

**MARYLAND STATE HIGHWAY
ADMINISTRATION PILOT OF THE
DATA BUSINESS PLAN GUIDE FOR
STATE AND LOCAL DEPARTMENTS
OF TRANSPORTATION**

DATA BUSINESS PLAN

Final Report

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CHAPTER 1. INTRODUCTION

Maryland Department of Transportation (MDOT) State Highway Administration (SHA) has developed a number of initiatives and partnerships that have helped the agency reach a highly mature stage in their mobility data management practices. Among these are 1) the *Transportation System Management & Operations (TSMO) Strategic Implementation Plan*, which institutionalizes planning for operations in Maryland; 2) The *Strategic Highway Research Program (SHRP 2) L06* implementation assistance from the Federal Highway Administration (FHWA), focusing on providing reliable travel time and performance-based planning; and 3) the *Reliability Roadmap* that implements a four-step process for managing congestion.

The *TSMO Strategic Implementation Plan* includes a vision to “maximize mobility and reliable travel for people and goods within Maryland by efficient use of management and operations of transportation systems”. The third goal in the plan is to “Develop data-and performance-driven approaches to support TSMO planning, programming, implementation, and evaluation decisions”. The Implementation Plan identified the need for a Data Business Plan (DBP) to organize mobility data pertaining to planning and operations. At the same time, FHWA approached MDOT SHA to conduct a pilot DBP to test a draft FHWA Data Business Plan Guidance for State and Local DOTs. This DBP serves both as a pilot for FHWA and as a plan for continuing to improve the management and governance of mobility data at MDOT SHA.

As far as external collaboration, MDOT SHA has existing relationships with data repositories (e.g., University of Maryland’s Center for Advanced Transportation Technology (CATT) Lab) as well as providers of data—including speed, asset, and traffic count data. The agency has a strong interest in bringing asset and performance data together, and to involve MPOs and other jurisdictions to be able to more easily coordinate in strategic and tactical processes. Data management and governance is of crucial importance for SHA to move forward in these efforts.

However, many of these initiatives have been conducted somewhat independently, and while a number of MDOT SHA’s offices already have established their own data processes, the agency would greatly benefit from having a unified Mobility DBP to help synchronize all the existing efforts and build upon each other’s strengths. MDOT SHA has already built momentum for this to happen through recent efforts:

- Created a new office for Performance Management.
- Developed a Mobility Dashboard.
- Has expanded Enterprise Geographic Information System (eGIS) (now in its 6th year)—This is an online platform, with about 2,000 internal users, that stores basemaps, map services and widgets and enables their use without requiring an ArcGIS license. They have developed data governance, including identifying data stewards, are finishing an inventory of the authoritative data layers they have, and are developing a catalog and metadata.

SCOPE

Despite the fact that different MDOT SHA offices have collaborated in their data efforts in the past, there is an important need to identify common data sets, common performance measures, and to establish a governance structure that helps identify roles and responsibilities for each office. Specifically, this DBP aims to develop a mobility DBP Framework that includes automobile and freight traffic volume and speed. The Framework will also support data associated with travel origin/destination (O/D) movements, accessibility to transportation, work zone performance, data available from signals related to signal timing, and data generated by connected/automated vehicles. These data topics were prioritized as part of this DBP as follows:

- **Tier 1.** Traffic volume and speed.
- **Tier 2.** Origin/Destination, accessibility, truck freight, work zone, and signal timing.
- **Tier 3.** Connected and Automated Vehicle.

The tiers are intended to assist with prioritizing action items in the Plan. The data elements are described in more detail in Section 3 of this Plan.

The Framework developed in this Plan represents the interaction, structure, and components for MDOT SHA to integrate and report on mobility data. It has three components:

- **Data**—Description of data elements including data inventory and required improvements related to availability, timeliness, coverage, and quality.
- **Architecture**—A high-level description of the interaction between databases and tools to support use of the integrated mobility data.
- **Governance**—Components of an institutional structure describing roles and responsibilities related to ensuring all data is available and able to be integrated.

In summary, this Plan is intended to be:

1. A high-level action plan for improving mobility data and serve as the TSMO DBP recommended in the TSMO Strategic Plan.
2. A pilot of the FHWA Data Business Plan Guidance for State and Local DOTs.
3. An example of how other areas within MDOT SHA could approach the process of developing similar plans.
4. Documentation of existing GIS related data governance and recommendations for MDOT SHA to enhance data governance activities at an enterprise level.

ORGANIZATION

The remainder of the DBP is organized as follows:

- **Section 2: Stakeholder Outreach.** This section identifies the stakeholders for mobility data and summarizes outreach activities used to engage stakeholders throughout each step of the DBP development process.

- **Section 3: Data Definitions, Assessment, and Improvement Strategies.** This section defines the data considered in the DBP and describes the results of a data and capability assessment.
- **Section 4: Architecture.** This section discusses a draft high-level relationship between mobility data sets and integration methods.
- **Section 5: Data Governance Framework.** This section recommends a framework for using data governance principles to support mobility data. It provides a governance framework and defines roles and responsibilities for data governance.
- **Section 6: Implementation Plan.** This section provides a roadmap and steps for implementing the DBP.
- **Appendix A. Stakeholder Registry.**
- **Appendix B. Stakeholder Letter.**
- **Appendix C. Example Data Sharing Agreement.**
- **Appendix D. Example Data Governance Manual.**
- **Appendix E. Glossary.**
- **Appendix F. Acronyms.**

CHAPTER 2. STAKEHOLDER OUTREACH

Stakeholders for Maryland Department of Transportation (DOT) State Highway Administration's (SHA) Data Business Plan (DBP) include internal and external persons and organizations that collect, own, maintain, use, interface with, access, or benefit from mobility data. This section identifies internal and external stakeholders for mobility data in the Maryland SHA area and describes their involvement throughout development of the DBP. Stakeholders assisted in defining the data to be considered in the plan, conducting a capability maturity assessment of the data elements, identifying the desired state for the data, and offering ideas for improvement strategies.

STAKEHOLDER REGISTRY

Table 1 identifies the pilot site champion and supporting staff who served as the main points of contact for the Maryland SHA pilot.

Table 1. Pilot contacts.

Agency	Name	Role	Email	Phone Number
Maryland DOT SHA	Subrat Mahapatra	Pilot Site Champion	smahapatra@sha.state.md.us	410-545-0412
Maryland DOT SHA	Laurie Goudy	Pilot Site Co- Champion	lgoudy@sha.state.md.us	410-545-5681
FHWA Office of Operations	Walter During	FHWA	walter.during@dot.gov	202-366-8959
Cambridge Systematics, Inc.	Anita Vandervalk	Principal Investigator	avandervalk@camsys.com	850-671-0204
Cambridge Systematics, Inc.	Dena Snyder	Deputy Principal Investigator	dsnyder@camsys.com	713-977-0745

Regional mobility data stakeholders are identified in a stakeholder registry in appendix A. These stakeholders played a vital role in identifying the business needs and uses for mobility data from the perspective of their individual offices and agencies.

STAKEHOLDER OUTREACH

Stakeholder outreach was conducted throughout each step of the DBP development process. The Stakeholder Engagement Plan in table 2 identifies the stakeholders engaged in each step of the DBP development, the feedback desired, and engagement mechanisms to gather input from stakeholders.

Outreach with the pilot site took place through the following activities:

- **Stakeholder Letter.** Subrat Mahapatra distributed a stakeholder letter introducing the pilot project. The letter is provided in appendix B.
- **Phone interviews.** Phone interviews were conducted with pilot site champions and partner agency stakeholders to further discuss stakeholder needs and gather information for the DBP.
- **Stakeholder workshop.** One on-site stakeholder workshop was conducted in September 2016 to gather information needed to develop the DBP.
- **Capability Maturity Assessment.** A teleconference was held in December 2016 to conduct an assessment of the maturity of the data elements in terms of data usability, standards, integration, storage, tools, and governance.
- **Stakeholder Meetings.** On-site meetings were held in April 2017 with key data owners to review results, finalize the DBP, and gather feedback for enhancement of the FHWA Guidance.

During the early stages of the outreach, it was decided to focus the DBP internally but to still consider needs of external stakeholders at a high level.

Table 2. Stakeholder engagement plan.

Data Business Plan Development Process	Key Actions	Relevant Pilot Site Stakeholders	Stakeholder Input Needed	Outreach Mechanism
Step 1. Stakeholder Outreach	Identify and document stakeholders Develop stakeholder registry and plan for engaging stakeholders.	Pilot Site Champions	Obtain input on regional stakeholders to include in the Data Business Plan development effort.	Phone interviews
Step 2. Data Assessment	Identify issues related to the collection, management, governance, or use of mobility data programs and stakeholder cooperation / coordination Assess level of maturity within assessment areas using a Data Management Maturity Model.	Pilot Site Champions Regional Stakeholders	Obtain input on specific issues, symptoms, and root causes within each assessment area. Obtain input on maturity within each assessment areas.	Phone interviews Stakeholder workshop
Step 3. Gap Assessment	Identify gaps and overlaps that exist in program activities related to data, data architecture, and data governance.	Pilot Site Champions Regional Stakeholders	Obtain input on what mobility data is being collected within their organizations and at the regional level, how the data supports mobility planning, operations and performance measure activities, and who is responsible for managing/updating data. Obtain consensus on gaps and overlaps that exist in program activities related to data, data architecture, and data governance.	Phone interviews Stakeholder workshop

Table 2. Stakeholder engagement plan (continuation)

Data Business Plan Development Process	Key Actions	Relevant Pilot Site Stakeholders	Stakeholder Input Needed	Outreach Mechanism
Step 4. Improvement Actions	<p>Identify improvements needed to address gaps within each assessment area.</p> <p>Identify desired future condition.</p> <p>Identify strategies/actions needed to move to next level of capability.</p> <p>Prioritize strategies/actions.</p> <p>Develop Improvement Actions.</p> <p>Revise the Improvement Actions as needed.</p>	<p>Pilot Site Champions</p> <p>Regional Stakeholders</p>	<p>Obtain input on improvements needed to address gaps.</p> <p>Obtain input on desired maturity level and steps needed to achieve the goals and objectives of the DBP.</p> <p>Obtain input on priorities and schedule for implementing strategies/actions.</p> <p>Assign responsibilities for plan implementation.</p> <p>Obtain updates on shifting priorities or other data management/governance initiatives.</p>	<p>Phone interviews</p> <p>Stakeholder workshop</p>
Step 5. Data Governance Processes and Documents	<p>Develop data governance model.</p> <p>Determine data governance roles and responsibilities.</p> <p>Develop supporting documentation.</p>	<p>Pilot Site Champions</p> <p>Regional Stakeholders</p>	<p>Obtain consensus on the data governance model and data governance roles and responsibilities.</p> <p>Obtain input and consensus on supporting documentation.</p>	<p>Phone interviews</p> <p>Stakeholder workshop</p>
Step 6. Data Management Practices	<p>Identify data management practices, standards, and policies needed to support management of mobility data.</p>	<p>Pilot Site Champions</p> <p>Regional Stakeholders</p>	<p>Obtain input on data management practices, standards, and policies needed in each focus area.</p>	<p>Phone interviews</p> <p>Stakeholder workshop</p>

Table 2. Stakeholder engagement plan (continuation).

Data Business Plan Development Process	Key Actions	Relevant Pilot Site Stakeholders	Stakeholder Input Needed	Outreach Mechanism
Step 7. Develop Data Business Plan	Document the Data Business Plan.	Pilot Site Champions Regional Stakeholders	Obtain feedback on the Data Business Plan.	Phone interviews Stakeholder workshop
Step 8. Implement Data Business Plan	Execute the strategies/actions contained in the Improvement Actions. Formalize roles and responsibilities to support data governance. Implement performance measures to track success. Report on implementation progress.	Pilot Site Champions Regional Stakeholders	Obtain feedback on proposed revisions of the Data Business Plan. Obtain feedback on training needs and plan effectiveness. Provide an update on plan implementation and seek strategic direction from senior management.	N/A

CHAPTER 3. DATA DEFINITIONS, ASSESSMENT, AND IMPROVEMENT STRATEGIES

This section defines the data considered in the Data Business Plan (DBP); describes the results of a data assessment to identify issues related to the collection, management, governance, and use of mobility data at Maryland Department of Transportation (MDOT) State Highway Administration (SHA); and summarizes MDOT SHA's capability maturity level for each data type according to its use for planning or operations functions.

DATA DEFINITIONS

The following section defines the mobility data in the context of the DBP. All data elements and measures can be reported for freight or automobile, freeway or arterial and are used for either planning and/or operations purposes. There is a "real time" versus "archived" aspect to the data. Note that all data pertains to demand of transportation services rather than supply.

Tier 1

Traffic Volume—Represents number of vehicles travelling on a certain facility of the transportation network. It represents the quantity dimension of mobility. It is expressed as number of vehicles during a certain timeframe. Performance indicators include Vehicle Miles Traveled (VMT) and Annual Average Daily Traffic (AADT). The measures may be expressed in terms of hourly, daily, peak period, weekly, monthly, annually, etc. They can be reported at a facility, network, or area wide level. The source is generally a combination of permanent and portable traffic count devices.

Traffic Speed—Represents the speed of travel on a facility or network. Can be expressed as average miles per hour and can easily be converted to travel time if the distance of travel is known. The source can be travel time runs or probe data such as provided by Inrix or HERE.

Tier 2

Origin/Destination—Generally referred to as flow data, characterizes the movement of people or goods within a transportation network, and is represented as the number of vehicles or people traversing from one zone to another. Traditionally, the collection method was by extensive surveys; however, newer technologies such as Bluetooth and probe data are starting to provide alternate sources.

Accessibility—Defined as the ease in engaging in activities or an ability to reach a desired destination, activities, good and services. Commonly used measures include time, distance, or cost to reach a destination; modal choices/alternatives; connectivity; and number of transfers. For the purposes of this effort, accessibility is defined as the number of jobs accessible through a particular mode (e.g., transit or highway) within a particular timeframe (e.g., 30 minutes). Sources usually include household travel surveys.

Truck Freight—Refers to the movement of goods using ground transportation. This includes tonnage, commodity flow, VMT, speed, and truck parking.

Work Zone—Includes lane closure and movement of vehicles through a work zone. It can be used in conjunction with volume and speed.

Signal Timing—Includes the following components:

1. Inventory—Number and location of signals, system type, controller type, etc.
2. Warehouse data—Timing at certain times and dates.
3. Base timing plan—Queue, signal phase and timing.

Tier 3

Connected and Automated Vehicle—Includes data coming from connected and/or automated vehicles and the FHWA Research Data Exchange (RDE).

DATA ASSESSMENT

MDOT SHA has access to multiple data sources and is interested in various mobility data initiatives. However, it has yet to articulate an overarching direction of where it wants to go with respect to mobility data management and governance. At the moment, data governance efforts are ad hoc, and the agency does not have a governance framework.

