ADVANCED
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PARTNERSHIP

Data and data sharing discovery report

April 2021

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Department of Transportation

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Introduction

Several years ago, the Colorado Department of Transportation, Denver Regional Council of Governments, Regional Transportation District and the Denver Metro Chamber of Commerce came together under the Mobility Choice Blueprint Initiative to plan for the future of emerging technology and rapid innovation in the transportation sector. The effort culminated in the development of the Mobility Choice Blueprint, the region's proactive vision for transportation technology, which was completed in 2019. Shortly after the blueprint was completed, and in the spirit of moving from planning to action, the same partner agencies formed the Advanced Mobility Partnership in December 2019.

Priority tactical actions

The Mobility Choice Blueprint describes a number of tactical actions across various focus areas, from transportation electrification to driverless vehicle preparation amongst many others. The Advanced Mobility Partnership Executive Committee and Working Group discussed each of the 34 tactical actions and collaboratively prioritized the partnership's initial activities. In 2020, stakeholders and leadership overwhelmingly supported initial activities around mobility data and data sharing, specifically the following two tactical actions from Mobility Choice Blueprint:

- 4.1 Establish a regional mobility data platform.
- 4.2 Establish data-sharing requirements for private sector roadway users.

What is a regional mobility data platform?

While the Mobility Choice Blueprint does not explicitly define what constitutes a regional mobility data platform, Advanced Mobility Partnership partner agency staff have agreed upon a brief description for the purpose of this discovery document: a platform may be a system or set of components that includes data management, tools, technologies and capabilities. Partner agency staff and stakeholders will work together to further define this during visioning and planning phases in 2021.

Initial work and discovery

The importance of mobility data and data sharing was underscored by several other priority tactical actions identified in Mobility Choice Blueprint. Analyzing travel data and improving transportation system performance is foundational to many of the tactical actions identified in the Mobility Choice Blueprint. Following the Advanced Mobility Partnership identification of data and data sharing as a priority focus area, and prioritization of two tactical actions from Mobility Choice Blueprint, the project team engaged staff and stakeholders to outline specific activities associated with implementation. The outreach resulted in the identification of several project phases, including an initial discovery phase. This discovery document details the work and findings associated with the discovery and visioning phase, which began in the fall of 2020.

State of the practice

In support of initial discovery activities, partner agency staff wanted to better understand the current state of practice as it pertained to mobility data and data sharing. The discovery effort consisted of several components, including:

- Understanding current efforts in the region.
- Identifying and learning from case studies.
- Better understanding the capabilities of existing partner agency tools and products.

The team used regional stakeholder interviews, a survey, presentations and discussions to collect baseline information regarding knowledge and practice related to data use, needs, practice and governance in the region.

Existing coalitions

The Denver region has a long history of collaboration and coordination, and continuing that legacy through the Advanced Mobility Partnership's mobility data and data-sharing efforts is a priority of the partner agencies. Supporting the Advanced Mobility Partnership's work on data and data sharing are a variety of existing stakeholder groups in the region, state and nation. With missions are specific to data and data sharing, engaging these groups and understanding their work will inform the Advanced Mobility Partnership's initial planning and visioning regarding a regional mobility data platform. Some of the key coalitions are described here.

Regional groups

Advanced Mobility Partnership Executive Committee and Working Group

Advanced Mobility Partnership partner agency staff are leading the effort to explore the development of a regional mobility data platform. Both the Advanced Mobility Partnership Executive Committee and Working Group will be the primary stakeholders throughout the process and the decision-makers regarding implementation of any related efforts. To date, these bodies have participated in engagement efforts, decision points and discussion around the development of a regional mobility data platform and associated strategies.

Advanced Mobility Partnership Steering Committee on Data and Data Sharing

While identifying next steps and activities, partner agency staff consulted the Advanced Mobility Partnership Steering Committee on Data and Data Sharing, an ad hoc group made up of mobility data-related subject matter experts and interested stakeholders. Partner agency staff will continue to consult the steering committee as they refine the vision for data and data sharing and as they develop specifications and products.

DRCOG Data Management Committee

DRCOG recently developed an agencywide Data Privacy Policy and as part of the development of the policy, identified a governance structure to assist in implementing the policy.[1] The cross-divisional Data Management Committee provides guidance and oversight as it pertains to data policy development, management and implementation at DRCOG.

