Preliminary Investigation

Caltrans Division of Research, Innovation and System Information

Meeting Notes on California Safety Data Business Planning, Data Governance and Management – Southern California Peer Exchange

Requested by
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Executive Summary

Background

The Federal Highway Administration (FHWA) has sponsored many Department of Transportation (DOT) peer-to-peer exchange meetings in the past. This Preliminary Investigation (PI) summarizes the Peer Exchange – Safety Data Business Planning Data Governance (DG) and Management Meeting hosted by Caltrans/Southern California Association of Governments (SCAG) February 13-15, 2018. The meeting location was SCAG's new office at 900 Wilshire Blvd. 17th Floor, Los Angeles, CA 90017. The meeting aimed to exchange ideas and best practices on data governance in DOTs and the use of safety data for planning and other DOT business.

The three-day meeting started with several presentations by DOTs and local governments on DG and the use of safety data on Day 1. The meeting facilitators conducted group discussions on multiple topics on different aspects of DG and safety data analysis on Days 2 and 3.

Summary of Findings

Day 1

The first day of the meeting began with attendee introductions followed by presentations from DOTs and local agencies. The presentation PowerPoint files are available from the FHWA. The presentations focused on DG and safety data enhancement for better analysis and project planning.

- NCHRP Report 814 Data to Support Transportation Agency Business Needs: A Self-Assessment Guide[1] was referenced in the presentations.
- Presenters also stressed the importance of Linear Reference System (LRS) as a location reference for all asset and safety data. Safety data analysis is vital for planning that prioritizes safety project deployments. Pedestrian and bicyclist injury data is limited, according to Lake McTighe, the Oregon Metro Project Manager.
- The deployment of All Road Network of Linear Referenced Data (ARNOLD) and Model Inventory of Roadway Elements (MIRE) in the future was discussed in a few presentations, and presenters think that ARNOLD and MIRE deployment will be critical and lead to changes DG, data sharing, and collaboration with local governments.
- Wendy Bates of the Idaho Transportation Department stated that project planning requires integration of local roads into the LRS with local safety data.
- DOTs have used "Radar Charts" to assess their data maturity in various programs. Gap and risk analysis approaches have also being used in DG by other DOTs.
- Access to data is hard, which then leads to data silos.
- There is a need for open data policies compatible with local laws and government policies.
- Next Gen 911[2] was also discussed as a challenge and catalyst for change for better DG.

[1] http://www.trb.org/Publications/Blurbs/173470.aspx
[2] https://www.911.gov/issue_nextgeneration911.html

- A clear and well-defined data dictionary is vital for each dataset and should be completed with DG Policies.
- Caltrans personnel, consultants, and FHWA personnel had a meeting at the end of Day 1 to discuss plans and priorities for group discussions during meeting Days 2 and 3.

Day 2

Penelope Weinberger, American Association of State Highway and Transportation Officials (AASHTO) Transportation Data Program Manager, provided details of the AASHTO subcommittee on Data Management and Analytics priorities on:

- Data practices
- Core data principles
- Analytic tools
- Data standards
- TransXML,[3] (Transportation eXtended Markup Language (XML))
- GIS-T program[4]
- Pooled fund studies

UC Berkeley Safe Transportation Research and Education Center's (SafeTREC's)[5] Transportation Injury Mapping System (TIMS)[6] was presented.

The remainder of meeting Days 2 and 3 consisted of several group discussions on various topics related to DG and safety data analysis.

Local, and State Collaboration on Safety Data

The challenges of sharing safety data were discussed by participants. Caltrans presented their plans on improving the LRS, including support for dynamic segmentations. Caltrans plans to replace its Transportation Systems Network (TSN) by 2024 and use ESRI Roads and Highways[7] for LRS. Caltrans Strategic Highway Safety Plan (SHSP) has identified SHSP Challenge Areas[8, 9] to reduce accidents.