This section provides an assessment of MDOT SHA’s current mobility data efforts. The discussion is organized by data type, ending with a list of items that are relevant to multiple data types. For each of the data elements, the following is described:

- **Overview**—Description of data/measures and current efforts underway.
- **Assessment**—Results of a data and gap assessment to identify issues related to the collection, management, governance, and use of mobility data in Maryland.
- **Desired State**—Discussion of desired status of data in the future, including coverage, timeliness, accessibility, and quality.
- **Improvement/Action Strategies**—Strategies that can be implemented to address challenges and reach a desired end state.

Traffic Volume

Overview

- Volume is collected at different levels, with higher-functional class roads having 1-hour cycles and lower-functional class roads having 6-year cycles.
- All volume data is geospatially referenced.
- Maryland SHA is currently working with the Coordinated Highways Action Response Team (CHART) to obtain volume from their devices.

Assessment

- Volume data collection and management are at a fairly mature stage at Maryland SHA and satisfies existing business needs.

Desired State

- Desire to better optimize processes of data collection and processing.

Improvement/Action Strategies

- Receive and implement stakeholders' recommendations on how to optimize volume processes.

Traffic Speed

Overview

- Through the Vehicle Probe Project, Maryland SHA has access to Inrix, HERE, and TomTom probe speed data.
- Spot speed is also collected at Highway Performance Monitoring System (HPMS) sites.
- There are locations with Bluetooth readers.
- Agency also uses the National Performance Management Research Data Set (NPMRDS).
- CHART detectors have the potential to give speed, but they need to be set up and validated to do so.

Assessment

- While probe speed data has been successfully used to develop freeway mobility performance measures, it is still not reliable enough for arterials.

Desired State

- Desire to have lane differentiation for freeways (e.g., high-occupancy vehicle versus general purpose lanes).
- Desire to have probe data broken down by vehicle type. Even with NPMRDS, it categorizes various types of commercial vehicles under the passenger vehicle category.
- Desire to have a tool that generates time-space diagrams for arterials. The probe data is still not good for mobility reporting.
- CHART detectors have the potential to provide speed, but they need to be set up and validated to do so.
- Desire to have a tool that generates time-space diagrams.

Improvement/Action Strategies

- Explore the development of a task for vendors or consultants to generate speeds from probe speed data by vehicle type.
- Work with vendors to improve quality of arterial probe data for mobility reporting.
- Work with vendors to have lane differentiation of probe speed data.
- Determine if there is a need to have speed data from CHART detectors and, if so, when and how to set them up.
- Determine when and how to develop a tool that generates time-space diagrams.

Origin/Destination

Overview

- MDOT SHA is currently participating in a household travel survey—this will be a source of data.
- They have procured Inrix origin/destination (O/D) data (4-month sample with waypoints).
- They are exploring the use of StreetLight data.
- They are exploring to see if they can use Inrix or NPMRDS for O/D.
- The District of Columbia MPO has standards for household travel surveys based on its several decades' worth of experience.
- Maryland SHA has been exploring the new Inrix O/D data.
- Currently, O/D information is obtained from the statewide model, which is link based. The model looks at base versus build cases, and existing versus future scenarios.
- The statewide model produces two types of outputs—bandwidth and O/D zone (for AM/PM trips).
- The statewide model is being compared to StreetLight data.
- O/D data overlaps multiple and diverse data focus areas.

Assessment

- MDOT SHA is exploring Inrix vehicle probe data and still has to validate it.
- Oversize/overweight data is obtained through MDOT SHA's Permit System. It is sample data only but of good quality.
- The statewide model is validated based on survey data. It is useful for planning efforts but still needs more accuracy to be used for operations.
- American Transportation Research Institute (ATRI) Trip table and HERE O/D data are still in an initial exploratory phase.

Desired State

- Anticipating utilizing trip-based metrics—e.g., what does a long-distance trip look like?
- Goal for Inrix O/D data—Within three years, MDOT SHA staff expects processes to be in place for an entire year, all trips in and out of Maryland, and collecting raw data.
- Cross-validate the various data sources. Potentially use truck trip tables from ATRI for modeling.
- For StreetLight/Inrix data—Expects to review reports comparing broader traffic flows to support planning/operations, percentage of trucks, etc.
- The development of a Geographic Information System (GIS) layer to tie the data into the linear referencing system.
- Analyze the impact of an accident at O/D level. Currently, MDOT SHA can analyze the impact of accidents on travel time.
- Conflation issues with Traffic Message Channels (TMC)—It would be nice to have data from Inrix waypoint snapped to Inrix High Definition (XD) roadway segments.

Improvement/Action Strategies

- Discuss how to potentially get O/D of commodities.
- Collaborate with vendors to obtain necessary data for trip-based metrics.
- Join with vendors to obtain more granular O/D data.
- Work with Inrix to obtain O/D data for all trips in and out of Maryland for an entire year.
- Develop correlation between truck O/D and HPMS data.
- Determine how to analyze the impact of accidents for O/D.
- Have a smaller group convene to determine how to use new O/D data sources to decide on Transportation Systems Management and Operations (TSMO)/advanced traffic management strategies.

Accessibility

Overview

- Maryland is part of the University of Minnesota's pooled fund study to conduct accessibility measures.
- There is an accessibility analysis being conducted by ATRI.

Assessment

- Auto:
 - Accessibility data for auto serves existing needs from a planning perspective.

- Freight:
 - The ATRI data was purchased and used for one specific project, and they do not obtain freight data regularly. From a business planning perspective, obtaining freight data for performance measure development is a goal.
- Transit:
 - They have a lot of headway and boarding information. It is a mature system, but SHA has not used the data.
- Pedestrian:
 - Americans with Disability Act (ADA)/sidewalk shapefile layer.
 - » Tracks which side of the road the sidewalk is on, ADA compliance, etc.
 - » Does not have the capability to provide route(s) with complete sidewalk access.
 - Log of pedestrian push button activation at traffic signals. Can be used to determine delay to pedestrians (assuming pedestrians push buttons).
- Bike:
 - Multiple bike GIS layers exist, but SHA does not track where bikes travel.
 - STRAVA application—currently, the sample data is not reliable, and it is also isolated.
 - Potentially explore the Map My Ride application.
- Data governance:
 - From a planning perspective, data governance is well set.
 - Accessibility metrics are currently done on an ad hoc basis for a specific project(s) and does not have a formal structure.
 - It would be helpful to develop accessibility in a map format.
 - Would make sense to have a contact point at other agencies.
- Multimodal accessibility:
 - Combine some of the individual accessibilities discussed above.
 - Consider shared use mobility, bike share, etc.

Desired State

- Develop dashboard type measures with heat maps and other means to visualize accessibility.
- Maryland Department of Planning has existing accessibility data, which can be used to validate some models.
- Conduct an inventory check.
- Develop/estimate how fast users can reach major employers such as the National Institutes of Health, etc.

- Identify external points of contact regarding accessibility.
- Opportunity for private sector using granular O/D data for accessibility.
- Desire to account for multi-modal trips (e.g., walk, transit, walk).

Improvement/Action Strategies

- University of Maryland should make a recommendation on how to use O/D data for accessibility.
- Develop standards/structure to conduct accessibility metrics for projects.
- Develop/estimate how fast users can reach major employers such as the National Institutes of Health, etc.
- Develop dashboard to visualize accessibility.
- Discuss how to account for multi-modal trips.
- Address regional accessibility by engaging other agencies.

Truck Freight

Overview

- SHA started an ESRI Freight Storymap that would ensure freight data is available in the future. The short term goal is to release the tool in six to nine months. Tabs of the storypage include infrastructure, asset management (pavement and bridges), inventory, and mobility/accessibility. The mobility tab will include congestion levels and travel time reliability (Planning Time Index and Travel Time Index). The storypage is intended to capture high-level freight.
- Freight Initiative: SHA is coordinating with BMC and other agencies to document the different types of freight data available in the State. The long-term goal is to develop an application that makes the data available. However, many of these datasets are uploaded outside of SHA, with each having its own governance activities.
- The Regional Integrated Transportation Information System (RITIS) offers weigh-in-motion data, and there is an application called Maryland 1 (a real-time GIS page for truck drivers to gauge crashes and congestion).
- A lot of data is owned by other organizations outside of SHA.
- Need truck parking data.
- Most of the data available is ATRI data, which is used to calibrate/validate models.
- SHA is having a discussion on addressing needs for data.

Assessment

- Truck data:
 - Using road tubes and automated traffic recorder stations, collect truck data for the 13 FHWA type classifications.
 - Use of non-intrusive devices—a lot more work needs to be done; issues with length-based identification.
 - Vehicle classification still needs improvement in accuracy.
 - Virtual weigh-in-motion—aggressive program, accessible through RITIS, but SHA is not leveraging this data.
- Speed data:
 - Obtained from NPMRDS, Vehicle Probe Project Suite.
 - Vehicle Probe Project Suite processes missing data.
 - Currently, there is no freight data for non-National Highway System (NHS) roadways.
- Maryland Freight Data Finder:
 - Visual representation of State freight plan using ArcGIS.
 - Displays other modes and assets (like bridges, signals, etc.)
 - Being developed in phases and estimated completion in 2018.
 - The DBP can help get the word out on this.
- State Freight Plan:
 - Will be working on this in 2017.
- Have supply information but cannot keep up with demand.

Desired State

- Make definitions clear (e.g., class eight and above are buses classified as freight?).
- SHA should procure freight data on a regular basis for freight performance measures reporting.
- Collaborate with seven MPOs and the State Freight Advisory Committee (although they have not met in over a year).
- Need a business process to keep freight data robust.
- Would like to see O/D of commodities.
- Identify additional legal truck parking (illegal truck parking is a major issue).
- Would like to have truck O/D.

- Need improvement for truck parking data. SHA already provides a web-based tool for trucks to find emergency parking. They do annual counts of truck parking (since 2012 as part of MAP 21).
- Desire to know “what’s in the truck.” SHA is doing an online survey with trucking associations this year to determine what is being transported within Maryland (long-haul trips).
- Need to develop data governance for freight data.

Improvement/Action Strategies

- Look at four months of data to see if it is adequate (University of Maryland is already looking into this).
- Develop data collection standards.
- Explore ways to provide volume and speed for freight routes.
- Discuss how to improve commodity flow data.
- Discuss data needs to produce freight performance measures on a regular basis.
- Pursue if Inrix can provide truck probe data or percentage of trucks.
- Develop better system for vehicle classification.
- Develop tool to identify additional legal truck parking.
- Discuss how to improve truck parking data.
- Discuss how to better know “what’s in the truck”.
- Develop data governance for freight data.
- Clarify definitions of what counts as freight and what doesn’t (e.g., buses).
- Develop a business process to keep freight data robust.

Work Zone

Overview

- Lane closure permitting is housed in CHART Emergency Operations Reporting System database. This data is used for informing people about permitting.
- Office of Traffic and Safety look at performance in real time.
- There is a Work Zone Dashboard that uses data from RITIS. One could get speed and user delay cost and average delay from the Dashboard. The Dashboard was intended to help construction area engineers better manage work zones, although it may need to be promoted so more people know about it and use it. Real time data is used to better determine when to close lanes. There is an archiving section of the Dashboard that could be used to plan for future programs (may not be fully utilized—consider as an action item).

- The Operations Office sees value in having more data for work zones to better plan for lane closures. Currently, there are policies that suggest closing lanes at a certain time of the day. However, actual data within work zones may indicate that closing at different times may be more desirable.
- Work zone management is part of TSMO activities.
- CHART has governance for their own use for work zone performance as well as other types of operational data.
- There is a task force looking at work zone metrics and costs—there is a data feed to leverage Lane Control System in CHART.
- SHA uses probe speed data for work zone analysis.
- SHA has a dashboard with work zone data. The dashboard is real time only, and the data is not archived.
- The NHS is almost covered in the Arterial Work Zone Program.

Assessment

- There is not a Work Zone Planning Program to analyze the impact on corridors.
- Work zone data initiatives have been part of the operations realm and, as such, practices are moderately robust. For planning, however, the existing initiatives need to be improved.

Desired State

- Would be good to develop targets for user delay in work zones. SHA would need to incorporate this in contracts at the beginning.
- Would like a work zone program to bring all the data together.
- Want to analyze the impact of work zones as part of SHRP 2 program—want to do real time archive of work zone performance.
- Archiving data from the Work Zone Dashboard would be beneficial.
- Potentially stage work zones one after another to minimize impacts.
- Lane closure permitting is not directly linked to construction projects. However, there is a program in CHART where alternate routes are recommended. Would be good to have a standard layer.
- Need to establish governance for planning use of CHART's operational data.

Improvement/Action Strategies

- Develop work zone performance measures.
- Archive impacts of work zones from the Dashboard.
- Start to assess impacts (modeling impacts of effects and impacts—before and after).

- Need to establish governance for planning use of CHART's operational data.
- For work-zone performance data, determine a way to include what network system each signal belongs to.
- Develop data collection standards.
- Archive work zone data for the Work Zone Dashboard.
- Develop a standard layer of alternate routes linked to construction projects.
- Archive work zone data for performance measures.
- Develop a work zone plan to stage work zones one after another to minimize impacts.
- Develop a process to analyze the impact of work zones (potentially as part of the SHRP 2 program).
- Develop a streamlined system to bring all work zone data together.
- Establish a work zone program to bring all the data together.

Signal Timing

Overview

- Upgraded signals will have the capability to deliver volume data, video, etc.
- A key activity of the TSMO plan is to develop an arterial and freeway master plan.
- The Traffic Operations Division maintains a Google layer for signals.

Assessment

- Currently using Econolite equipment. It is industry standard but will be a limiting factor.
- Asset data layer not connected to field data.
- Library of Synchro models for signal systems. No link between the system models and intersections.
- Approximately 2,500 signals.
- Research being conducted.
- Integrate signal systems with Centracs.
- Deploy a test site using Naztec adaptive signal controllers; potentially install other systems.
- Would like Bluetooth travel time, percent arrival on green, and signal phasing and timing statewide.
- Each signal has a unique identifier, so there is potential to combine with GIS layers (e.g., using latitude/longitude).
- There is a GIS layer for signals, but the origin is not known, and it may not be updated.

Desired State

- More coordination between Signal and GIS offices.
- Mapping the signal database with signal data.
- Desire to tie Centracs data into other systems.
- Desire to archive traffic signal data for performance measures.
- Need to develop a plan to use and implement fiber infrastructure.
- Need to include what system a signal belongs to and allow for modification.