1 https://drcog.org/sites/default/files/Data-Privacy-Policy.pdf

Denver Regional Data Consortium

DRCOG has long supported regional data initiatives. DRCOG's Regional Planning and Development division has led the Denver Regional Data Consortium since 2009.[2] The consortium, which meets several times a year and issues a quarterly newsletter, is composed of geographic information system professionals in the region.

Statewide groups

The Governor's Office of Information Technology

The Governor's Office of Information Technology is the State of Colorado's centralized information technology office and provides IT infrastructure, telecommunication tools, cloud computing, application development and support and provisioning for more than 28,000 state employees across 1,300 locations. The Governor's Office of Information Technology supports state agencies and proactively protects the state's information systems and data for the executive and judicial branches of state governments.

Government Data Advisory Board

The Governor's Office of Information Technology convenes the Government Data Advisory Board, a group of state agency stakeholders that advise the state chief information officer on activities and policies necessary to increase the effectiveness and efficiency of how the state governs and manages data. The board provides advice and guidance to the Office of Information Technology to improve the interdepartmental data protocol as outlined in House Bill 08-1364. The group is composed of state agency subject matter experts and stakeholders that generate, use and rely on data in their state role. The group typically meets monthly, and all meeting information is available online.[3]

CDOT Enterprise Data Management Advisory Committee

CDOT has an Enterprise Data Management Advisory Committee which is responsible for identifying and implementing user-level data needs. The group assists the executive management team steering committee in supporting CDOT's overall governance. Given the ever-changing role and significance of data in CDOT's day-to-day operations and mission, efficient data governance is a key driver of CDOT's approach to data management.

University Transportation Alliance for Colorado

The University Transportation Alliance for Colorado is a joint effort by the University of Colorado Denver, the University of Denver and Colorado State University to address transportation, mobility and accessibility related issues along the Front Range. The alliance's premise is that the strengths of the various schools in a coordinated effort will be more robust than their individual resources related to developing and conducting transportation technology and innovation research in Colorado.

National coalitions

There are numerous agencies and organizations coordinating and collaborating on mobility data throughout the nation, from teams at the U.S. Department of Transportation and Federal Highway Administration to public-private sector collaboratives such as the Open Mobility Foundation and SAE International's Mobility Data Collaborative.

The U.S. Department of Transportation has advanced work in the open-source arena, promoting collaboration and community-building among deployers of technology and data systems. Open Source Software for Intelligent

2 https://drcog.org/services-and-resources/data-maps-and-modeling/denver-regional-data-consortium
3 http://www.oit.state.co.us/cto/cim/government-data-advisory-board#:~:text=Board%20Mission,data%20and%20data%20management%20systems

Transportation Systems is an ecosystem that advances the deployment of interoperable transportation systems.[4] Its environments feature infrastructure that provides deployers with a robust and flexible framework that they can implement and maintain in their environments while also contributing to the broader community to accelerate future deployments. Several tools that support connected and automated technologies include CARMA, V2X Hub, Operational Data Environment and the Secure Data Commons. CDOT has leveraged the tools offered in the Operational Data Environment as a foundation for its connected vehicle back-end ecosystem.

The Federal Highway Administration is facilitating infrastructure owner operators in the development of a Work Zone Data Exchange specification that harmonizes work zone data to make it easily available for third-party use.[5] Not only does the specification account for planned work zone events, it also allows for the ability to provide up-to-date information on dynamic roadway conditions, such as construction events. CDOT is developing a Work Zone Data Exchange feed for work zones in Colorado that can be used by third parties, while also improving the information regarding work zones communicated to the public.

DRCOG is a member of the Open Mobility Foundation and supports the use of the Mobility Data Specification in the Denver region to facilitate local agency management of shared micromobility programs and regional partner agency data-sharing efforts. Additionally, DRCOG has participated in SAE International's Mobility Data Collaborative to further public-private sector partnership in the identification of key metrics and data privacy considerations.

Case studies on mobility data sharing

The project team conducted a desktop review of several existing data-sharing systems to evaluate the range of mobility data platforms in use, or under development, by public agencies around the country. The examples that follow do not constitute an exhaustive list of all existing systems; rather, they provide an illustration of the variety of systems and approaches to constructing systems that various agencies have taken. In each case, prerequisites for successful platform creation included a clear vision for how the data-sharing platform serves broader agency interests and robust policies for data privacy and management.