Caltrans' current challenges include:

- Local partnerships and Next Gen 911
- MIRE data collection
- How to best collaborate with local agencies and integrate local road data into the LRS
- Linking multiple sources to the roadway network
- Support for dynamic segmentation for LRS

[3] http://www.trb.org/Main/Blurbs/158531.aspx
[4] http://www.gis-t.org/
[5] https://safetrec.berkeley.edu/
[6] https://tims.berkeley.edu/
[7] http://www.esri.com/software/arcgis/extensions/roads-and-highways
[8] http://www.dot.ca.gov/trafficops/shsp/challenge.html
[9] http://www.dot.ca.gov/trafficops/shsp/docs/SHSP15_Update.pdf

Iowa DOT has a data portal[10] and an LRS Application Programming Interface (API).

The group discussion identified the following challenges in traffic and crash data:

- Integrating data from the Traffic Records Coordinating Committee (TRCC), Department of Motor Vehicles (DMV), Office of Traffic Safety (OTS), California Highway Patrol (CHP), and the Department of Public Health (DPH)
- Poor traffic data quality
- Traffic data stuck in storage
- Timing, cost, integration, lack of quality and performance measures, and difficulties maintaining and managing traffic data

Los Angeles (LA) County has a data portal and follows a federated model for traffic data. LA Metro pointed out the need for standard performance measures for traffic data and cost sharing for cloud services. LA Metro and Georgia DOT buy traffic data as a service. SCAG uses traffic data from the Performance Monitoring System (PeMS), INRIX Traffic,[11] and in-house local data sources. SCAG plans to supply tools and support to gather accurate data from local jurisdictions using the cloud.

Data Governance

The Minnesota DOT (MnDOT) has a statewide GIS data portal, Minnesota Geospatial Information Office (MnGeo),[12] run by MN Information Technology (IT). MN has a statewide geospatial advisory council which defines goals. MnDOT added temporary and part-time staff for data management, and these staff are transitioning to full-time staff.

Staff require additional training. Using subject matter experts to do internal training has been successful. Staff must work both internally and externally (outside their division).

GeoCommons,[13] a community contributed collection of open data from around the world, was mentioned during the group discussion. Uploaded by the public, data are often from public and open government websites and sources. The searchable archive includes over 150,000 datasets as GeoJSON (JavaScript Object Notation) stored on GitHub[14] and available to preview, download, or explore in ArcGIS.com.[15]

Florida DOT (FDOT) went through an IT consolidation from 2010 to 2014. FDOT has hired a Geospatial Information Officer/Civil Integrated Management (GIO/CIM) manager. FDOT divisions put together their own data business plans internally. FDOT executive support is strong and promotes an enterprise approach for data access. FDOT structure gives districts autonomy. FDOT districts have set up dedicated staff for collaboration.

Iowa DOT agrees that “getting your own house in order first” is essential. After “getting your own house in order,” then a DOT will be ready when asked to collaborate.

Oregon DOT (ODOT) has worked with consultants with good results in DG. Every ODOT district has an active IT coordinator and dedicated staff for DG.

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[10] http://data.iowadot.gov/
[11] http://inrix.com/products/traffic/
[12] http://www.mngeo.state.mn.us/
[13] http://geocommons.com/
[14] https://github.com/geocommons/
[15] arcgis.com

Start by working with other local agencies who are ready to collaborate. Some agencies may not be ready to collaborate.

Georgia DOT advised that a DOT should make sure systems can handle data size and the level of usage.

Connecticut DOT has one active key staff to act as coordinator.

Change Management

Caltrans advised on Change Management in order to achieve consistency among districts and divisions due to structural differences between Headquarters (HQ) and districts. Getting buy-in and resource allocation is difficult. Defining and enforcing roles and responsibilities is tricky.