Improvement/Action Strategies

- Set up meeting with relevant stakeholders to better coordinate Signal and GIS offices.
- Map signal database with signal data.
- Use archived traffic signal data to develop various performance measures such as percent arrival on green.
- Develop a fiber infrastructure plan.
- Signal phasing and timing should be part of Connected and Automated Vehicles (CAV) initiative in the future.
- Include signals in Intelligent Transportation System (ITS) Asset Management inventory.
- Develop a plan to use and implement fiber infrastructure for signals.
- Develop data collection standards.
- Orient research efforts to get statewide signal phasing and timing.
- Talk to Econolite about how to tie Centracs into other systems.
- Discuss how to best combine signal timing data with GIS.

Connected and Automated Vehicles

Overview

- MDOT has been trying to investigate how to plan for connected and automated vehicles. Most of the discussion centers on safety.
- The University of Maryland's Center for Advanced Transportation Technology (CATT) Lab is working with connected/automated vehicle stakeholders, including auto makers, to develop new datasets out of those technologies.

Assessment

- Connected/automated vehicle data is still in a developing stage, and SHA has been proactive in identifying this as a future data source.

Desired State

- Desire to develop a framework to identify and deal with connected/automated vehicles, not only for safety but also mobility and asset conditions.

Improvement/Action Strategies

- Discuss the development of a framework to develop and manage connected/automated vehicle data for safety, mobility, and asset conditions.

General Items

- There is too much mobility data with varying degrees of granularity. There needs to be a process to better synchronize it.
- Mobility data may not have all quality checks needed. With the Mobility Dashboard, there is a need to better understand the data quality of each source (perhaps through a disclaimer in the metadata), and a need to raise awareness of this resource.
- Desire for all data outputs to have a spatial component.
- Linear referencing systems used are not consistent. Desire to have a common linear referencing system for all datasets.
- Need consistent data standards, governance, and metadata.
- Desire for data collection and management to be more automated.
- Desire to conduct a data inventory and inventory check.
- Desire to have cross validation checks for all data types.
- Develop system of cross-validation of all data sources.
- Desire to have governance for planning use of CHART's operational data.

ASSESSMENT OF CAPABILITY

An assessment of MDOT SHA's capabilities for collecting, managing, governing, and using mobility data was conducted using a capability maturity model. A maturity model helps agencies assess their current capabilities with respect to data management and governance and identify next steps in achieving the goals and objectives of the DBP.

There are three distinct levels of capability:

- **Level 1—Initial/Under Development.** Activities and relationships are largely ad hoc, informal, and champion driven, substantially outside the mainstream of other activities. Alternatively, the capability is under development, but there is limited internal accountability and uneven alignment with other organizational activities.
- **Level 2—Defined/Managed.** Technical and business processes are implemented and managed, partnerships are aligned, and training is taking place.

- **Level 3—Optimized.** Data management and governance is a full, sustainable program priority, with continuous improvement, top-level management support, and formal partnerships in place.

The assessment of capability is based on the workshops and a self-assessment exercise with MDOT SHA staff and addresses each of the data types that define mobility data for this DBP. The results of the assessment will help prioritize data systems for enhancements or replacements to support mobility planning, operations, and performance measure activities.

Figure 1 shows the current level of maturity for each data type according to its use for planning or operations functions.

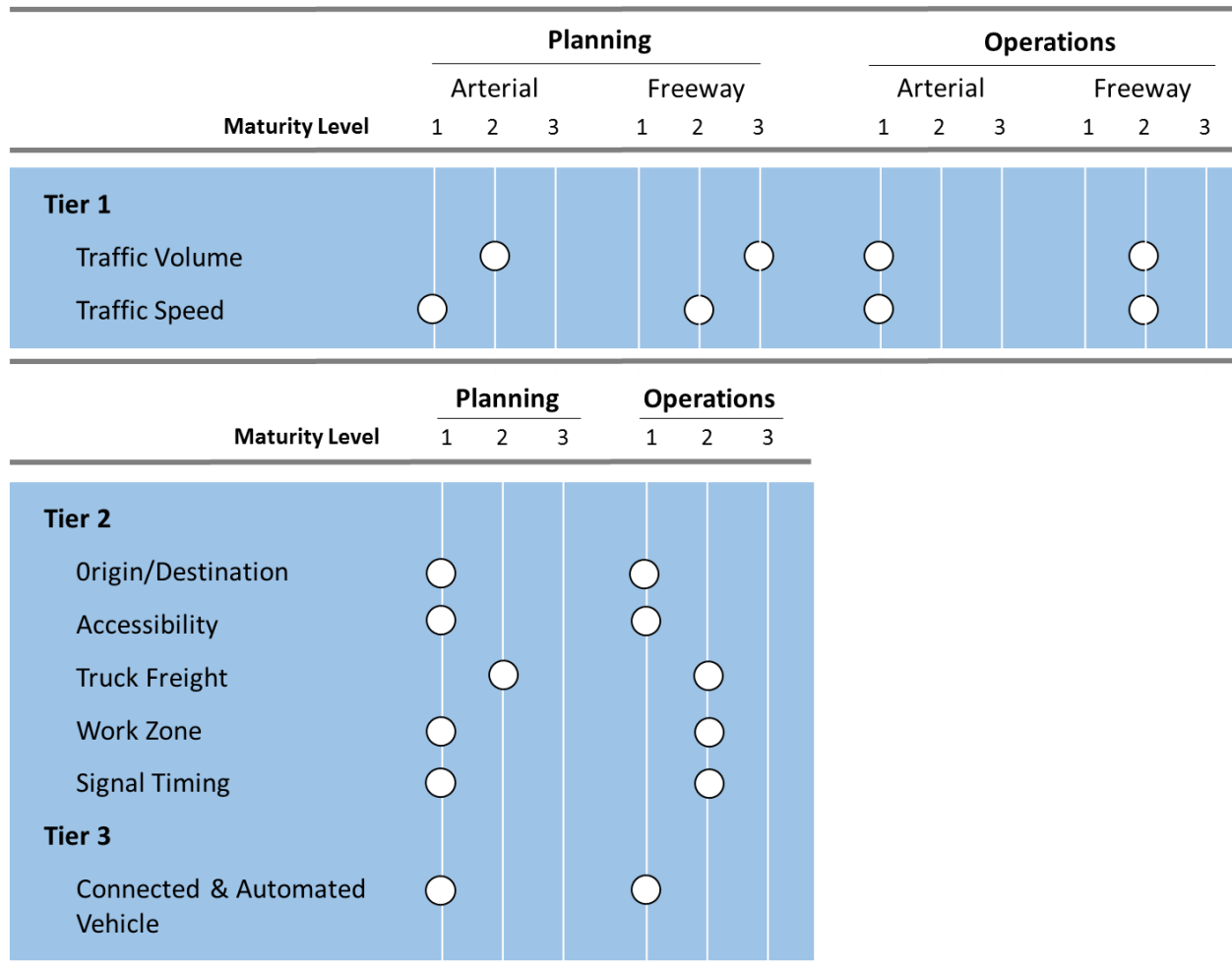


Figure 1. Charts. Assessment of capability.

(Source: Cambridge Systematics, Inc.)

CHAPTER 4. HIGH LEVEL ARCHITECTURE

The second component of the Data Business Plan (DBP) Framework is the architecture that is a high-level description of the interaction between databases and tools to support use of the integrated mobility data. The following draft High Level Architecture was developed during the Data Business Planning process.

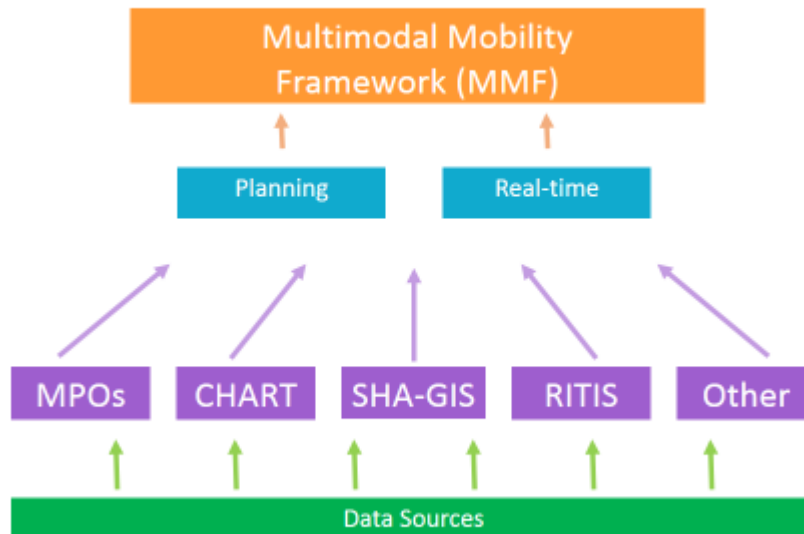


Figure 2. Flow chart. High level architecture.

(Source: Cambridge Systematics, Inc.)

The architecture depicts that a variety of data sources would feed through Metropolitan Planning Organizations (MPO), Coordinated Highways Action Response Team (CHART), State Highway Administration (SHA) Geographic Information System (GIS), Regional Integrated Transportation Information System (RITIS), and other databases. The data would then be used to support planning or real-time analyses and ultimately be accessed through the Multimodal Mobility Framework.

It is intended to be a draft and should be discussed and refined by Maryland Department of Transportation (DOT) SHA as part of the implementation of this DBP.

CHAPTER 5. DATA GOVERNANCE FRAMEWORK

This section describes the current state of governance processes at Maryland Department of Transportation (MDOT) State Highway Administration (SHA), as well as a recommended framework for mobility data governance.

CURRENT STATE

MDOT Secretary's Office recently hired a Data Chief, indicating that data governance will certainly become a priority. This section is intended to provide background on existing governance processes and documentation.

Data Governance Division Data Business Plan

In 2016, SHA created the Data Governance Division (DGD) as a branch of the Office of Planning and Preliminary Engineering (OPPE). One of its missions is to identify a strategic approach to data management agency wide. DGD is developing a Data Business Plan to support overall data management throughout the agency, and to provide a starting point for development of data governance standards and policies for categories of data such as safety, asset, and mobility data.¹ The goals of the Plan are as follows:

1. **Complete SHA data inventory (agency-wide)** to identify high-value datasets and descriptive metadata such as the dataset purpose, creation date, update frequency, use constraints, and data security, privacy and confidentiality requirements.
2. **Establish Data Management Plan (agency-wide)** to define the architecture, policies, practices and procedures to determine how data will be authored, maintained, managed, and made available for use.
3. **Establish data governance framework (agency-wide)** to provide data owners and data custodians guide on how to define data policies for accountability, usage, storage procedures, and audit controls.
4. **Enhance GIS server architecture (agency-wide)** to optimize performance and support development, pre-production, and production environments.
5. **Establish change management protocols** for managing and updating SHA's data assets.
6. **Establish access mechanism for SHA data** that is user-friendly, well-organized, searchable, consistently updated, and capable of supporting both centralized and distributed resources.

¹ DGD Data Business Plan. Maryland SHA Data Governance Division, Draft 2017 (Under Development).

The Data Business Plan also recommends establishing a Data Management Board to lead the implementation of recommendations and provide oversight for future data business planning efforts. The details and structure of the Data Management Board are still under development.

Data Management Plan

Consistent with the goals of their Data Business Plan, DGD is developing a Data Management Plan that outlines a plan and data governance framework at SHA to make data more accurate, consistent, defined, secure, and available.² The goals of this plan are to:

- Implement standards and procedures that facilitate information management.
- Improve the quality of the data, including accuracy, timeliness, and definition.
- Improve the security of the data, including confidentiality and protection from loss.
- Improve ease of access, assuring that data are easily located, easily accessed once located, and that people have enough information about the data to understand what they have found.
- Provide clear and accessible documentation about data.
- Make data more accessible to non-technical users.
- Reduce the redundancy of the data, by supporting sharing of data rather than replicating it in multiple sources, and by integrating data from separate operational systems.
- Make data accessible from legacy systems, bridging the gap until new systems are in place.
- Prepare for potential conversions to new systems by improving data and processes.

Once complete, the Plan will include the following components: 1) administrative roles and responsibilities for data management; 2) data architecture, including a data inventory, an assessment of existing data sources, metadata standards, and a policy for data creation, collection, and updates; 3) data security requirements, including data auditing, database access control, and schema change management; 4) data availability requirements, including performance monitoring, database development, and backup/recovery; 5) data governance plan; and 6) data governance framework.

Data Governance Roadmap

MDOT SHA recently contracted with JMT Technology Group to develop a Data Governance Roadmap.³ The project consists of the following tasks:

- Review data governance in other organizations.
- Establish goals for the Data Governance Division.
- Identify data to be included in Data Governance Plan.

² Data Management: Proposed Plan. Maryland SHA Data Governance Division, Draft March 1, 2017 (Under Development).

³ Data Governance Roadmap v1.0. Prepared for Maryland Department of Transportation and Maryland State Highway Administration. JMT Technology Group, April 17, 2017.

- Perform gap analysis between data governance goals and current data.
- Develop strategic plan for data governance.

The effort will result in the development of a strategic plan for implementing data governance at SHA. The strategic plan will include a summary of data governance goals for SHA, the general policies and standards to be implemented, and specific actions to achieve those goals.

Enterprise GIS

SHA Geospatial Metadata Standards

This document describes how to create and update metadata for geospatial data in the eGIS. Metadata content is summarized in table 3.⁴

Table 3. Enterprise Geographic Information System metadata content.

Section	Metadata Content
Overview	Item Description Topics and Keywords Citation Citation Contacts Locales
Metadata	Details Contacts Maintenance Constraints
Resources	Details Extents Points of Contact Maintenance Constraints Spatial Reference Spatial Date Representation Content Quality Lineage Distribution Fields References Geoprocessing History

⁴ SHA Metadata Standards, Maryland State Highway Administration, (Undated).

SHA Geospatial Data Policy and Standards

This document establishes the Maryland SHA GIS policy and standards for the format of geospatial data that is acceptable for incorporation into the eGIS systems of the Administration.⁵ The policy addresses data standards and its operations in the context of data life cycle phases, including planning, collection and acquisition, processing and documentation, storage and access, and maintenance and retirement.

GIS Data Delivery Standards

This document specifies standards for data delivery for all data layers developed for projects that have a GIS component.⁶ Standards are specified for acceptable file formats, coordinate system, metadata, and media.

eGIS Data Catalog

The eGIS Data Catalog contains a data catalog for eGIS contents. The data catalog identifies geospatial datasets and descriptive metadata such as data layer name, health status, dataset purpose, contact information, update frequency, map scale, geometry type, data category, source location, etc. The eGIS Data Catalog currently includes Fund 77 Active Projects, Annual Average Daily Traffic, Structures, Green Asset Management System, Highway Lighting, Line Striping, Park and Ride, and Rumble Assets.

The vision for eGIS is to complete an inventory of all data sets within SHA.

