax funds, as well as Transportation Research Board/American Association of State Highway Transportation Officials (TRB/AASHTO) for research projects. FHWA Division Offices are also available to provide assistance in finding funding, and also provide funding for case studies and peer exchanges.

Don't be overly optimistic, or gloss over the bad stuff. Show the areas of opportunity.

The WSDOT reported that their financial systems are part of the first wave of a system overhaul so that the agency can perform effective accounting. The agency also needs to build a coalition of people who will support the work, and be able to work across divisions. Users are a great addition to this pool of supporters.

Other Key Takeaways:

- Transparency in the data governance process yields more and faster progress.
- Don't be overly optimistic, or gloss over the bad stuff. Show the areas of opportunity. Look at deficiencies and achievement gaps.
- Ensure that the agency is making progress, but don't try to do it all at once.
- Showing good follow through can improve relationships and trust within an organization.
- Be okay with failure, and with learn from mistakes.
- Schedule time for learning, adopting new tools, and change management.

Roundtable #3: Noteworthy Practices

Maintaining Institutional Knowledge

‘Criticality’ is important to analyze when determining what information to maintain on the institutional level or being able to let information go when an employee leaves. Understanding the agency’s core mission and how the data serves this mission can help answer these questions. The WSDOT has a data catalogue that attempts to do this, with applications organized into “families”—what are they used for, functional domains, and organizational domains. The ODOT suggested using this during employee orientations, as it would be highly useful for staff to understand all of this up front. MITRE has been piloting anticipatory information systems to answer what a new employee may need and when they may need it.

Communication Is Key

Most of the issues discussed thus far are communication-based. Data governance is relatively new for many State DOTs from a GIS perspective, so miscommunication and the need for new communication models should be expected. These DOTs are realizing that they need data governance in place to do what they want to do, and there is a great deal of interest in pursuing it.

It is also important to have effective communication between the top-level executives of an agency, the mid-level data governance council/group, and the implementers and data stewards. Having open and frank conversations about what is working and what is not across multiple levels increases the chances of success. Emotional intelligence is at the core of this step. It is important to think of how someone may hear the information being told to them, and if they understand what is being communicated.

The approach to communication and the overall process is just as important—as one participant said, “The more you grip, the more systems slip through your fingers.” Top-down mandates concerning data governance are usually ineffective when compared to a grassroots effort to build staff buy-in and capitalize on staff knowledge. Involving staff early and often in the process will produce better results from both a change management perspective and in the overall data culture.

Dealing with Agency-to-Agency Integration before Emergencies

The WSDOT has been struggling to keep up with the changes happening in its agency and new requirements of its customers, and is now working with local agencies who may be more advanced in data methods and systems. The CTDOT did not involve local governments early enough in their process, and were afraid of being told by the local agencies that their processes were wrong or ineffective. “If we started earlier we may not have had some of the relationship issues we are having now,” CTDOT expressed. Agencies are often coming to each other when there are emergency needs, which is less effective than advance coordination. Caltrans had an oil spill flowing through culverts into the ocean, and because the data on culverts was in good shape they were able to respond in hours to the data needs on where the affected culverts were and how to reach them.

Understanding the Benefits

Staff with better quality data can sell their projects to legislature better and more readily answer questions. “What does it cost, what is the benefit? How many of this asset do you have, and how much equipment/labor goes into maintaining it?” More and better data prevents having to ask the legislature to simply trust the DOT.

Data governance can also aid in appropriating funds and using them to greater effect. The underfunding of IT infrastructure across the country has led to gaps in the infrastructure needed to absorb the volume and diversity of data being generated and used. Data governance can help stay ahead of this issue by directing funds to where the data needs are.

Questions for criticality:

- Is the data unique?
- How difficult is it to maintain?
- How important is it?

Dealing with Legacy Systems

Fifteen years ago, Utah DOT migrated from their legacy mainframe to Oracle databases housed within the GIS department, and then virtualized to off-campus servers. Now, UDOT is migrating to Cloud technology, but there is one mainframe application still running. The agency has centralized all the data into a geospatial Oracle database, and all new applications must have APIs that link into that database system. This approach helped them effectively move toward a more functional and effective system, while updating legacy systems.

The WSDOT has 14 legacy systems and the last time the agency performed an assessment of them was 10 years ago. The WSDOT applied for funding to replace these systems, but was rejected. The agency is going to be performing another assessment, starting with their financial system, and hopes that including these updates in an agency-wide data integration and enterprise data strategy will yield more favorable results.