Atlanta Regional Commission

The Atlanta Regional Commission has proposed the development of a centralized regional data hub.[6] The proposed platform will provide easier access to regional traffic operations and transit data for stakeholder agencies. To create the platform, the Atlanta Regional Commission plans to expand on existing data infrastructure as a foundation. Many of the commission's upcoming transportation technology initiatives involve the development of datasets that would be stored in the platform or use data from the platform for analysis and optimization of the transportation system. Additionally, in anticipation of future automated and connected vehicles, the Atlanta Regional Commission has prioritized creating a central repository of data that can be drawn upon for managing new technologies on roadways. With the expectation of coordinating data resources throughout the region, the commission has also developed a Joint Agency Data Acquisition Group with the Georgia Department of Transportation to standardize data practices between the agencies and engage in joint procurement.

4 https://www.pcb.its.dot.gov/CV_deployer_resources.aspx
5 https://www.transportation.gov/av/data/wzdx
6 https://atlantaregional.org/TSMO/

San Diego Association of Governments

The San Diego Association of Governments has proposed creating the Next Operating System as one of its Five Big Moves in its upcoming regional plan, San Diego Forward.[7] Next Operating System will consist of a data repository and analysis tools to allow partner agencies to better plan and manage the transportation system in the San Diego region. The plan for the platform includes traffic operations data, as well as transit and micromobility data. Among the San Diego Association of Governments' goals is that Next Operating System would also provide the digital infrastructure for a multimodal trip planning and fare payment app to streamline users' commutes.

North Florida Transportation Planning Organization

The North Florida Transportation Planning Organization has recently created an Integrated Data Exchange.[8] The platform is a repository for data collected by a range of partners, and eventually will include real-time data collected by smart city sensors throughout the region. The Data Exchange includes not only transportation data, but also human services and health data. The North Florida Transportation Planning Organization intends to collaborate with third-party app developers to create a regional trip planner and traffic app for residents to find the best way to traverse the region based on current conditions.

Plan Hillsborough

Plan Hillsborough, the metropolitan planning organization for the Tampa, Florida, area, has been using the Iteris ClearGuide platform since November 2019.[9] ClearGuide is an off-the-shelf data repository product which also has robust visualization and analysis capabilities for traffic congestion. Access to the Plan Hillsborough platform is currently limited to agency staff and staff of authorized partner agencies. The platform is currently limited to traffic operations data, though Plan Hillsborough is exploring adding crash data as well as a publicly accessible portal. While ClearGuide has been used by state departments of transportation, this is an innovative example of a proprietary product being used regionally.

City of Columbus

The City of Columbus, Ohio, received a 2016 Smart City Challenge grant from the U.S. Department of Transportation to design a more efficient, data-centered transportation system.[10] As part of the grant, partners developed the Smart Columbus Operating System. The data platform collects data related to transportation, health and other topics from a variety of public and private sources. To increase the effect of the demonstration grant, the city worked with developers and the public to create a range of applications for the data. The source code for the Operating System is publicly available for peer cities and agencies to use and adapt.

City of Chicago

The City of Chicago operates an Open Data Portal.[11] A distinct feature of the Chicago data portal, however, is the inclusion of near real-time datasets. Regularly updated datasets for bike-sharing vehicle availability and traffic congestion, for example, are more robust than is often typical for municipal open data portals. While the data collected is primarily city-owned (or provided from private operators as a condition of their regulatory agreement with the city), Chicago's approach may be adapted to a regional level, especially if a regional agency already has a data portal that hosts data from several regional partners.

7 https://www.sdforward.com/mobility-planning/next-os
8 https://smartnorthflorida.com/data-exchange/
9 http://www.planhillsborough.org/wp-content/uploads/2020/08/Overview-of-ClearGuide.pdf
10 https://www.smartcolumbusos.com/
11 https://data.cityofchicago.org/

Other findings

While conducting discovery work, partner agency staff observed that while there are various ongoing data efforts throughout Colorado, there is not a single, statewide approach. Data is a complex and broad topic. Many mobility data-related components and topics require distinct expertise and experience. For example, while statewide data governance may be desirable, it may also be a significant barrier for organizations to uniformly tackle given their individual requirements, statutes and policies. Staff observed shared interest by several stakeholders to have greater access to information available by organizations in the region. This feedback highlighted existing barriers like lack of a universal directory for open, protected and internal data among public agency assets. Stakeholder feedback suggests that a potential statewide data approach to promote and enable broad data access and data sharing should be considered in developing models specific to a regional mobility data platform.