Open Architecture

SHA has adopted open architecture as a basic information processing strategy to ensure information is available to the people authorized to receive it, regardless of the specifics of their computing platform. SHA developed computer architecture standards for information technology that describe the current computing environment, including software, network environment, hardware requirements, and security requirements.⁷

Mobility and Economy Dashboard

Annual Mobility Reporting and Mobility Dashboard

Since 2012, Maryland SHA has been producing an annual Mobility Report. The mobility report demonstrates SHA's focus on applying a performance-based approach to provide a high quality and reliable highway system. In 2014, SHA improved accessibility to the contents of the Mobility Report by creating a web-based Mobility Dashboard.

⁵ SHA Geospatial Data Policy and Standards, Maryland State Highway Administration, (Draft, Undated).

⁶ GIS Data Delivery Standards, Maryland State Highway Administration, (Draft, Undated).

⁷ SHA Computer Architecture Standards for Information Technology, Updated July 2014.

Mobility Dashboard Data Catalog

The Mobility Dashboard Data Catalog identifies mobility and economy datasets used to support the Mobility Dashboard. The data catalog provides descriptive metadata such as the target location, source data layers, dependent-derived data sets, data owner, data steward, update frequency, historical data storage process, data format, processing requirements, dependent reports or applications, recurring deadlines for data, stakeholders, and map service supported.

The eGIS Data Catalog includes bike routes, congestion costs, counties and regions, HOV lanes, MDTA tolls, Park and Ride locations, pedestrian sidewalk locations, Consolidated Transportation Program (CTP) projects, reliability (planning time index), reversible lanes, Traffic Message Channel (TMC) segments, transit-oriented development location, congestion (travel time index), and volume data. Other mobility datasets are listed in the data catalog but are not included in the current version of the dashboard.

Mobility and Economy Dashboard Database Architecture Guide

This document describes the Mobility and Economy Dashboard database architecture.⁸ The basic structure is a customized relational database management design that allows for retrieval of statistical information based on user input and interaction. The architecture consists of the following components: TMC segments, locations, trends and measures, projects, programs, policies, and lookup and reference tables.

Consolidated Transportation Program (CTP) Projects

The Consolidated Transportation Program (CTP) is Maryland's six-year capital budget for transportation projects and programs across the DOT. MDOT SHA maintains spatial data for major and minor projects in the CTP. The CTP Projects Data Processing document describes standards for CTP spatial data format, including project details, project location, financial information, and construction status.⁹

RECOMMENDED GOVERNANCE FRAMEWORK

There is a good process in place, and the Data Governance Roadmap project will continue SHA's initial efforts to develop and implement an enterprise governance framework. It is recommended that governance for mobility data complement and leverage efforts at the enterprise level.

This section recommends a data governance framework for mobility data in the region. This includes adopting core data principles, implementing a data governance model, defining roles and responsibilities for managing mobility data, and developing supporting documents such as a Data Governance Manual, Data Catalog, Business Terms Glossary, and Data Sharing Agreements.

⁸ Maryland State Highway Administration Mobility & Economy Dashboard: Database Architecture Guide. Developed by KCI Technologies, Inc., Documentation Version 1.1, July 14, 2014.

⁹ Consolidated Transportation Program (CTP) Projects Data Processing v5.0, Maryland State Highway Administration.

Data Principles

It is recommended that SHA adopt core data principles to guide mobility-related decisionmaking. The following set of core data principles are recommended by the AASHTO Subcommittee on Data.¹⁰ These data principles are also applicable for enterprise level governance efforts.

- **Principle 1—VALUABLE: Data is an asset.** Data is a core business asset that has value and is managed accordingly.
- **Principle 2—AVAILABLE: Data is open, accessible, transparent, and shared.** Access to data is critical to performing duties and functions. Data must be open and usable for diverse applications and open to all.
- **Principle 3—RELIABLE:** Data quality and extent is fit for a variety of applications. Data quality is acceptable and meets the needs for which it is intended.
- **Principle 4—AUTHORIZED: Data is secure and compliant with regulations.** Data is trustworthy and is safeguarded from unauthorized access, whether malicious, fraudulent, or erroneous.
- **Principle 5—CLEAR: There is a common vocabulary and data definitions.** Data dictionaries are developed and metadata established to maximize consistency and transparency of data across systems.
- **Principle 6—EFFICIENT: Data is not duplicated.** Data is collected once and used many times for many purposes.
- **Principle 7—ACCOUNTABLE: Decisions maximize the benefit of data.** Timely, relevant, high-quality data are essential to maximize the utility of data for decisionmaking.

Data Governance Model

A data governance model depicts the relationship between the mobility data programs, the various individuals/agencies responsible for implementing data governance, and the users/stakeholders for the data programs.

The model diagram in figure 2 proposes a formal structure for mobility data governance for MDOT SHA. The proposed governance model builds on current governance initiatives and includes the following components:

- The proposed **Data Management Board (A)** will serve as SHA's enterprise-level governance structure that establishes the principles and policies for all SHA data management issues. The structure of the Board will be determined as part of the DGD's Data Business Plan and Data Governance Roadmap (once complete). It is recommended that Board membership include directors or senior level managers from key business areas of SHA, including the Information Technology director.

¹⁰ AASHTO Subcommittee on Data, Data Subcommittee Efforts on Core Data Principles website, <http://planning.transportation.org/Pages/Data.aspx>.

- One or more **Mobility Data Liaisons (B)** will liaison with the Data Management Board and chair the Mobility Data Working Group.
- The **Mobility Data Working Group (C)** includes designated individuals from Maryland SHA's offices responsible for the oversight of mobility data programs to support the business functions of their offices. This group dictates the policies, procedures, and business practices associated with SHA's mobility data programs.
- **Mobility Data Owners (D)** are responsible for the creation and maintenance of a spatial or non-spatial mobility-related dataset.
- **Mobility Data Stewards (D)** ensure mobility data is collected, maintained, and used in accordance with agency-adopted standards or policies.
- **Mobility Data Custodians (D)** provide technical development and support for mobility data applications.
- **Mobility Data Users and Stakeholders (E)** include individuals or agencies that use or interface with, access, benefit from, or are otherwise affected by mobility data.

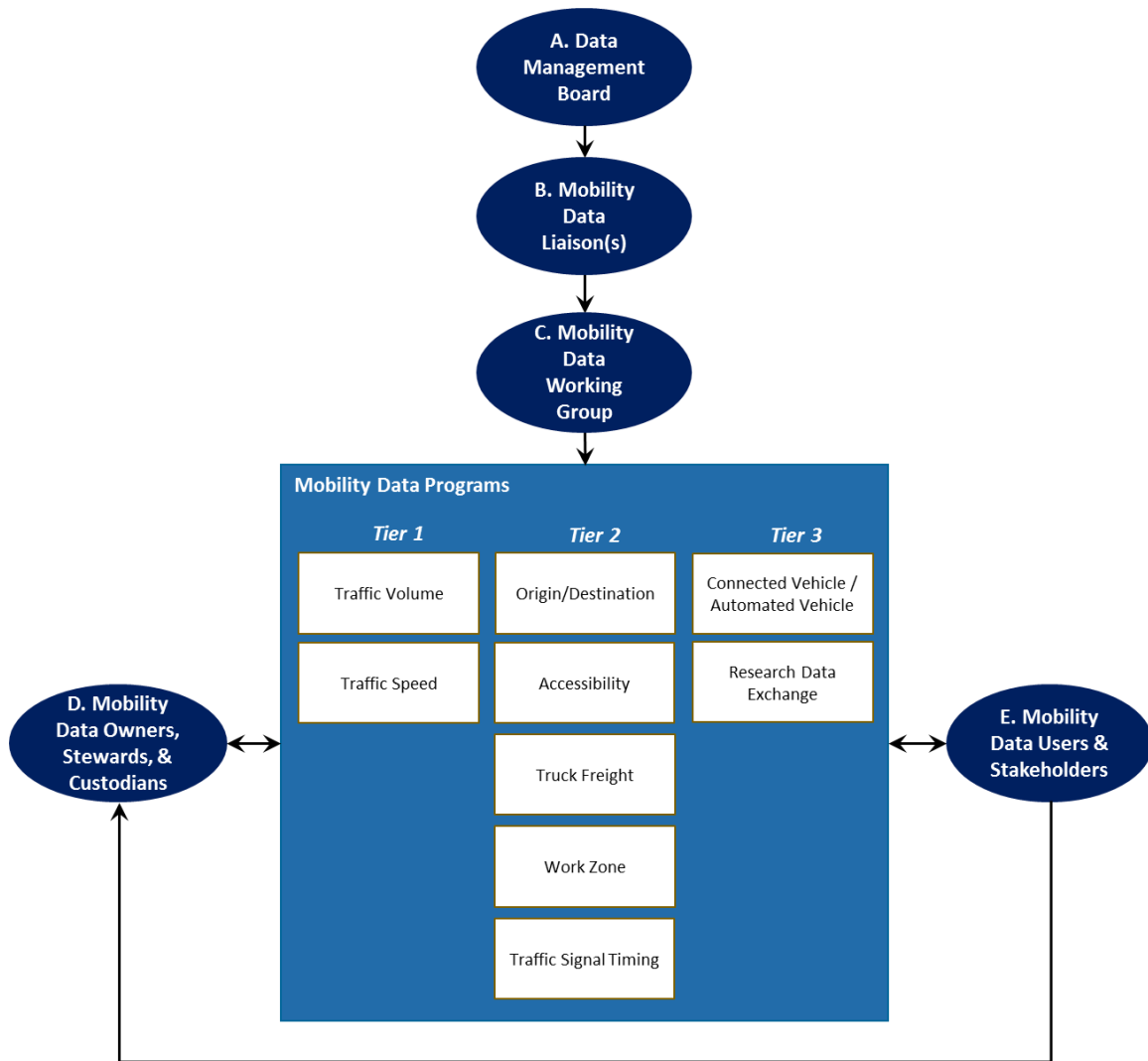


Figure 3. Flow chart. Data governance framework.

(Source: Cambridge Systematics, Inc.)

Roles and Responsibilities

Table 4 defines the roles and responsibilities for supporting the governance framework. These roles/responsibilities should be vetted with the Data Management Board. The roles and responsibilities listed are job functions and not necessarily job titles. In some cases, the duties of a data owner, data steward, and data custodian may be performed by the same individual.

Table 4. Data governance roles and responsibilities.^{11,12}

Role	Description	Responsibilities
1. Data Management Board	An enterprise level group comprised of directors and senior-level managers from key business areas of Maryland SHA, including the Information Technology Director.	<ul style="list-style-type: none"> a. Serve as policy-setting body for all SHA data management related issues. b. Establish strategic direction and efficient management of enterprise data assets across its life cycle phases, including planning, collection and acquisition, processing and documentation, storage and access, and maintenance and retirement. c. Provide executive level support for data governance. d. Dedicate resources to support data management and governance as needed. e. Other responsibilities as outlined in the DGD Data Business Plan and Data Governance Roadmap (once complete).
2. Mobility Data Working Group	Association of individuals from Maryland SHA offices who collect and provide data and establish business rules and processes for the mobility data that is collected, maintained, and used by Maryland SHA. These individuals may serve as data owners, data stewards, or subject matter experts for mobility data within their office.	<ul style="list-style-type: none"> a. Develop “rules of engagement” regarding collaboration and coordination for the working group. b. Establish policies and procedures for the collection and use of mobility data and information. c. Coordinate resources and cost-sharing strategies to reduce redundancy in regional data collection, integration, and data systems. d. Identify and address gaps and redundancies in regional mobility data collection activities. e. Share current activities and best practices in mobility data collection and management. f. Facilitate sharing of data with internal stakeholders.

¹¹ NCHRP 666: Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies, Volume II: Guide for Target-Setting and Data Management, 2010.

¹² Data Governance, Standards, and Knowledge Management, Alaska Department of Transportation and Public Facilities (ADOT&PF), 2009, Appendix B—Kansas Department of Education Roles and Responsibilities and Appendix C—Data Governance Manual.

Table 4. Data governance roles and responsibilities (continuation).

Role	Description	Responsibilities
2. Mobility Data Working Group (continued)	Association of individuals from Maryland SHA offices who collect and provide data and establish business rules and processes for the mobility data that is collected, maintained, and used by Maryland SHA. These individuals may serve as data owners, data stewards, or subject matter experts for mobility data within their office.	<ul style="list-style-type: none"> g. Share procurement plans and Request for Proposals (RFPs) for mobility data. h. Review RFPs and provide recommendations based on best practices. i. Determine standards and procedures for collection, maintenance, and use of data, programs, and products. j. Provide recommendations to the Data Management Board regarding development of mobility data products to meet business needs. k. Recommend technology tools to support mobility data management and sharing. l. Identify external data stewards. m. Reach out to external stakeholders to identify data stewards for mobility data programs within their respective agencies and facilitate collaboration. n. Establish data sharing agreements and memorandums of understanding internally and with external partner agencies as appropriate.
3. Mobility Data Owners	Individuals within Maryland SHA and partner agencies who are responsible for the creation and maintenance of a spatial or non-spatial mobility-related dataset. A data owner can be a steward or custodian, or they could assign a steward or custodian.	<ul style="list-style-type: none"> a. Establish business rules for use of data in their business area. b. Authorize or deny access to mobility data and is responsible for its accuracy, integrity, and timeliness.

Table 4. Data governance roles and responsibilities (continuation).

Role	Description	Responsibilities
4. Mobility Data Stewards	Individuals within Maryland SHA and partner agencies who are responsible for ensuring mobility data that is collected, maintained, and used by their agency is managed according to common standards or policies. This person is typically the “go to” person within a business unit for all inquiries related to a mobility-related dataset. A steward may or may not be a data owner or data custodian.	<ul style="list-style-type: none"> a. Identify and manage metadata. b. Identify and resolve data quality issues. c. Determine business and security needs of data. d. Communicate data quality issues to individuals that can influence change, as needed. e. Provide input to data analysis.
5. Mobility Data Custodians	Individuals within Maryland SHA and partner agencies who provide technical development and support for mobility data applications. This may include IT staff such as application developers, network administrators, database administrators, server administrators, and IT security. This may also include application programmers and systems analysts who work in business areas other than the IT Division.	<ul style="list-style-type: none"> a. Responsible for storage of the dataset or for making it available for use. b. Manage access rights to data they oversee. c. Implement controls to ensure the integrity, security, and privacy of the data.
6. Mobility Data Users and Stakeholders	Association of people comprised of internal and external stakeholders who share a common interest as users or consumers of mobility data.	<ul style="list-style-type: none"> a. Communicate their agency’s business needs supported by mobility data programs. b. Provide feedback on data quality and use of mobility data programs.

Rules of Engagement

Once the Mobility Data Working Group has been formally established, the group should develop and approve a Charter to set forth the purpose, goals, membership, roles and responsibilities, meeting schedule, and “rules of engagement” regarding collaboration and coordination for the group.