Next Steps for WSDOT

- NCDOT commented that WSDOT already has the business architecture in place, which is a great place to start from. Building executive buy-in is the next course of action. The presence of executives at the peer exchange shows promise and is an excellent first step.
- Florida DOT recommended that in addition to marketing successes, WSDOT should also focus on the impacts of investments (or costs of not investing) and market how those investments are performing.
- Washing State DOT should set realistic expectations and begin the data governance process knowing that some (or many) business processes are going to change. Some things may not work out, but that is part of the process. Ohio DOT has a chart that tracks what is working and what is not, the amount of time spent troubleshooting to address errors, and tracking the downstream impacts of having to use staff time to fix it. NCDOT implemented data governance thinking the policies were going reduce the time it takes to enter projects into the system, but actually wound up increasing it.
- Identify what implementation of data governance will do to WSDOT's HPMS.
- Establish some form of leverage to make sure software issues are addressed by your vendor. If one State can fix a problem, it may be possible to fix it for other States too. If five States contact Esri together, those States will not have to pay for five different troubleshooting problems. The CTDOT urged WSDOT to be more forceful with complaints to Esri. They will have no choice but to respond to these issues when multiple States ask for something. Roads and Highways doesn't seem to get enough support. Furthermore, Ohio DOT recommended negotiating with Esri in terms of business impacts (ex. amount of staff time loss) is effective.
- Assess if you are working with legacy systems that could simply be shut down—Alabama DOT took this approach, and just turned them all off and made a new system. Work from where you are—are you complex or are you simple?

Appendix - Agenda

Day 1 (Wednesday, November 14)

- 8:00 AM Opening Remarks
- Keith Metcalf, Deputy Secretary of Transportation, Washington DOT
 - Mindy Roberson, Assistant Division Administrator, FHWA Washington Division
- 8:10 AM Introductions, Agenda, and Meeting Logistics (*Moderator: Bob Scopatz*)
- Welcoming remarks **(15 minutes)**
 - John Milton—WSDOT perspective
 - Stuart Thompson—FHWA Office of Safety perspective
 - Don Petersen—FHWA Division Office perspective
 - Introductions **(20 minutes)**
 - Brief overview of agenda **(5 minutes)**
- 8:50 AM Discussion: Peer Exchange Objectives, Bob Scopatz and Stuart Thompson
- 9:00 AM Opening Presentations and On-going Activities (*Moderator: Tim Harmon*)
- Data Management, Governance & Integration - Bob Scopatz—VHB **(20 minutes)**
 - What is it?
 - Importance of for performance-based approaches to safety, planning, design, operations, and asset management.
 - What is a linear referencing system (LRS).
 - What is Enterprise GIS and why is it important for data integration and spatial data management.
 - Mark Sarmiento, Tom Roff, and Joe Hausman—FHWA Office of Planning **(20 minutes)**
 - Noteworthy practices from additional states (not at the peer exchange)
 - WSDOT Update **(20 minutes)**
 - Practical solutions & performance based practical design
 - Our performance framework and our challenges—where we've been and what we've done so far
- 10:00 AM *Morning Break (15 min)*

Executive Briefing

10:10 AM	<i>Executive Briefing Starts:</i> Executive Briefing Welcome & Introductions
10:15 AM	Recent Assessments and Key Findings (<i>Moderator: Bob Scopatz</i>) (20 minutes) <ul style="list-style-type: none">• RDIP, State Safety Data Capabilities Assessment, Traffic Records Assessment, and other recent findings. Bob Pollack and others—FHWA Office of Safety
10:35 AM	Executive Presentation (<i>Moderator: Bob Scopatz</i>) (50 minutes) <p>FHWA and peer States will discuss the benefits of integrated data and an Enterprise GIS. Each State listed below will start the discussion and other peer States can add their perspective as they see fit. (about 8 minutes each):</p> <ul style="list-style-type: none">• Collect once/use many times. (Greg Ciparelli—ConnDOT)• Authoritative data sources and eliminating redundancy. (Paul O'Rourke—FDOT)• Managed data, data quality, data standards, and enforced rules (John Farley—NCDOT)• Asset management in Enterprise GIS. (Ian Kidner—ODOT)• Enterprise decision-making with integrated BI support tools (Eric Abrams—IowaDOT)• Benefits of Data Integration and Enterprise GIS (Scott Jones—UDOT)
11:25 AM	Group activity/discussion (<i>WSDOT Facilitator: Stan Suchan</i>) (35 minutes) <ul style="list-style-type: none">• What opportunities are available to WSDOT?• What are the concerns?• What is WSDOT already planning to do?• What are the next steps?
12:00 PM	<i>Executive Briefing Ends</i>
12:00 PM	<i>Lunch (delivery – order by 9:30am) – (1 hour)</i>
1:00 PM	The Value of Data Integration and Enterprise GIS for Asset Management (<i>Moderator: Bob Scopatz</i>) <ul style="list-style-type: none">• Marc Starnes—FHWA Office of Safety (15 minutes including discussion)• Mark Sarmiento—FHWA Office of Planning (15 minutes including discussion)• Roundtable: Asset management & data integration (60 minutes)<ul style="list-style-type: none">○ Ohio, Iowa, Utah, Connecticut, North Carolina, Washington, others
2:30 PM	Planning for Enterprise GIS (<i>Moderator: Tim Harmon</i>) <ul style="list-style-type: none">• Enterprise GIS Capability Maturity Models, Bob Scopatz—VHB (10 minutes)• Roundtable discussion (20 minutes)<ul style="list-style-type: none">○ Iowa, Ohio, others
3:00 PM	<i>Afternoon Break</i>