Existing tools in the Denver region

In the Denver region, many mobility-related tools and products serve a variety of users and purposes. The project team evaluated regional products — a description of several follows. While not discussed here, many local jurisdictions in the region also provide transportation-related open data as part of their data offerings.

Regional products

Regional Data Catalog

DRCOG manages the Regional Data Catalog, a repository of open data.[12] DRCOG's Regional Planning and Development division develops and compiles data from a variety of sources and covering topics ranging from transportation to aging and economics to the natural environment. Each year, local governments provide data to DRCOG and staff compiles and develops it for regionwide coverage. Additionally, DRCOG purchases some data or produces it in-house from DRCOG's land use and travel models. In addition to the data, the Regional Data Catalog includes web and static map products.

Denver Regional Visual Resources

DRCOG also manages Denver Regional Visual Resources, a catalog of interactive, visual data about the Denver region.[13] The resources include topics such as economics, land use, regional profiles, travel and transportation and aging. Denver Regional Visual Resources uses data to tell stories about the Denver region in a visual way.

RTD Open Data Portal

RTD manages an Open Data Portal, through which it shares scheduled (General Transit Feed Specification-Static), real-time (General Transit Feed Specification-Real Time) and geospatial data.[14] Its General Transit Feed Specification products are open and available to third-party developers and other stakeholders to develop new apps, widgets and other tools. RTD's geospatial data offerings include datasets and interactive web maps that share information about RTD's system including locational information and planning datasets.

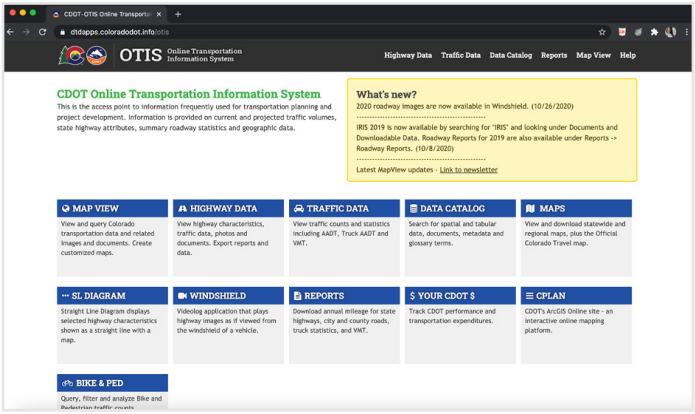
RTD apps

RTD has developed a variety of mobile apps, including Mobile Tickets, Next Ride and Transit Watch. The apps provide trip planning and ticketing, real-time arrival information, safety reporting and parking services. In addition to the RTD-developed apps, third parties have

12 https://data.drcog.org/
13 https://drcog.org/services-and-resources/denver-regional-visual-resources
14 https://www.rtd-denver.com/business-center/open-spatial-data

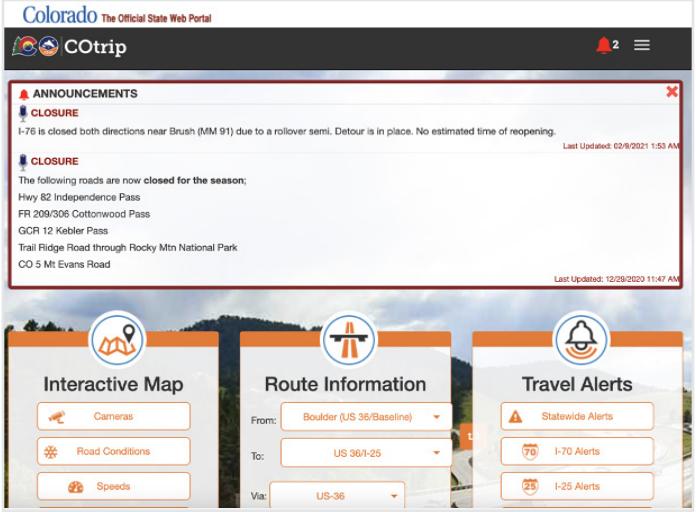
used RTD data to develop consumer apps available via app stores. Free and fee-based applications include Apple Maps, ezRide, Google Maps, Moovit, ParkMobile, TripGo, TransitTracker, Swiftly, Transit, Denver Ride, Transit Guru and RailBandit.