Potential rules of engagement could include the following:

- Share RFPs for current and upcoming data collection activities, data acquisitions, initiatives, activities, and projects related to mobility data.
- Share current initiatives, activities, and best practices related to mobility data, including data strategies, policies, standards, metadata, system architecture, procedures, performance metrics, etc.
- Identify needs and opportunities to integrate mobility data sets to support performance-based planning and asset management activities in the region.
- Identify needs and opportunities to create links between mobility data sets and connected vehicle data sets in the future to support performance-based planning in the region.
- Identify opportunities to coordinate resource, reduce data redundancies, and implement cost-sharing strategies for the collection, management, and maintenance of mobility data.
- Identify needs and opportunities to reduce redundancy in the development and maintenance of duplicative data systems and promote efficiency in system maintenance.
- Identify needs and opportunities to enhance data sharing and access among regional stakeholders, including the need for web portals for stakeholders to share data and information as needed.
- Understand and promote the value of mobility data as an asset within individual stakeholder agencies and regionwide.

An example data sharing agreement is provided in appendix D.

Governance Documentation

Once the Mobility Data Working Group has formally approved a Charter, the group should also develop and approve the following supporting documents to define policies, standards, and procedures for data governance in the region:

- **Data Governance Manual.** The manual serves as a centralized resource that formalizes data governance roles and responsibilities, data standards, policies, and procedures related to mobility data. An example Data Governance Manual is provided in appendix D.
- **Data Catalog.** The data catalog documents regional mobility data systems and the offices responsible for maintaining those systems. The catalog identifies the system of record for specific mobility data sources, metadata about the data systems, and contact information for the data stewards and data custodians responsible for updating and maintaining the data. It is recommended that SHA expand existing Data Catalogs to include mobility-related data assets.

- **Business Terms Glossary.** The business terms glossary defines how standard terminology for mobility data (such as location) is defined and used across the agency. The glossary assists IT professionals in defining/using the data correctly when developing or enhancing data systems. An example glossary is provided in appendix E.

CHAPTER 6. IMPLEMENTATION PLAN

Implementation is not a one-time event, but rather the policies, standards, and procedures identified in the Data Business Plan (DBP) should become part of the day-to-day business practices of Maryland Department of Transportation (MDOT) State Highway Administration (SHA). The Mobility Working Group is responsible for addressing the improvement items (identified in Section 3). Discussions at meetings should include reports on implementation progress (e.g., tasks completed, tasks remaining) and any adjustments needed due to changing priorities, policies, standards, or legislative priorities. In addition, Maryland SHA should provide an annual report or briefing to senior management that provides an executive level summary of data systems, status of integrating the data systems, regional collaboration, successes achieved or new enhancements needed for existing systems, and recommendations for addressing issues.

This section provides a proposed roadmap to implement this DBP. The roadmap is organized around the Framework concept including data, architecture, and governance to support MDOT SHA's ability to integrate and report on mobility data. The three components should be addressed at the same time. Actions are classified according to high, medium, and low priorities.

DATA ACTION ITEMS

Step 1: Address General Action Items from Data Assessment

High

- a. Develop a plan to raise awareness of the Mobility Dashboard and include a disclaimer in the metadata to enable a better understanding of the data quality of each source.
- b. Develop a plan to assign a spatial component for all data outputs.
- c. Develop a common linear referencing system for all datasets.
- d. Through the Data Management Board, establish consistent data standards, governance, and metadata.

Medium

- a. Determine opportunities for data collection and management to be more automated.
- b. Conduct a data inventory and inventory check.
- c. Establish governance for planning use of Coordinated Highways Action Response Team's (CHART) operational data.

Low

- a. Determine datasets that can be cross validated with one another (e.g., explore how to use Maryland Department of Planning data to validate models).

Step 2: Address Action Items Specific to Each Data Type from Data Assessment

High

- a. Speed Action Items
 - i. Explore the development of a task for vendors or consultants to generate speeds from probe speed data by vehicle types.
 - ii. Work with vendors to improve quality of arterial probe data for mobility reporting.
 - iii. Work with vendors to have lane differentiation of probe speed data.
 - iv. Determine if there is a need to have speeds from CHART detectors and, if so, when and how to set them up.
 - v. Determine when and how to develop a tool that generates time-space diagrams.
- b. Truck Freight Action Items
 - i. Look at four months of data to see if it is adequate (University of Maryland is already looking into this).
- c. Work Zone Action Items
 - i. Develop Work Zone performance measures.
- d. Signal Timing Action Items
 - i. Set up meeting with relevant stakeholders to better coordinate Signal and Geographic Information System (GIS) offices.
 - ii. Discuss how to best combine signal timing data with GIS.

Medium

- a. Speed Action Items
 - i. Determine when and how to develop a tool that generates time-space diagrams.
- b. Volume Action Items
 - i. Gather appropriate stakeholders to discuss how to optimize volume processes.
- c. Origin/Destination Action Items
 - i. Continue looking into Streetlight data and Inrix or National Performance Management Research Dataset (NPMRDS) for origin/destination (O/D).

- d. Accessibility Action Items
 - i. University of Maryland should make a recommendation on how to use O/D data for accessibility.
 - ii. Develop dashboard to visualize accessibility.
- e. Truck Freight Action Items
 - i. Develop data collection standards.
 - ii. Explore ways to provide volume and speed for freight routes.
 - iii. Discuss how to improve commodity flow data.
 - iv. Discuss data needs to produce freight performance measures on a regular basis.
 - v. Pursue if Inrix can provide truck probe data or percentage of trucks.
 - vi. Develop better system for vehicle classification.
 - vii. Develop tool to identify additional legal truck parking.
 - viii. Discuss how to improve truck parking data.
 - ix. Clarify definitions of what counts as freight and what doesn't (e.g., buses).
- f. Work Zone Action Items
 - i. Start to assess impacts (modeling impacts of effects and impacts—before and after).
 - ii. Develop data collection standards.
 - iii. Develop process to analyze impact of work zones (potentially as part of Strategic Highway Research (SHRP 2) program).
 - iv. Develop streamlined system to bring all work zone data together.
- g. Signal Timing Action Items
 - i. Map signal database with signal data.
 - ii. Use archived traffic signal data to develop various performance measures such as percent arrival on green.
 - iii. Include signals in Intelligent Transportation Systems (ITS) Asset Management inventory.
 - iv. Develop data collection standards.

- v. Talk to Econolite about how to tie Centracs into other systems.
- h. Connected and Automated Vehicles Action Items
 - i. Discuss the development of a framework to develop and manage Connected and Automated Vehicles (CAV) data for safety, mobility, and asset conditions.

Low

- a. Origin/Destination Action Items:
 - i. Discuss how to potentially get O/D of commodities.
 - ii. Work with vendors to obtain necessary data to obtain trip-based metrics.
 - iii. Work with vendors to obtain more granular O/D data.
 - iv. Work with Inrix to obtain O/D data of all trips in and out of Maryland for an entire year (within three years).
 - v. Develop correlation between truck O/D and Highway Performance Monitoring System (HPMS) data.
 - vi. Determine how to analyze the impact of accidents at an O/D level.
 - vii. Have a smaller group convene to determine how to use new O/D data sources to decide on Transportation Systems Management and Operations (TSMO)/advanced traffic management strategies.
- b. Accessibility Action Items:
 - i. Develop standards/structure to conduct accessibility metrics for projects.
 - ii. Develop/estimate how fast users can reach major employers such as the National Institutes of Health, etc.
 - iii. Discuss how to account for multi-modal trips.
 - iv. Address regional accessibility by engaging other agencies.
- c. Truck Freight Action Items:
 - i. Discuss how to better know "what's in the truck".
 - ii. Develop data governance for freight data.
 - iii. Develop a business process to keep freight data robust.
- d. Work Zone Action Items:

- i. Archive work zone data and impacts of work zones from the dashboard—for performance measures.
- ii. Need to establish governance for planning use of CHART's operational data.
- iii. For work-zone performance data, determine a way to include what network system each signal belongs to.
- iv. Develop a standard layer of alternate routes linked to construction projects.
- v. Develop work zone plan to stage work zones one after another to minimize impacts.
- e. Signal Timing Action Items:
 - i. Signal phasing and timing should be part of CAV initiative in the future.
 - ii. Develop a plan to use and implement fiber infrastructure for signals.
 - iii. Orient research efforts to get statewide signal phasing and timing.

ARCHITECTURE ACTION ITEM

Step 1: Finalize High Level Architecture

High

- a. Review Architecture diagram and revise/update.

GOVERNANCE

Step 1: Implement the Data Governance Framework

High

- a. Adopt policy to implement data governance at SHA. This provides a mechanism to enforce policies and procedures related to data governance and management.
- b. Establish the Data Management Board according to the framework established in the DGD Data Business Plan and Data Governance Roadmap.
- c. Formally adopt core data principles and incorporate them into governance policies, standards, and processes.
- d. Expand the existing data catalog to include mobility data assets. The data catalog should document the system of record for specific mobility data sources, metadata about the data systems, contact information for the data stewards responsible for updating and maintaining the data, linkage variables, and data access policies.

Medium

- a. Establish the Mobility Data Working Group to coordinate on mobility data collection, data acquisitions, and cross-cutting data management issues (e.g., data quality, standards, metadata, data privacy, and security).
- b. Establish liaison relationships between the Data Management Board and Mobility Data Working Group.
- c. Formalize data governance roles and responsibilities by incorporating them into staff job descriptions and job performance review criteria.
- d. Develop and approve a Charter to set forth the purpose, goals, membership, roles and responsibilities, and “rules of engagement” regarding collaboration and coordination for the Mobility Data Working Group. Develop supporting documents such as a Data Governance Manual, Business Terms Glossary, and Data Sharing Agreements.

APPENDIX A. STAKEHOLDER REGISTRY

Stakeholders include any internal or external person or organization that collects, owns, maintains, uses, interfaces with, accesses, or benefits from roadway travel mobility data. Internal stakeholders may include those involved in traffic operations, traffic safety, roadway design, pavement design, maintenance, air quality, modal, and connected vehicle capture activities. External stakeholders may include State and local transportation agencies, traffic management centers, transportation system managers, Corridor Coalitions, transit agencies, metropolitan planning organizations, researchers, freight operators, private data providers (e.g., Inrix, Nokia-NAVTEQ-HERE, TomTom, TrafficCast, etc.), neighboring State DOTs, media providers, the traveling public, and FHWA. Site stakeholders should also include the individuals who will fulfill various data governance roles identified in the Guide:

- **Data Governance Council**—Senior level managers across business areas responsible for roadway travel mobility data.
- **Data Stewards**—Individuals responsible for ensuring data is collected, maintained, and used in accordance to the policies established by the data governance council.
- **Data Business Owners**—Individuals responsible for establishing business requirements for the use of roadway travel mobility data in their business area.
- **Data Custodians**—IT staff responsible for data system support.
- **Working Group**—Collective group of internal and external stakeholders responsible for collecting and providing data and establishing business rules for roadway travel mobility data systems.
- **Community of Interest**—Collective group of internal and external stakeholders who are users of roadway travel mobility data.

Table 5 identifies specific stakeholders engaged in each step of the DBP development.

Table 5. Stakeholder Registry

Name	Agency	Email	Type
Laurie Goudy	SHA (OPPE)	lgoudy@sha.state.md.us	Internal
Candice Ottley-Francois	SHA/JMT	cotley@jmt.com	Internal
Abhay Nigam	SHA/ Synergy	anigam@sha.state.md.us	Internal
Subrat Mahapatra	SHA (OPPE)	smahapatra@sha.state.md.us	Internal
Nicole Katsikides	SHA (OPPE)	nkatsikides@sha.state.md.us	Internal
Mark Radovic	SHA (OPPE)	mradovic@sha.state.md.us	Internal
Matt Baker	SHA (OPPE)	Mbaker4@sha.state.md.us	Internal
Wenjing Pu	MWCOG/ TPB	wpu@mwcog.org	External
Ben Myrick	SHA-OOTS	bmyrick@sha.state.md.us	Internal
Tom Jacobs	UMD-CATT	tjacobs@umd.edu	External
Nikola Ivanov	UMD CATT Lab	ivanovn@umd.edu	External
Drew Lund	UMD CATT Lab	Alund1@umd.edu	External
Eileen Singleton	BMC	esingleton@baltometro.org	External
Jen Lishman Nunn	JMT	jlishman@jmt.com	External
Carole Delion	MDOT SHA-TFAD	cedelion@sha.state.md.us	External
Marshall Stevenson	SHA/MDOT	mstevenson@sha.state.md.us	External

APPENDIX B. STAKEHOLDER LETTER

Dear Stakeholders,

The Maryland State Highway Administration (Maryland SHA) is excited to announce its selection to participate as a pilot site for a Federal Highway Administration (FHWA) data business planning initiative. The FHWA Office of Operations and its consultant team, Cambridge Systematics, Inc., will assist the Maryland SHA in developing a tailored data business plan to improve the management and governance of roadway travel mobility data, which, for the purposes of this effort, is defined as volume, speed, lane occupancy, and connected vehicle data for vehicle, freight, bicycle/pedestrian, and transit modes. The data business plan will be a living document that addresses the data needs of the Maryland SHA and its local partners, tackling technical and institutional needs alike. The pilot effort will involve stakeholder outreach to gather your feedback and input, a data gap assessment, and development of an action plan for improving the management and governance of mobility data in the region.

This initiative is part of the U.S. DOT Roadway Transportation Data Business Plan project, whereby the FHWA Office of Operations developed a data business planning guidance document for State and local transportation agencies. The guide is intended to help these agencies understand what mobility data is being collected within their organizations and at the regional level, how the data supports mobility planning, operations, and performance measure activities, and who is responsible for managing and updating the data. The process will also help solidify working relationships by identifying how various offices/agencies share and exchange roadway travel mobility data to both internal and external stakeholders. Finally, the data business plan will help identify potential duplicative data collection efforts, leading to more rapid, targeted data acquisitions that would reduce future data collection/management costs.

In order to have a positive impact in our data processes, commitments are needed not only from the Maryland SHA but also from our stakeholders. We hope your offices can engage in a meaningful and collaborative way, including responding to a survey, participating in two on-site meetings, and committing to working with other stakeholders in the creation and implementation of the data business plan.

Within the next few weeks, the consultant team will reach out to stakeholders with a survey to gather your input regarding data practices, goals, and issues. Subsequent follow-up phone interviews are planned.

Should you have any questions on this initiative, please do not hesitate to contact me or Mr. Walter During at his below address.

We look forward to working with you on this exciting initiative!