The following is advice derived from the group discussion:

- Stewardship policies and charters for stewards are important.
- FDOT has a CIM Officer.
- Managing expectations and having well-defined roles and responsibilities for the data steward and IT is vital.
- LA Metro found that centralized control does not work; a federated system is better. A centralized IT adds layers of approval.
- Let the business area control the data, and then ask for what they need from IT.
- If it takes too much time and effort to collaborate, this will foster work-arounds and data silos.
- “Good employees follow policy; great ones tweak it.”
- Informal get-togethers can develop cooperation.
- Arizona DOT (ADOT) advised that policy might be a band-aid. A GIO should focus more on guiding principles. Next Gen 911 was a catalyst for change.
- The top few key data elements in ARNOLD and LRS are important to many agencies.
- Set up partnerships with non-traditional partners such as 911
- Washington DOT (WSDOT) advised always keeping business partners in the room. Staff-level participation builds relationships.
- Leave an open door with raw data and an API for data analysts. Data analysts can program, and they are often sources of innovation.
- An asset data management committee can coordinate and understand the members’ needs.
- If you know the different business units’ needs, you are better able to tailor the message and get buy-in and collaboration. Roadshows to districts and divisions are important to promote buy-in and collaboration and to find or get to the right persons in the districts and divisions.

Advice on Data Inventory, Data Catalog, and Metadata Management

- There is a need for a data dictionary. A well-defined glossary and data definition are an important first step.
- Data inventory is ongoing but helpful.

- Data inventory is a second step after system implementation. The GIO should focus on key data.
- Data catalog availability spurs innovations.
- If you go for open data, that is your catalog. If the system changes, the open system is automatically updated.
- ADOT uses OneNote to document workflow, dictionary, and knowledge management as well as track changes.
- National Highway Traffic Safety Administration (NHTSA) G Teams can help DOTs improve accident data.
- A data catalog is not enough—users need to know the usage policies.
- David Winter (FHWA) is working on data cataloging issues.
- DG must be discoverable and open.

What Is Your Ten-Year Goal?

The meeting moderator asked everyone about their ten-year goals. The responses were as follows:

- Improve internal and external sharing.
- Data availability: can users access data when staff are not there?
- All data has primary keys and spatial links.
- All integrated data opens doors for more analysis.
- Uniform data formats and standards.
- Open data portal, regular maintenance, consistent LRS.
- Improved safety data quality (for locals).
- Improving Caltrans/CHP accident data:
    - Caltrans/CHP data is not current (2015). Reduce lag time for Caltrans/CHP data.
    - Link CHP data to LRS.
    - It is difficult to extract and verify the quality of data in Statewide Integrated Traffic Records System (SWITRS), Fatality Analysis Reporting System (FARS), etc.
    - Comparable portal to WSDOT's.
    - Open portal for local and state partners, from all agencies for all agencies.
    - Improve funding for data portal, SWITRS, FARS, Highway Performance Monitoring System (HPMS), etc. with ten years data.
    - Caltrans is working on a MIRE charter now.
- Authoritative data sources/agencies clearly assigned.
- Improve crash data: geocoding and timeliness. Currently, WSDOT codes all crash data in-house.
- Improve crash data of transit, non-motor vehicles, pedestrians, and bicycles.

- Beyond safety data, open portals include Business Intelligence (BI) and other capabilities
- SafeTREC identifying critical data elements for safety analysis.
- Vision statement: “right data, right people, right time.”
- Open data portal includes internal and external web service LRS.

Day 3

Business Intelligence (BI) Software

California Senate Bill 1 (SB1) has reporting requirements. Caltrans is looking into deploying Business Intelligence (BI) Software. Chad Baker asked for feedback on BI software such as Tableau,[16] Informatica,[17] and Power BI.[18]

- WSDOT commented that Informatica is good on metadata.
- Having a data model available would promote collaboration with local governments.
- Power BI is good for queries.
- BI software should be considered as a tool in toolbox. Both easy-to-use tools and advanced tools that handle spatial data are needed.
- WSDOT has a crash data portal and is working on a secure portal for government users.
- A data portal needs to capture usage statistics.
- FDOT uses Tableau, and both Virginia DOT (VDOT) and ODOT use Tableau and Power BI.
- A data warehouse needs to support other analytic tools, such as Statistical Analysis System (SAS) and Structured Query Language (SQL).
- A few DOTs use an FME[19] tool to perform spatial datum transformations.
- An API is a key component, besides tabular data.