Statewide products



Online Transportation Information System

CDOT hosts the Online Transportation Information System, which provides access to transportation planning and project development information.[15] Data hosted on the Online Transportation Information System includes current and projected traffic volumes, state highway attributes, roadway statistics and geographic information. Various datasets are frequently updated, with summary information about the updates provided on the Online Transportation Information System webpage.



COtrip

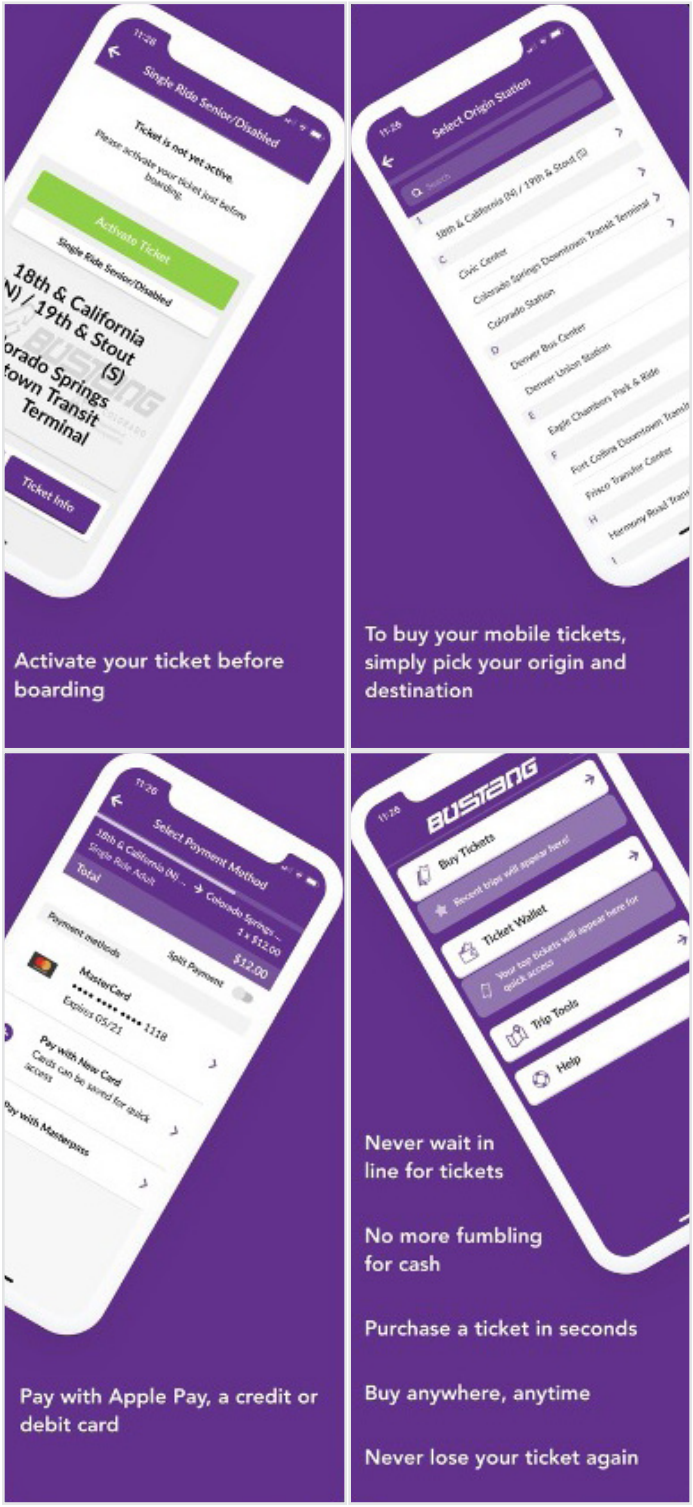
CDOT maintains and manages COtrip.org, which keeps the traveling public informed using real-time and up-to-date information on roadway conditions, incidents and alerts.[16] COtrip provides access to several real-time transportation data feeds maintained by CDOT including roadway camera feeds, speeds, travel time, alerts, weather, message signs, snowplow information and route information. Third-parties provide COtrip data as an XML data feed subscription. CDOT is planning significant upgrades to COtrip later in 2021, and as such data availability and type may change.