Gregory Slater, Director of Planning
and Preliminary Engineering
410-545-0412
gslater@sha.state.md.us

Walter During, FHWA Office
of Operations
202-366-8959
walter.during@dot.gov

APPENDIX C. EXAMPLE DATA SHARING AGREEMENT

**VOLUNTARY DATA CONTRIBUTION AGREEMENT
BETWEEN THE
U.S. DEPARTMENT OF TRANSPORTATION
AND
{CONTRIBUTING ENTITY}**

In an effort to support the needs of Intelligent Transportation System researchers and developers while reducing costs and encouraging innovation, the Office of the Assistant Secretary for Research and Technology (OST-R) and the Federal Highway Administration (FHWA) of the U.S. Department of Transportation (US DOT) have developed the Research Data Exchange (RDE), a web-based transportation data sharing system to promote the sharing of multi-source and multi-modal data. In furtherance of this effort, this Agreement acknowledges the voluntary contribution of such data to the RDE.

WHEREAS, I, _____, am authorized to execute this agreement for and on behalf of _____ (hereinafter "Contributor");

WHEREAS, Contributor desires to voluntarily add its Data, as defined and described below, to the US DOT RDE;

WHEREAS, Contributor desires to grant to US DOT the rights to use and disseminate the Data as needed in support of the goals and objectives of its research projects; and

WHEREAS, US DOT desires Contributor to voluntarily add its Data, as defined and described in detail below;

Contributor definition and description of submitted data: _____

Now Therefore:

I, the undersigned, hereby grant irrevocable, non-exclusive rights to the US DOT to copy, use, disseminate, publicly display, store, and to grant others these rights in advancing their own research goals and objectives.

Signature of Data Contributor Representative

Date

Title of Representative and Organization Name

APPENDIX D. EXAMPLE DATA GOVERNANCE MANUAL

INTRODUCTION

This Data Coordination Manual provides comprehensive guidance to members of the U.S. DOT Roadway Mobility Data Coordination Group (hereafter called the Coordination Group) on the background and purpose of the Coordination Group, its overall structure, the kinds of topics that the Coordination Group addresses, how the Coordination Group works, expectations of Coordination Group members, and a plan for measuring the outcomes and overall success of the Coordination Group.

The following provides a basic understanding and overview of the Coordination Group:

- The Coordination Group is a forum for facilitating cross-organizational collaboration, data sharing, and integration of roadway travel mobility data within U.S. DOT to address gaps and redundancies documented in the U.S. DOT Roadway Transportation Data Business Plan (Phase 1) and to collaborate on data management functions related to roadway travel mobility data.¹³
- Since the Federal Highway Administration (FHWA) is the largest provider of roadway mobility data, the Coordination Group is managed under the Operations Regime of FHWA's Data Governance Advisory Council (DGAC).
- The Coordination Group includes members from other DGAC regimes such as Planning, Policy, and Research, as well as from other operating administrations and programs of the Department.
- Coordination Group activities and priorities are guided by the Data Business Plan, which documents stakeholder needs and gaps related to roadway travel mobility data programs and data business planning within U.S. DOT; establishes a framework for data coordination; and provides recommendations regarding data management functions related to roadway travel mobility data.
- The culture of the Coordination Group is one of collaboration and mutual trust, with shared ownership of decisionmaking as a key characteristic.

WHAT IS THE ROADWAY MOBILITY DATA COORDINATION GROUP?

The Coordination Group is charged with facilitating cross-organizational collaboration, data sharing, and integration of roadway travel mobility data within U.S. DOT to address gaps and redundancies (documented in the U.S. DOT Roadway Transportation Data Business Plan (Phase 1) report) and to collaborate on data management functions related to roadway travel mobility data.¹⁴

¹³ <http://ntl.bts.gov/lib/48000/48500/48531/6E33210B.pdf>.

¹⁴ <http://ntl.bts.gov/lib/48000/48500/48531/6E33210B.pdf>.

Roadway travel mobility data includes travel data from roadway travel modes, including vehicle, truck freight, bicycle/pedestrian, and transit.

Travel data includes vehicle volume, speed, and lane occupancy data, as well as connected vehicle data such as vehicle location, presence and speed within the system, internal vehicle status such as fuel consumption rate, or externally measured data such as recorded external temperature. Travel data for transit vehicles could include location, speed and status data, as well as passenger counts and schedule adherence data. Freight carriers may supplement a standard location and position report with gross weight data or data regarding the type and time-critical nature of good carried. Public sector fleet vehicles may be able to contribute other key data related to their primary functions, such as snowplows reporting blade position or estimates of roadway snow depth. Additional travel data could include a multimodal trace of individual travelers through the transportation system.

The need for the Coordination Group evolved from the white paper, *Needs and Gaps in the Operation and Coordination of U.S. DOT Data Capture and Management Programs*, which was commissioned by the FHWA Office of Operations, Office of Transportation Management (HOTM) to examine current data capture and management activities across various U.S. DOT program areas and identify gaps and potential opportunities to effectively and efficiently coordinate and manage the programs' activities. The white paper identified the need for a communication and coordination mechanism at the Federal level through formation of a data coordination team to address the gaps and share issues related to the capture and management of roadway travel mobility data.

The U.S. DOT Roadway Transportation Data Business Plan (Phase 1) report formalized the recommendation and proposed an initial structure, framework, and rules of engagement for the Coordination Group. The Data Business Plan also established that the scope of the Coordination Group be limited to formally recognized data programs within U.S. DOT that involve the collection, analysis, or reporting of roadway travel mobility data.

The member offices of the Coordination Group are listed in Table 6.

Table 6. Coordination Group Member Offices

Membership
OST-R/Intelligent Transportation Systems Joint Program Office (HOIT)
Bureau of Transportation Statistics (BTS)
FHWA Office of Highway Policy Information (HPPI)
FHWA Office of Program Performance Management (TPM)
FHWA Office of Transportation Management (HOTM)
FHWA Office of Transportation Operations Road Weather Management (HOTO)
FHWA Office of Transportation Operations Research & Development (HRDO)
FHWA Office of Human Environment (HEPH)
FHWA Office of Planning (HEPP)
FHWA Office of Freight Management & Operations (HOFM)
Federal Motor Carrier Safety Association (FMCSA)

HOW IS THE COORDINATION GROUP STRUCTURED?

The Coordination Group is managed under the Operations Regime of the FHWA Data Governance Advisory Council (DGAC), which is formally chartered and empowered to provide strategic review and oversight of all FHWA data collection efforts. The DGAC has authority and responsibility to corporately advise on the utilization of FHWA’s data resources and recommend major changes in FHWA data collection efforts that will result in increased consistency and coordination between existing and new data programs; the elimination of redundant data collection; the consolidation of data sources and resources; and compliance with external mandates.

As documented in *FHWA Data Governance Plan Volume 1: Data Governance Primer* (draft February 2014), data governance at FHWA is comprised of the following three-tiered hierarchy:

- **Data Governance Advisory Council.** The DGAC is responsible for developing the FHWA Data Governance Plan and Framework and serves as the point of contact for coordinating data collection efforts with other modes within the Department and with other branches of government. The DGAC is assisted by Technical Advisors that assist in developing formal documentation on data governance principles and provide input into the decisionmaking process.
- **Data Governance Regimes and Coordinators.** Regimes are responsible for coordinating with individual data programs and ensuring that the Data Governance Plan and Framework are adhered to, while Regime Coordinators liaison with the DGAC and provide oversight of

stewardship and management processes of data programs within their regime. There are twelve Data Governance Regimes:

- HQ Administrative.
 - Financial.
 - Planning.
 - Operations.
 - Policy.
 - Research.
 - Infrastructure.
 - Chief Council.
 - Safety.
 - Federal Lands.
 - Division Office.
 - Technical Services.
- **Data Stewards.** Data Stewards are subject matter experts and points of contact for the data programs they oversee. They are responsible for managing their data programs in accordance with the processes and procedures established by the DGAC and the Regime Coordinator.

The Coordination Group is managed under the Operations Regime of the DGAC, with members from other DGAC regimes such as Planning, Policy, and Research, as well as from other operating administrations and programs of the Department. Figure 3 shows how the Coordination Group fits within the DGAC framework. The Coordination Group also influences other activities/areas outside of FHWA (such as safety).

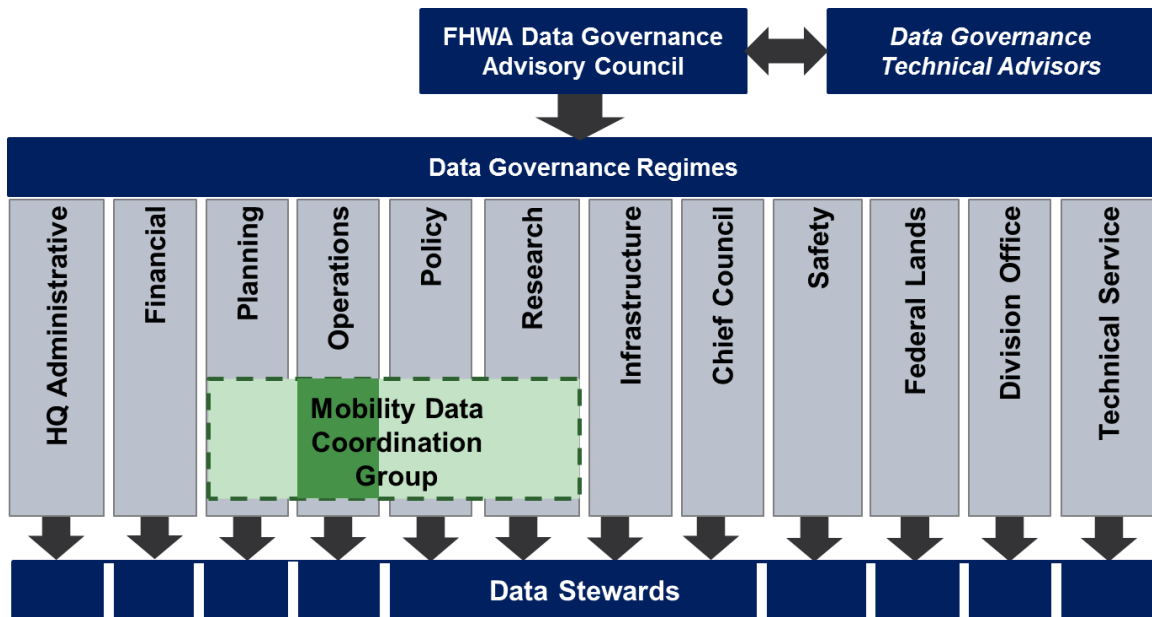


Figure 4. Flow chart. Framework for the coordination group with the Data Governance Advisory Council.

(Source: FHWA Data Coordination Manual (internal document).)

The structure for the Coordination Group is comprised of the Coordination Group Chair/Co-Chair, the Coordination Group itself, Working Groups, and Supporting Staff, as shown in figure 4.

- **Roadway Mobility Data Coordination Group Chair/Co-Chair.** The Chair/Co-Chair are designated individuals from within the FHWA Office of Operations and one member agency representative who would co-chair the Roadway Mobility Data Coordination Group and liaison with the FHWA Data Governance Advisory Council and other offices outside of FHWA (such as Safety). The FHWA Office of Operations Data Business Plan champion (Walter During) would serve as the permanent chair, while the rotating Co-Chair would be selected from one member agency representative.
- **Roadway Mobility Data Coordination Group.** The Coordination Group consists of designated individuals within U.S. DOT who are responsible for the oversight of roadway travel mobility data programs to support the business functions of their offices.
- **Working Groups.** Working Groups may be temporarily formed to address issues that are pertinent to a specific type of mobility data (e.g., travel data, connected vehicle data, climate data, etc.) or that cross-cut multiple types of mobility data (e.g., data quality, data standards, data privacy and security, analysis tools, etc.). Working Groups can also be formed to conduct work on specific activities deemed necessary by the Coordination Group (e.g., provide comments on upcoming RFPs, develop a Strategy Document for the Coordination Group, oversee coordination project activities, etc.).
- **Supporting Staff.** Supporting staff provide administrative support and technical guidance to the Chair/Co-Chair, Roadway Mobility Data Coordination Group and Working Groups, as needed. Supporting staff members include consultants and other administrative staff support as needed.

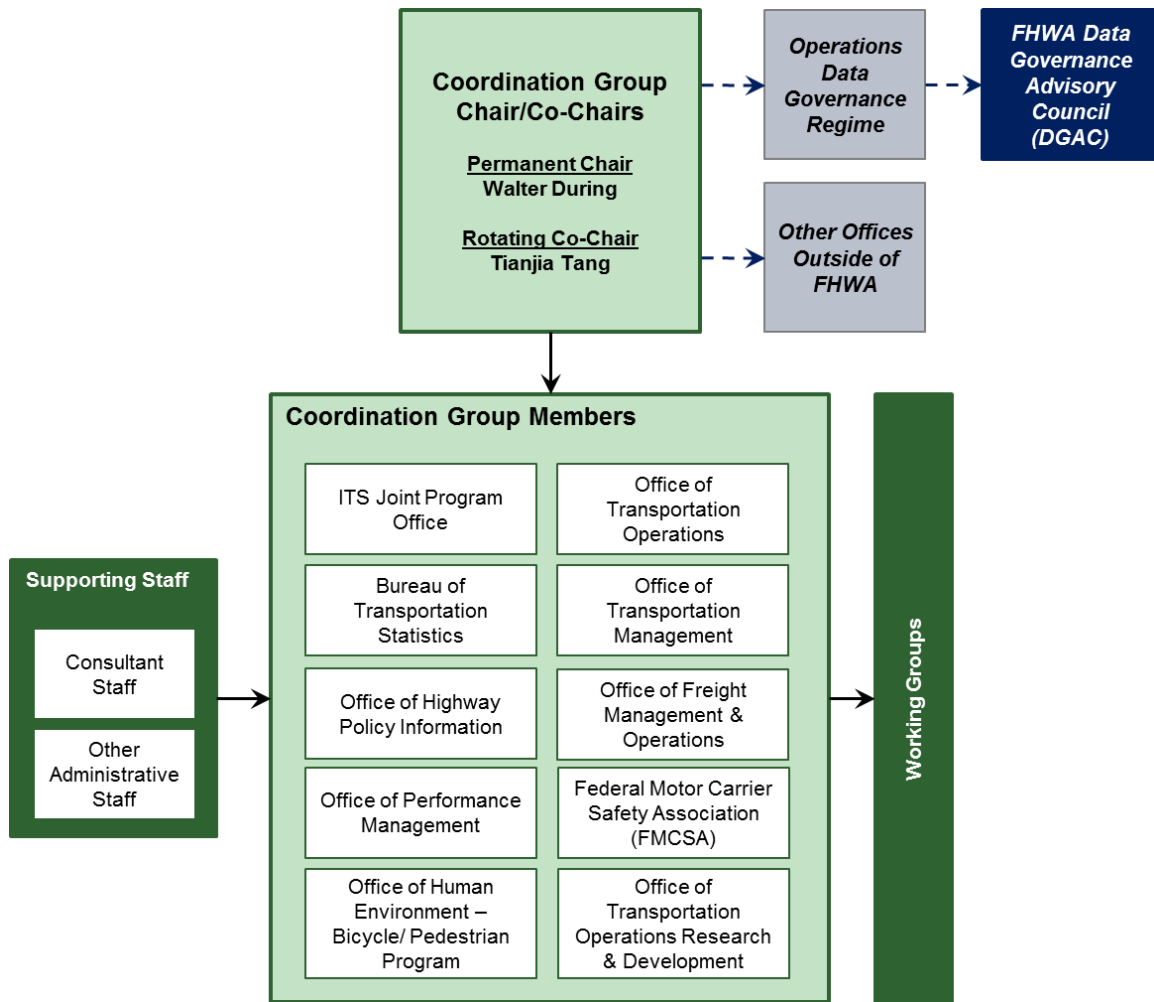


Figure 5. Organizational chart. Structure for roadway mobility data coordination group.