Turnover in data warehouse work is a problem due to high salaries in the private market. Maintenance of the DG and BI software effort is a concern both in budget and personnel retention.

Possible solutions:

- Get people on fellowships
- Work with university partnerships and university internships
- Leverage internal personnel with skills
- Leverage people from different, related fields, such as library science, statistics, and public health

[16] https://www.tableau.com/
[17] https://www.informatica.com/#fbid=j_t46qrqDkp
[18] https://powerbi.microsoft.com/en-us/
[19] https://www.safe.com/fme/fme-server/

Data Governance Best Practices and Business Plan

Caltrans Geographic Information Systems (GIS) and general data governance are not blended. Caltrans' IT enterprise architecture committee is purely IT. Some IT enterprise architecture committee members are also on the DG board. Caltrans developed a Data Business Plan in 2010.

MnDOT developed a GIS strategic plan and advised that an action/work plan is more useful. MnDOT also found that:

- The work plan needs to track users' issues
- Break down issues into actionable tasks
- Data access is generally the number one issue
- Speed is a secondary issue

ODOT has performed interviews, user surveys, and focus groups in order to develop a living document containing vision, goals, strategy, and action items. In addition, they have also re-interviewed users to get feedback and see if their problems have been fixed.

WSDOT indicated that a skilled facilitator is helpful in DG board meetings. DG board meetings should result in actionable items and measurable results. Every DG board meeting should have a decision to make and solid objectives. Quick wins help inspire people.

Creating a data dictionary or data definitions for existing data is often a good first step. Existing standards, such as the Traffic Management Data Dictionary (TMDD) and the National ITS Data dictionary, are helpful references.

Complaints have value, particularly the complaint source. Complaint volume is a useful indicator of problems.

Outside help can be useful.

MnDOT suggested that IT projects should be reviewed by the DG board.

"Open data and free exchange prevent data silos."

DG Policy vs. Guidelines

Peer group members agree that guidelines are often better than policies. Guidelines allow for experimentation and tolerate failure. Changing out old and outdated policies can be a struggle. There is also a cost in enforcing policies.

Some things must be at a policy level, such as procurement.

The book *Data Governance: How to Design, Deploy and Sustain an Effective Data Governance Program*,[20] written by John Ladley, was recommended.

Pros and Cons of Using Memorandum of Understanding (MOU) for Data Sharing

Caltrans lawyers advised that Caltrans should use MOUs for data exchanges. Chad Baker asked the peers about their experiences with MOUs.

Where are MOUs essential?

[20] https://www.amazon.com/Data-Governance-Effective-Kaufmann-Intelligence/dp/0124158293/ref=sr_1_1?s=books&ie=UTF8&qid=1525126290&sr=1-1&keywords=data+governance

- Mission critical data
- Make sure you have a backup data source for mission critical data
- Financial exchanges between state agencies
- Useful with local governments and native tribes
- Some agencies require MOUs to share
- Avoids project death when key people leave
- MOU creates buy-in and fosters relationships/partnerships
- Require data recipients agree not to sue DOT (WSDOT requires crash data user to agree with WSDOT hold-harmless clause.)
- MOUs clarify what the data can be used for

Cons of MOU

- MOU can be a lot of work
- Tracking and maintaining MOUs can be a problem and requires personnel time

Data Governance Roles and Responsibilities

FDOT thinks that definitions of roles and responsibilities are very important. FDOT has developed a Data Governance Data-Steward-Custodian-Placemat, shown in Appendix A. The FDOT placemat can be taken back to users' offices and allows everyone to know each other's roles and responsibilities. Many peer group members like it and think that it is very useful in prompting DG efforts.

WSDOT has a similar definition documentation, not available to the public, for their data steward. WSDOT also finds that informal working groups are helpful.