CDOT applications

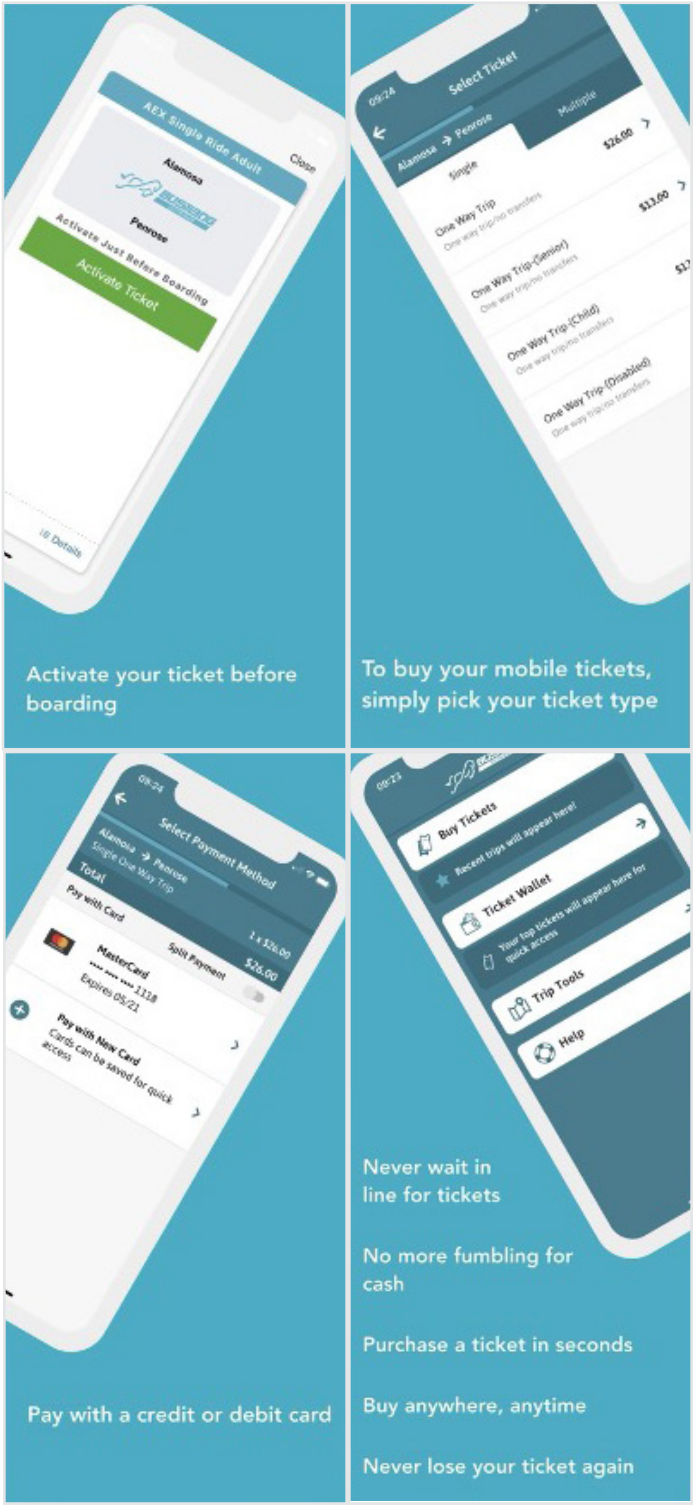
CDOT provides interregional and intercity express bus service throughout the Colorado with its Bustang and Outrider operations. Bustang and Outrider have several routes connect the urban and rural areas of the state via public transit service. For rider convenience and to enable access to information, Bustang and Outrider mobile applications allow riders to find route information, plan a trip, purchase a fare and receive contact customer service.

15 https://dtdapps.coloradodot.info/otis
16 http://www.cotrip.org/

Bustang



Outrider



Connected Colorado

CDOT is currently engaged in a multiphase initiative to enable regional transit coordination and collaboration with transit providers in Colorado. Connected Colorado leverages real-time General Transit Feed Specification travel data sourced from transit providers throughout Colorado. CDOT is developing a platform plan that includes centralized trip planning and ticketing across multiple public and private transit providers.