(Source: FHWA Data Coordination Manual (internal document).)

WHAT KIND OF TOPICS DOES THE COORDINATION GROUP ADDRESS?

The Coordination Group is intended to be a forum for U.S. DOT and FHWA stakeholders involved with roadway travel mobility data to coordinate on the following types of activities:

- Share RFPs for current and upcoming initiatives related to roadway travel mobility data.
- Review and provide input on possible FHWA procurement actions related to roadway travel mobility data.
- Share current initiatives, activities, and/or best practices related to roadway travel mobility data, including data strategies, policies, standards, metadata, architecture, procedures, metrics, etc.

- Participate in in-depth vetting of data standards/procedures and standards for linear referencing attributes/terminology to facilitate sharing/integration of U.S. DOT roadway travel mobility data.
- To the extent possible, identify and address gaps and redundancies (documented in the Data Business Plan) in mobility data programs within their respective offices.
- Identify needs and opportunities to coordinate resources, reduce data redundancies, and implement cost-sharing strategies for the collection, management, and maintenance of roadway travel mobility data.
- Identify needs and opportunities to reduce redundancy in the development and maintenance of duplicate data systems, promote efficiency in system maintenance, and promote open source initiatives.
- Identify needs and opportunities to integrate national data sets to support performance measurement and asset management purposes.
- Identify needs and opportunities to create links between existing data sets and connected vehicle data sets in the future.
- Identify needs and opportunities to enhance access to information and data for roadway travel mobility data programs, including the need for web portals accessible by internal and external stakeholders to share data and information as needed.
- Identify and oversee potential data coordination projects or additional research needed to demonstrate reduced cost or improved Federal capability.
- Identify potential funding to conduct agreed upon research projects and data coordination activities.
- Understand and promote the value of data as a U.S. DOT-wide asset.

DATA COORDINATION PROJECTS

Data coordination projects will be conducted to demonstrate the benefit and value of the Data Business Plan in terms of reduced cost or improved efficiency in business operations and work processes. The Coordination Group will be responsible for identifying and overseeing potential data coordination projects or research topics of interest to them, as well as potential funding sources to conduct agreed upon projects.

The following types of projects have been identified by the Coordination Group:

- Development of a searchable, sustainable, current data catalog and SharePoint site for Coordination Group members to share internal information on projects and inform offices of upcoming initiatives related to roadway travel mobility data.
- Develop guidance on developing data business plans for States and local jurisdictions.
- Investigate “big data” sources such as crowdsourcing, social media, and private sector data sources that haven’t been traditionally utilized as sources for roadway travel mobility data.

- Investigate how current standards such as the National Information Exchange Model (NIEM) and open source could be applied within the Data Business Plan or within an individual stakeholder office.
- Develop a tool for visualizing and analyzing large roadway travel mobility data sets within a cloud environment.

A complete list of candidate data coordination project concepts will be maintained on the Roadway Mobility Data Coordination Group Document Share site (FHWA internal site) (<https://collaboration.fhwa.dot.gov/dot/fhwa/xhcx/dbp/default.aspx>). Work on the first project concept will be conducted by Cambridge Systematics as part of the Data Business Plan (Phase III) project, Implementation and Maintenance of the Overall Mobility Data Coordination Group.

HOW DOES THE COORDINATION GROUP WORK?

Meetings

The Coordination Group meets quarterly on the first Tuesday of the months of March, June, September, and December to discuss data management/coordination issues. An annual one-day symposium/working meeting will be convened at the time of the March meeting for members to share information on current initiatives, activities, and best practices and to establish and review the strategic direction and priorities for the Coordination Group for the coming year.

Meetings and teleconferences will be announced at least a week in advance and conducted in accordance with a published agenda. Coordination Group members will be asked to update the group on their office's current initiatives and activities related to roadway travel mobility data. A draft agenda and any requests for presentations/updates will be sent to Coordination Group members in advance of the meeting. Members may request that additional discussion topics be added to the agenda by notifying the Chair/Co-Chair.

Meetings are normally open to all interested parties but may be restricted to Federal participants when necessary (e.g., when RFPs or other upcoming initiatives are shared). Draft minutes documenting action items and responsibilities will be circulated to all members following the meeting. The meeting announcement and final minutes will be posted within two weeks on the Roadway Mobility Data Coordination Group Document Share site (FHWA internal site) (<https://collaboration.fhwa.dot.gov/dot/fhwa/xhcx/dbp/default.aspx>).

Coordination Group members seeking input on RFPs and other procurement actions related to roadway travel mobility data should share the RFP with the Chair/Co-Chair, who will decide whether it should be distributed to Coordination Group members for input/review. The Chair/Co-Chair will also decide the review mechanism (e.g., form a Working Group, distribute the RFP for review by all Coordination Group members, etc.), duration of review period, and whether to initiate a meeting to resolve issues.

Working Groups

The Coordination Group will be supported by Working Groups that are temporarily formed to address needs/gaps that are pertinent to a specific type of roadway travel mobility data (e.g., travel

data, connected vehicle data, climate data, etc.) or that cross-cut multiple types of roadway travel mobility data (e.g., data quality, data standards, data privacy and security, analysis tools, etc.). Working Groups may also be formed to conduct work on specific activities deemed necessary by the Coordination Group (e.g., provide comments on upcoming RFPs, develop a Strategy Document for the Coordination Group, oversee data coordination project activities, etc.).

A request to form a Working Group may be made by the Chair/Co-Chair, any Coordination Group member, or through consensus by the Coordination Group. Working Groups will consist of 2 to 4 interested members, with one member serving as the lead and the remaining members serving as key content reviewers.

Working Groups will meet via conference call or in person as agreed upon by members of the group. The Working Group leader will report on their results at the next regularly scheduled Coordination Group meeting. The Working Group may be disbanded after their work is complete.

Data Coordination Mechanisms

Document Share Site

The Roadway Mobility Data Coordination Group Document Share site (FHWA internal site) (<https://collaboration.fhwa.dot.gov/dot/fhwa/xhcx/dbp/default.aspx>) will be used as a clearinghouse for Coordination Group members to share best practice documents and Coordination Group documents, meeting announcements, and meeting summaries. Hyperlinking to Share Site documents will be used for sending out requests for document review/comments to members.

Awards

The Coordination Group will give annual awards to recognize significant contributions that advance the Data Business Plan's goal to improve coordination and communication mechanisms across U.S. DOT and FHWA offices involved with roadway travel mobility data. In addition to a custom-designed award, recipients receive recognition for their efforts at the annual symposium/working meeting convened at the time of the March meeting.

Each year, nominations for the award will be accepted by members of the Coordination Group. To submit a nomination, the nominator must submit the following information:

- Nominator's name, office, title, address, phone number, and email.
- Nominee's name (or contact person for a nominated organization or program), office, title, address, phone number, and email.
- A narrative, not to exceed 500 words, in support of the nomination, addressing the following areas:
 - Provide a clear, direct, and specific statement of why the nominee deserves recognition.
 - Elaborate on why the nominee's accomplishments are worthy of the award, including what the nominee did (e.g., projects, activities), any challenges or issues encountered and overcome, how they did it (initiative/leadership, teamwork/collaboration, and/or

creativity/innovation), and the results/outcomes (or major milestones) that the nominee's efforts accomplished.

Nominations should be submitted to the Coordination Group Chair by January 31st of each year. A Working Group will be formed to review nominations and select a winner, which will be announced during the annual symposium/working meeting.

WHAT IS EXPECTED OF MEMBERS?

Members of the Coordination Group shall:

- Maintain a culture of collaboration and mutual trust by regularly attending and participating in quarterly Coordination Group meetings and Working Groups and presenting their office perspective.
- To the extent possible, identify and address gaps and redundancies in roadway travel mobility data programs within their respective offices.
- Identify data standards and stewardship recommendations for consideration by the FHWA Data Governance Advisory Council.
- Engage Coordination Group members in procurement decisions by sharing RFPs for current and upcoming initiatives related to roadway travel mobility data.
- Develop recommended language for insertion into Statements of Work.
- Share best practices related to roadway travel mobility data, including data strategies, policies, standards, metadata, architecture, procedures, and metrics.
- Ensure that Coordination Group best practices are communicated to data stewards within their respective office.
- Identify potential data coordination projects or additional research needed to demonstrate reduced cost or improved Federal capability.
- Identify potential funding to conduct agreed upon research projects and data coordination activities.
- Provide feedback on research project ideas.

Coordination Group products include:

- Documentation of best practices related to roadway travel mobility data, including data strategies, policies, standards, metadata, architecture, procedures, and metrics.
- Recommendations for enhancements to Statements of Work or RFPs for current and upcoming procurements related to roadway travel mobility data.
- Completion of data coordination projects and research activities that reduce costs or improve the quality and effectiveness of roadway mobility data.

HOW WILL SUCCESS OF THE COORDINATION GROUP BE MEASURED?

The Data Business Plan outlined the expected outcomes of improved coordination of roadway travel mobility data programs through the Coordination Group, which include:

- Improved availability of data to support planning, operations, and performance measure activities.
- Elimination of redundant data collection efforts, resulting in a decrease in possible expenditure for duplicate data.
- More rapid, targeted data acquisitions.
- Broader sharing of data resources.
- Systematic coordination and clarification of data-related federal policy.
- Reduced data collection and management costs.
- Better serve the needs of customers of FHWA.
- Improved efficiency in business operations and work processes through use of data sharing technology.
- Consensus in the use of streamlined data sources across organizational business units.

Success of the Coordination Group will be assessed using performance indicators to measure program activities (i.e., outputs) and confirm the program is effectively delivering results (i.e., outcomes). The linkages between program activities (i.e., outputs) and expected outcomes (both immediate and long term) are shown in figure 5.

Performance indicators for Coordination Group activities (i.e., outputs) and outcomes are shown in figures 6 and 7, respectively. Output indicators quantify the activities of the Coordination Group and reflect the level of effort expended or scale/scope of activities. These indicators are both qualitative and quantitative in nature and will be assessed on an annual basis as part of the Data Business Plan Annual Update. Outcome indicators quantify the effectiveness of the Coordination Group in terms of meeting its mission and stated goals. These indicators will depend on the availability of internal U.S. DOT data to support calculation of the measure, and they may be refined as implementation of the Data Business Plan continues. After three years, an assessment of the effectiveness of the group will be made using the outcome indicators, and the Coordination Group will decide whether to continue its activities or disband the group.

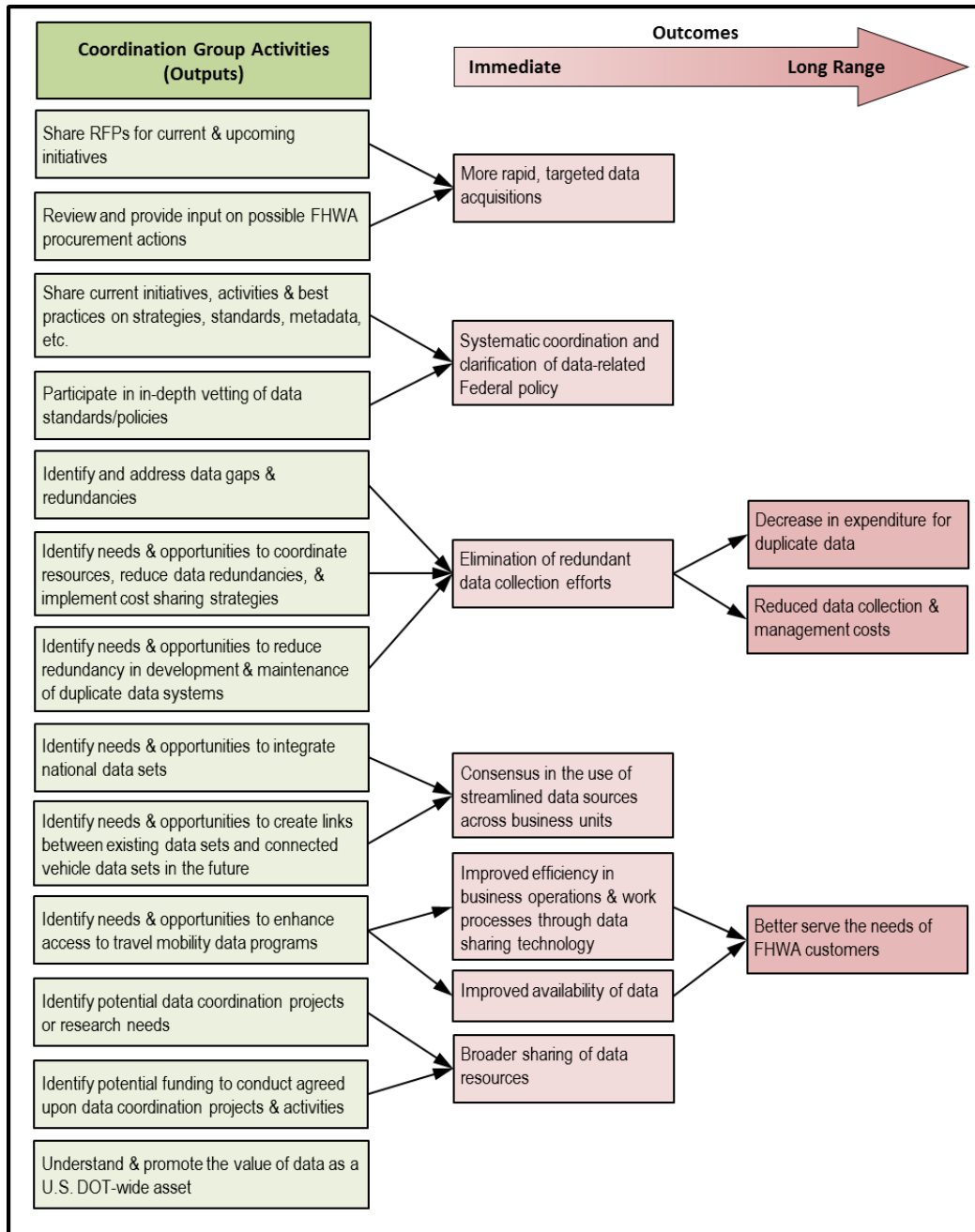


Figure 6. Flow chart. Relationship between group activities (outputs) and outcomes.