ADOT uses OneNote to document data schemes, terminology definitions, and workflow.

ODOT advised that data stewards' roles and responsibilities should be included in personnel descriptions.

Safety Analysis Software

From WSDOT:

- ARNOLD updates need to come from local agencies.
- DOTs and local governments need to integrate their road geometry information.
- Cities are tough to work with. The DOT handles their data collection.
- It is an issue especially for International Roughness Index (IRI) data. Who needs or wants it determines who has to collect it, i.e. the DOT.

Related Research and Resources

DG often goes hand-in-hand with CIM and BI. FHWA All Road Network of Linear Referenced Data (ARNOLD)[21] and Model Inventory of Roadway Elements (MIRE)[22] efforts will promote and standardize safety data programs among DOTs and local governments. LRS and dynamic segmentation[23] features are critical data infrastructure for safety and other DOT data.

Gaps in Findings

This safety data and DG peer exchange identified challenges in development and implementation of GIS strategic plans, DG policies, data sharing, and open data portals. To improve planning and safety data analysis, improvement in crash data quality and timeliness is also vital.

Next Steps

Peer exchange members provided a lot of good advice.

1. Develop an Action Plan
2. Identify a key dataset that has maximum effects
3. Identify a key dataset that is easiest to implement
4. Set up a data portal
5. Develop data dictionaries/gather existing data standard dictionaries
6. Define roles and responsibilities
7. The use of temporary staff, student interns, and partnerships with universities could speed up the process
8. Develop partnerships with local governments and work with those who are ready to share

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[21] https://www.fhwa.dot.gov/policyinformation/hpms/documents/arnold_reference_manual_2014.pdf

[22] https://safety.fhwa.dot.gov/rsdp/mire.aspx

[23] http://desktop.arcgis.com/en/arcmap/10.3/guide-books/linear-referencing/dynamic-segmentation.htm

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Appendix A: Florida DOT Data Governance Roles and Responsibilities (Courtesy FDOT)

FDOT ROADS RELIABLE, ORGANIZED, ACCURATE DATA SHARING

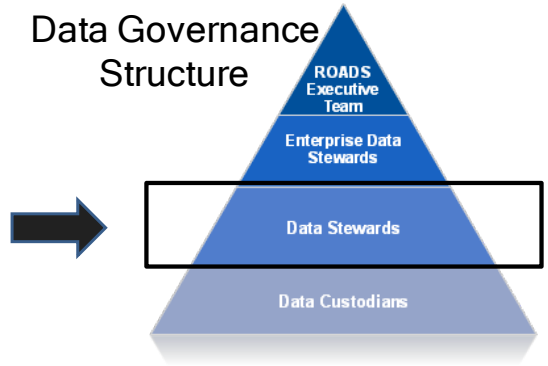
Reliable, Organized, and Accurate Data Sharing (ROADS) Initiative

Seeking to improve data reliability and simplify data sharing across FDOT in order to have readily available and accurate data to make informed decisions.

DATA STEWARDS

Business functional expert supporting the ROADS Initiative, ideally the Functional Application Coordinators or other delegate within the business functional area, responsible for business aspects of data management and governance which includes definition, control, and accountability for data elements within their data sources such as applications or purchased/collected data. A Data Steward works with business personnel to define data needs for their particular functional area. Individuals that are selected as Data Stewards are typically already doing many of the activities of a Data Steward, but just in an informal manner. High level responsibilities include:

- Understand strategic priorities of the business (Enterprise, Central, District, and/or Turnpike) related to functional area along with the processes and data that support the business
- Participate in defining rules, processes, and quality metrics
- Act as a strong communicator and champion of data quality within functional area
- Involved in gathering requirements for tools used in the transformation of data into meaningful and useful information for business analysis purposes, including reporting



Key Data Steward Activities

The following provides an overview of most day-to-day activities that a Data Steward will be involved in as part of the overall Data Governance Structure.