- 3:15 PM Linear Referencing (*Moderator: Tim Harmon*)
- MPOs and Linear Referencing in an Enterprise Approach, Sunil Dhuri—ICF and Maks Alam—Independent Consultant to ICF **(30 minutes including discussion)**
 - Roundtable: State LRS and value for data integration **(30 minutes)**
 - All States
- 4:15 PM Discussion: Key Takeaways and Day 1 Wrap-up (*Moderator: Bob Scopatz*) **(15 minutes)**
- 4:30 PM *Adjourn*

Day 2 (Thursday, November 15)

- 8:00 AM Opening Discussion (*Moderator: Bob Scopatz*)
- Introductions (for those not present on Day 1) **(15 minutes)**
 - Recap/discussion/feedback on Day 1 and any outstanding topics. **(15 minutes)**
- 8:30 AM Roundtable: Enterprise GIS for Data Integration (*Moderator: Tim Harmon*) **(90minutes)**
- What are the benefits and how important is the LRS?
 - Biggest returns from enterprise GIS for data integration?
 - Challenges of moving toward an enterprise approach/change management?
 - Practical examples of successes and potential failures?
 - What tools and technology to use and why?
- 10:00 AM *Morning Break (15 min)*
- 10:15 AM Institutionalizing Data Governance and System Maintenance (*Moderator: Bob Scopatz*)
- Leni Oman: Washington Accelerated Innovation (AID) project **(30 minutes)**
 - Round Table **(60 minutes)**
 - Role of Data Governance in Data Integration
 - Structuring and Enforcing a Data Governance Model
 - Succession Planning
 - Consistent terminology and single source of truth
 - Culture, implementation, and change management
 - Results of not implementing data governance framework
- 11:45 AM Themes/conclusions from morning sessions (*Moderator: Tim Harmon*) **(15 minutes)**
- 12:00 PM *Lunch (delivery – order by 9:30am) – (1 hour)*

- 1:00 PM Roundtable: Noteworthy Practices (*Moderator: Mark Sarmiento*) **(90 minutes)**
- What has worked well with various states.
 - Introducing changes to policies and procedures.
 - Moving from a Legacy System and bridging across silos.
 - Practical Implementation of Enterprise GIS.
 - Best Practices/Lessons Learned.
 - What training is needed.
 - Other important notes/topics as needed.
- 2:30 PM *Afternoon Break (15 min)*
- 2:45 PM Discussion—Questions/Topics from Peers (*Moderator: Bob Scopatz*) **(45 minutes)**
- 3:30 PM Discussion—Next Steps for WSDOT (*Moderator: Tim Harmon*) **(45 minutes)**
- 4:15 PM Concluding Remarks **(15 minutes)**
- 4:30 PM *Adjourn*



Attendees from Washington DOT

Last Name, First Name	WSDOT Division	Office/Section	Unit/Branch	Email
Baker, Lou	HQ Multimodal Planning	Transportation Data, GIS & Modeling	GIS & Roadway Data Branch	BakerL@wsdot.wa.gov
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* Attending in satellite conference room @ HQ (Brad Manchas as lead)

Note: For phone numbers and contact information of other WSDOT employees: <https://access.wa.gov/contact.wa.gov/#/>

WSDOT Executives Invited to Executive Session (Day 1: 10 – noon)

- Dayton, Kevin
- Elizer, Marshall
- Pasco Bakotich, Pasco
- Carpenter, Jeff
- Woehler, Kerri
- Milton, John
- Chamberlain, Barb
- Davis, Kathleen (Kyle McKeon identified as representative for exec briefing)
- Nisbet, John
- Modarelli, Matthew
- Lagerberg, Brian
- Alexander, Jay

FHWA Washington Division Attendees

- Roberson, Mindy Melinda.Roberson@dot.gov
- Petersen, Don (FHWA) Don.Petersen@dot.gov
- Bakeman, Sharleen (FHWA) Sharleen.Bakeman@dot.gov
- Kunic, Matthew (FHWA) Matthew.Kunic@dot.gov