CDOT cloud assets

CDOT is currently undergoing a significant cloud migration that will optimize not only how it ingests, maintains, analyzes and stores its own data, but also how it will share data in the future. CDOT is building the Advanced Data Analytics Platform, a data lake that it will use to store and archive its longer-term data. CDOT is also is developing a Real-Time Data Hub that enables standardization of several types of data sources for ease of use and analysis. Both the Advanced Data Analytics Program and the Real-Time Data Hub will enable data sharing in the future using APIs, publication and subscription services.

Colorado Information Marketplace

The Governor's Office of Information Technology hosts the statewide open data portal, the Colorado Information Marketplace.[17] The Colorado Information Marketplace is a public use repository that includes information on a wide range of subject areas. The Colorado Information Marketplace is the primary way the State shares data with the public and supports transparency efforts. The Colorado Information Marketplace's primary user groups are data consumers (app developers, researchers, analysts and general public) and data providers (public agencies, such as DRCOG). In addition to the data catalog, the marketplace also offers data visualization tools.

Ad hoc mobility data-sharing program examples

As part of the discovery phase, the project team explored existing mobility data-sharing efforts. The following summary does not serve as an inventory, rather, it's an example of various programs that currently support mobility data collection, sharing and analysis in the Denver region.

INRIX

CDOT has an existing contract with INRIX to provide transportation data and services. Data services include real-time data sources such as speed and travel times. The contract also includes access to RITIS, an analytical tool used by CDOT to support various projects and initiatives.

DRCOG Shared Micromobility Data Pilot

DRCOG is piloting the use of a shared micromobility data platform in the region, which ingests Mobility Data Specification and General Bikeshare Feed Specification data generated from shared micromobility vehicles and provided by the operator via a set of APIs. These Mobility Data Specification feeds are ingested by the Ride Report platform, which aggregates and presents the data in a user-friendly format local agencies can use to manage and analyze their shared micromobility programs. Approaching micromobility data sharing from a regional perspective levels the playing field for local agencies and promotes multijurisdictional partnerships and decision-making.

17 https://data.colorado.gov/

Initial engagement on mobility data sharing in the Denver region

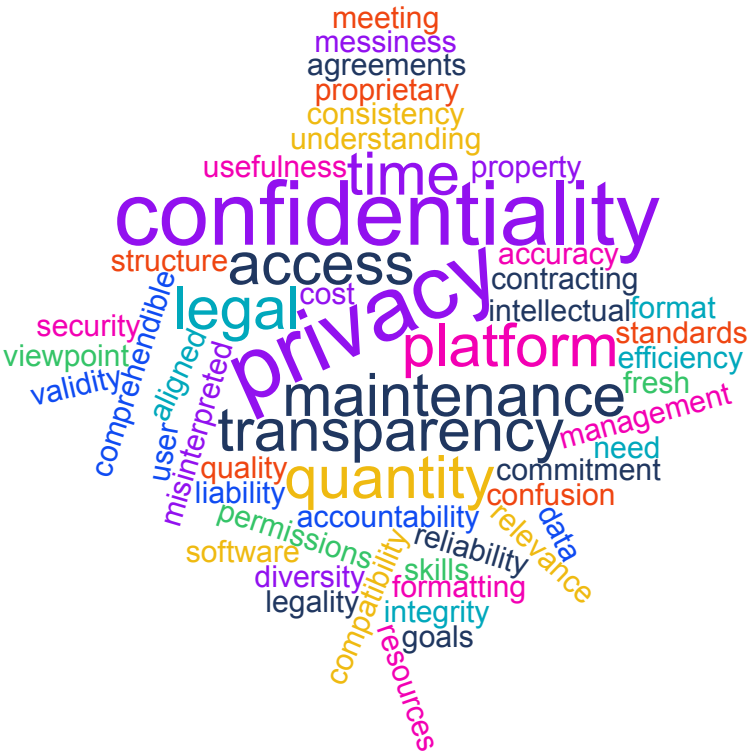
Following the Advanced Mobility Partnership identification of data and data sharing as a priority focus area and prioritization of two tactical actions from Mobility Choice, partner agencies engaged staff and stakeholders to outline future activities associated with implementation. The project team identified several project phases, including an initial discovery phase. An outline of stakeholder engagement during the initial discovery phase follows.