(Source: FHWA Data Coordination Manual (internal document).)

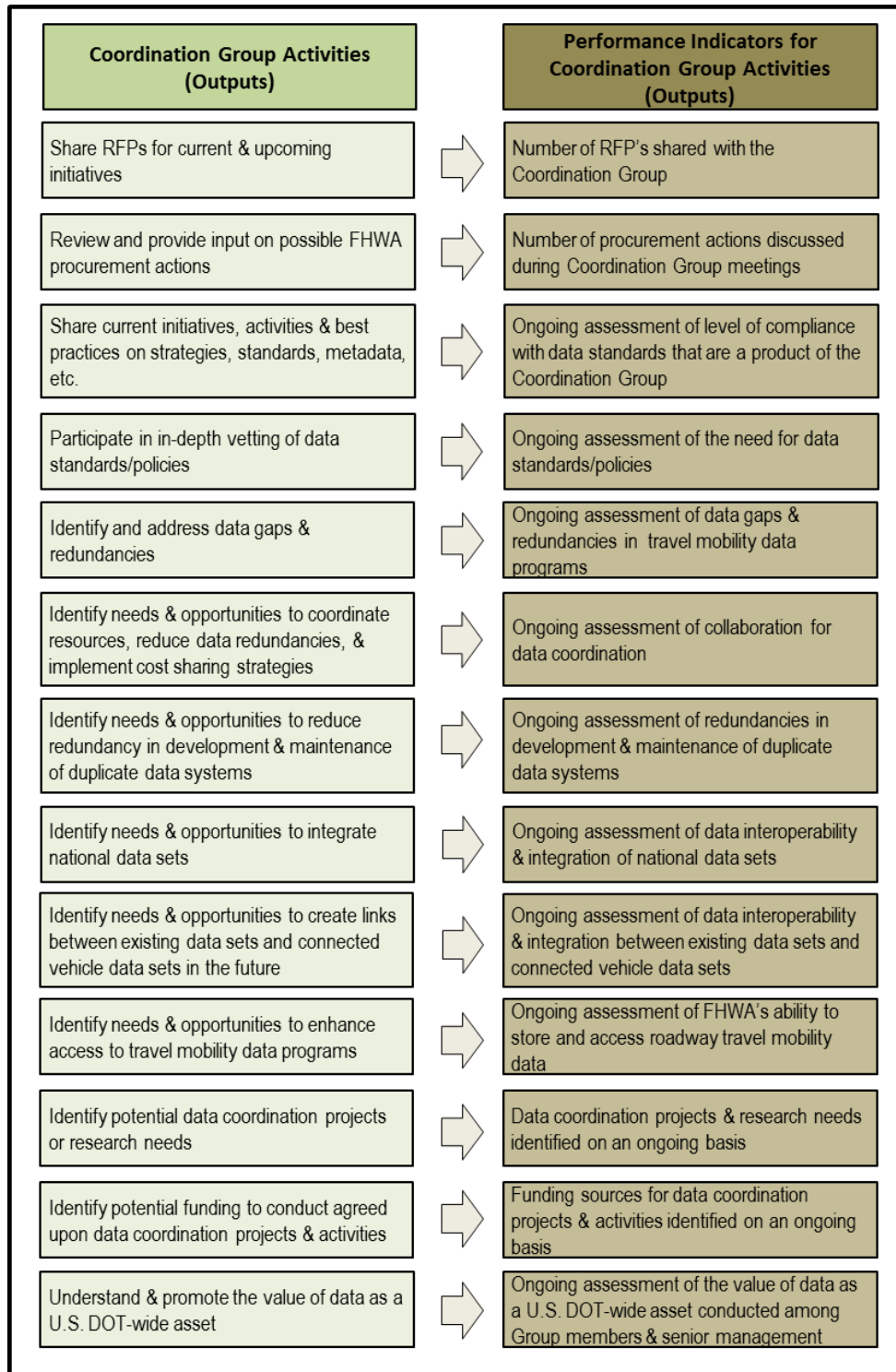


Figure 7. Process chart. Performance indicators for group activities (outputs).

(Source: FHWA Data Coordination Manual (internal document).)

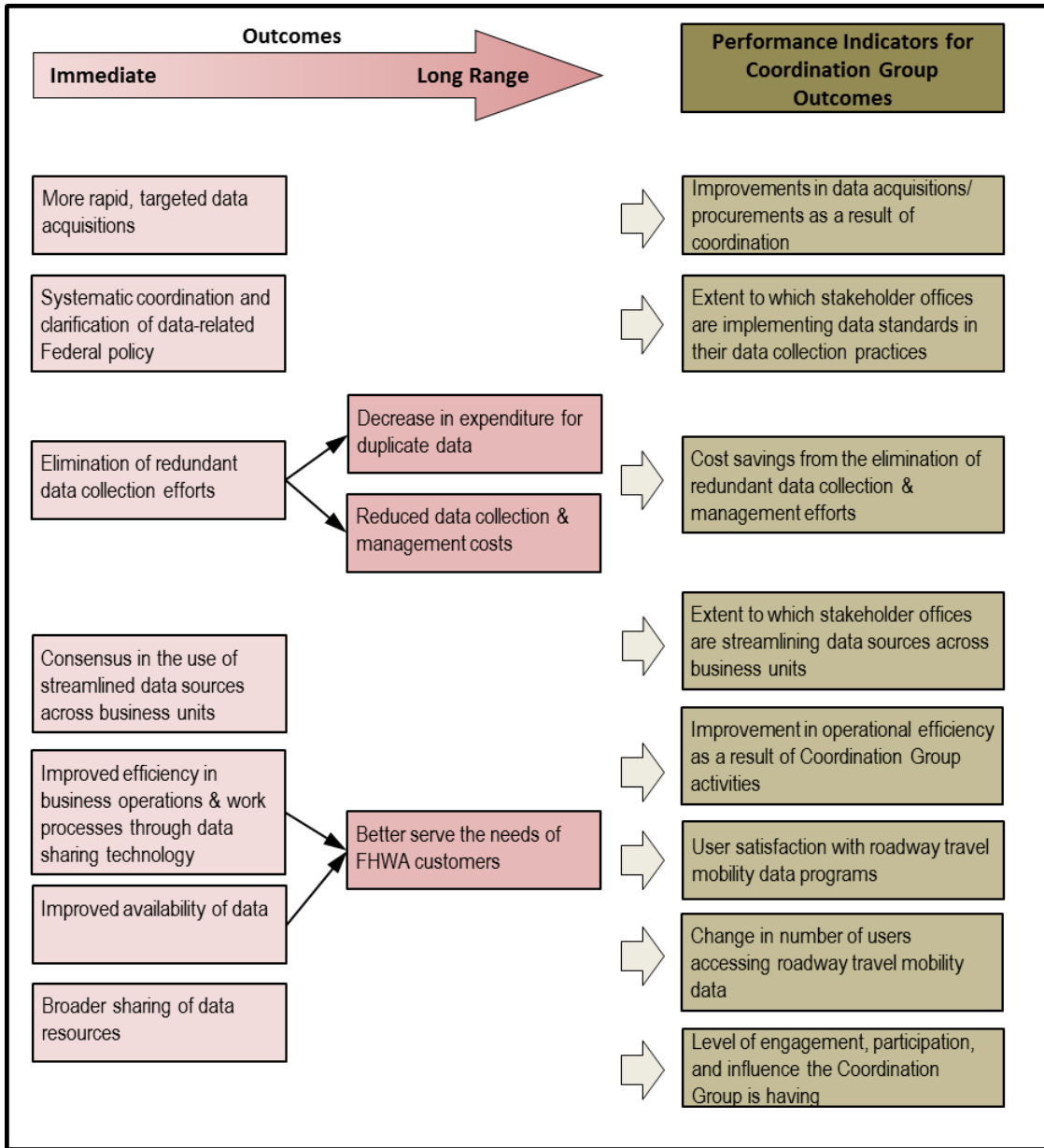


Figure 8. Flow chart. Performance indicators for outcomes.

(Source: FHWA Data Coordination Manual (internal document).)

WHAT ADDITIONAL DOCUMENTATION IS AVAILABLE?

The following supporting documents provide additional information on the history of the Coordination Group and U.S. DOT Roadway Transportation Data Business Plan:

- *Data Capture and Management: Needs and Gaps in the Operation and Coordination of U.S. DOT Data Capture and Management Programs*. This white paper examines current data capture and management activities across various U.S. DOT program areas and identified gaps and potential opportunities for filling the gaps to effectively and efficiently coordinate and manage the programs' activities. The primary recommendation from the white paper was that the Office of Transportation Management (HOTM) develop a Data Business Plan to address the gaps identified in the paper.
- *U.S. DOT Roadway Transportation Data Business Plan (Phase I): Data Business Plan* (January 2013). This report documents the results of Phase 1 of the Data Business Plan, which serves to improve coordination among real-time data capture programs within U.S. DOT by clearly defining U.S. DOT needs for real-time data, address gaps and overlaps in program needs with respect to stakeholders, and ultimately result in cost savings for U.S. DOT (Available at: <http://ntl.bts.gov/lib/48000/48500/48531/6E33210B.pdf>).
- *U.S. DOT Roadway Transportation Data Business Plan (Phase II): Data Business Plan* (June 2013). This report documents the results of Phase 2 of the Data Business Plan, which includes execution of the Data Business Plan coordination, as well as conducting two data integration test pilots to demonstrate the benefits and value of the Data Business Plan (Available at: <http://ntl.bts.gov/lib/48000/48500/48536/EBBC1DA.pdf>).

WHO IS THE KEY CONTACT FOR INFORMATION?

The key FHWA contact for additional information on the Coordination Group and *U.S. DOT Roadway Transportation Data Business Plan* is:

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APPENDIX E. GLOSSARY OF DATA MANAGEMENT AND GOVERNANCE TERMS

This appendix provides a glossary of terms related to data coordination, management, and governance.

Connected Vehicle Data—Data collected via a vehicle that has an independent onboard wireless capability to establish a two-way data linkage between a system onboard and another system not onboard, for the purpose of transferring information.

Data Business Plan—Describes a systematic process for Maryland SHA to follow while conducting activities related to the collection, management, and maintenance of mobility data.

Data Catalog—A catalog of information about the data used by stakeholders involved with mobility data programs in the Maryland SHA region. The data catalog includes a list of relevant data programs, data business owners, data stewards, and instructions for accessing data standards and definitions with that program.

Data Custodian—IT staff including IT security, network administrators, Database Administrators, server administrators, and Business area staff who are responsible for the “technical application” support for data systems. This may include application programmers and systems analysts who work in business areas other than the IT Office or Division.

Data Governance—The execution and enforcement of authority over the management of data assets and the performance of data functions. The management of data assets is accomplished through the Data Management Board. This role is critical in successfully managing data programs that meet business needs and in supporting a comprehensive data business plan for the organization.

Data Governance Charter—Sets forth the purpose, mission, vision, goals and objectives, and data management policies for implementation of the Data Management Board.

Data Governance Manual—Provides comprehensive guidance to the Data Management Board in implementing the Data Governance Model and Charter.

Data Governance Model—A diagram depicting the relationship between mobility data programs, the various individuals/agencies responsible for implementing data governance, and the users / stakeholders for the data programs.

Data Management—The development, execution, and oversight of architectures, policies, practices, and procedures to manage the information lifecycle needs of an enterprise in an effective manner as it pertains to data collection, storage, security, data inventory, analysis, quality control, reporting, and visualization.

Data Management Practices—Activities necessary to acquire, update, describe, standardize, analyze, store, and protect data to ensure it can be used.

Data Stewards—Individuals within Maryland SHA and external agencies who are subject matter experts and points of contact for the data programs they oversee. They are responsible for managing their data programs in accordance with common processes and procedures.

Data Stewardship—The formalization of accountability for the management of data resources. Data stewardship is a role performed by individuals within an organization known as data stewards. The functions of data governance and data stewardship typically are part of an overall data management program within an organization.

Mobility Data—On-time performance for transit, bike/ped counts, and travel time/speed and VMT for vehicles and truck freight.

Department Director’s Meeting—Senior level managers from Maryland SHA. This group would provide executive level support for data governance, including dedicating resources as needed and establishing memorandums of understanding for data sharing with other partner agencies.

Data Management Board—The designated individuals from Maryland SHA’s offices responsible for the oversight of data programs to support the business functions of their offices. This group dictates the policies, procedures, and business practices associated with mobility data programs.

Data Management Board Charter—Charter document that formally establishes the Data Management Board and sets forth the objectives, membership, structure, and operating framework for implementing the Data Management Board.

Mobility Data Program—A formal or informal program for the collection, analysis, or reporting of mobility data.

Mobility Data Users and Stakeholders—Any persons or agencies that use or interface with, access, benefit from, or are otherwise affected by mobility data.

Rules of Engagement—Practices followed or behavior displayed by the participants in situations of opposing interests such as negotiations. Unwritten rules of engagement determine what information is given, at what time, to whom, and in what manner; and what concession is granted and what is demanded in return. For work in a team, rules of engagement typically define the protocols of communication, conflict, decisionmaking, and meetings.

APPENDIX F. ACRONYMS

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway Transportation Officials
ADA	Americans with Disability Act
ATRI	American Transportation Research Institute
BMC	Baltimore Metropolitan Council
CATT	Center for Advanced Transportation Technology
CAV	Connected and Automated Vehicles
CHART	Coordinated Highways Action Response Team
CTP	Consolidated Transportation Program
DBP	Data Business Plan
DGD	Data Governance Division
DOT	Department of Transportation
eGIS	Enterprise Geographic Information System
FHWA	Federal Highway Administration
GIS	Geographic Information System
GPS	Global Positioning System
HPMS	Highway Performance Monitoring System
IT	Information Technology
ITS	Intelligent Transportation System
MDOT	Maryland Department of Transportation
MDTA	Maryland Transportation Authority
MPO	Metropolitan Planning Organization
NHS	National Highway System
NPMRDS	National Performance Management Research Data Set

OOTS	Office of Traffic and Safety
OPPE	Office of Planning and Preliminary Engineering
RDE	Research Data Exchange
RFP	Request for Proposal
RITIS	Regional Integrated Transportation Information System
SHA	State Highway Administration
SHRP 2	Strategic Highway Research Program
TMC	Traffic Message Channel
TSMO	Transportation Systems Management and Operations
UMD	University of Maryland
VMT	Vehicle Miles Traveled

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