- Provide business function expertise to the Department, Central Office, District, or Turnpike
- Actively collaborate across the department on current and future data governance activities
- Provide business expertise and assess business impact for proposed data initiatives
- Define and maintain clear and unambiguous business metadata including descriptions, definitions, validation rules, and lineage information
- Coordinate adequate documentation including enterprise data glossary, business rules, data quality metrics, and sources of origin and downstream systems from business perspective
- Drive the remediation of data quality defects; develop and implement processes to improve data quality; prepare and update data quality standards and business rules
- Understand the security protocols related to data. Classify the confidentiality and security requirements for the data elements.
- Attend knowledge sharing sessions to learn and use new concepts, tools, and processes

Ongoing Approach

The ROADS Initiative will continue to help close the Data / Information Gaps identified early in the project by:

People: Managing a formal Data Governance Structure to make key decisions related to Data / Information.

Process: Training FDOT on the Data Governance Component Model and Implementing Standard Processes & Routines to provide a formal approach to Data Governance.

Technology: Providing common standardized BI / DW Tools, Technologies and Frameworks that will be used across FDOT to make data/information more accessible.

November 2017, ROADS Team

Reliable, Organized, and Accurate Data Sharing (ROADS) Initiative

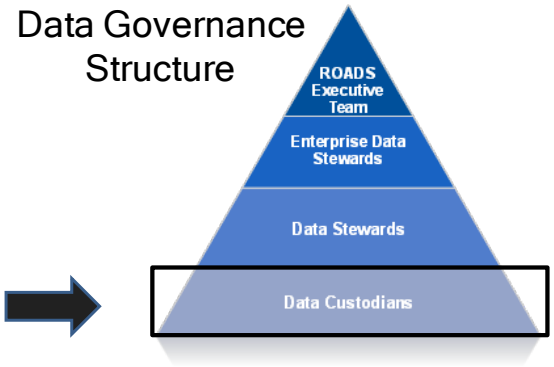
Seeking to improve data reliability and simplify data sharing across FDOT in order to have readily available and accurate data to make informed decisions.

DATA CUSTODIANS

Technical functional expert supporting the ROADS Initiative, ideally from a Business office, responsible for supporting and implementing data governance and best practices for data elements within their data sources, such as applications or purchased/collected data. Data Custodians may work with other technical resources within the business functional area or OIT resources may be relied on to support the responsibilities. Individuals that are selected as Data Custodians are typically already doing some or many of the activities of a Data Custodian, but just in an informal manner. High level responsibilities include:

- Respond to research and information requests of the Data Stewards
- Escalate any items which have an impact on data quality requirements for reporting tools
- Implement data transformations, resolve data issues, and collaborate on system changes
- Maintain quality of the data that they manage

Data Governance Structure



Key Data Custodian Activities

The following provides an overview of most day-to-day activities that a Data Custodian will be involved in as part of the overall Data Governance Structure.

- Serve as the technical resource responsible for the day to day management of data including custody, safekeeping, usage, integration with the business functional area
- Support Enterprise Data Stewards (EDS) and Data Stewards on data governance activities
- Provide technical expertise and assess the technical impact of proposed data initiatives
- Assist with documentation including enterprise data glossary, entity relationship diagrams, data integration, data quality metrics, validation rules, and sources of origin and downstream systems from a technical perspective
- Identify and resolve data quality defects; help define and update data quality standards and technical rules as needed to improve data quality and for consistent usage of data
- Adhere to security protocols related to data. Implement data confidentiality and security requirements
- Attend knowledge sharing and training sessions to learn and use new concepts, tools, and processes

Work Functions Represented

FDOT Work Functions	CIM – Survey Mapping	CIM – TDA	Comptroller	Construction	Contracts Administration
Design	Emergency Management	Environmental Management	Freight & Logistics	General Counsel	GIS
Information Systems	Maintenance	Materials	Planning	Procurement Services	Program Management
Public Information	Research Center	Right of Way	Safety	Support Services	Work Program & Budget

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