Advanced Mobility Partnership Steering Committee engagement

Following the prioritization of focus areas and tactical actions, the Advanced Mobility Partnership formed a Steering Committee on Data and Data Sharing to develop a roadmap for future activities pertaining to the implementation of the two mobility data priority tactical actions. During the spring and summer of 2020, the Steering Committee on Data and Data Sharing discussed challenges, opportunities and activities that would be associated with the development of a regional mobility data platform and related strategies.

Opportunities for Mobility Data Sharing

Challenges for Mobility Data Sharing



Some of the visions the project team heard from stakeholders during initial conversations included:

- "A clearinghouse of available data … visualizations would be a bonus."
- "Dashboard and catalog … across agencies, modes and disciplines."
- "A common repository and data governance structure to which all contribute and from which all draw data, and whose maintenance is a community effort."
- "Distributed sets of data made accessible through a library or catalog."
- "A portal where agencies interested in mobility data can share the data they steward. Could include raw or processed data and potentially analytics."

Overwhelmingly, the conversations with stakeholders during the summer of 2020 highlighted the importance of setting a clear vision for the development of any product. Emphasis on some of the data governance pieces (such as privacy policy consistency, regional standards and preferred specifications) piqued significant interest among steering committee members. Many stakeholders cautioned against building anything too big, or too expensive, at the start of the project. Stakeholders emphasized purposeful development and rollout of a strategy and likely suite of deliverables, ensuring that maintenance, upkeep and operating costs were considered throughout project development.

Stakeholder survey

Throughout December 2020, the project team distributed a survey among regional stakeholders who may be involved or affected by a regional mobility data platform (such as by generating data, analyzing data, curating data or managing data). The survey engaged stakeholders in the regional transportation community — it did not include members of the public. The survey provided insights regarding stakeholder vision, internal approaches to data, needs, roles and potential involvement in a mobility data-sharing platform. The project team intended for the initial survey to help develop the overall guiding vision and path forward to enable broad mobility data sharing.

The project team received survey responses from more than 55 individuals representing over 30 agencies in the area, with most responses from local jurisdictions and state agencies. Survey result highlights follow:

Organizational data approaches and information

- 81% of respondents indicated their organization has dedicated resources for data and data management and provided information regarding the data experts in their organizations.

- The maturity level of existing or future plans regarding mobility data management greatly varied between the organizations.

- Many agencies have identified potential sensitivities with their data (such as personally identifiable information and proprietary or legal restrictions) that must be considered when sharing the data.

Platform vision, function(s) and role(s)

- Respondents provided information on their vision for a regional mobility platform. Many respondents indicated uncertainty regarding how to answer the survey question or provide a description to articulate their vision for a platform. Some respondents indicated they desired for one organization to host and be responsible for the platform with the possibility that other partner organizations could regularly supply data. Some respondents articulated the opportunity for a web-based platform, a data exchange catalog or a cloud-based system with real-time data. Some respondents described a preference for a platform that would be integrated, easy to use and multimodal. Two respondents requested that equity data be included and an equity framework for the regional mobility data platform partnership be established. Overall, respondents wanted a single location from which to access data with a unified format and methodology of collecting data.

- Many respondents overwhelmingly felt that the public, private and nonprofit sectors — as well as the public — would benefit from availability of regional mobility data.

- From an agency perspective, respondents identified as high priority efforts data processing, visualization, analysis and discovery (other's data or metadata). Respondents identified as medium priority efforts related to data distribution to the public and to partners, as well as storage. •

- If a platform existed:

  — 87% of respondents indicated they would use the platform.

- 56% of respondents believed their agency would curate data.
- 52% of respondents believed their agency would participate in ongoing data governance of the platform.
- 79% of respondents believed a potential data platform would help their agency conduct research or analysis.
- 81% of respondents believed a potential data platform would help their agency prepare for upcoming projects.
- 83% of respondents believed a potential data platform would help provide better information to the public.

- Respondents indicated some concerns such as the platform having a narrow focus, data privacy concerns, questions regarding how the Advanced Mobility Partnership would use data and concerns over data quality.

A full report of the Advanced Mobility Partnership Stakeholder Data Survey was developed and is available in the appendix.

Interviews, internal engagement and informational briefings

The project team held a series of stakeholder interviews and informational briefings at Advanced Mobility Partnership Working Group meetings to better understand each agency's existing efforts, enterprise approaches and their future plans regarding various data efforts and initiatives. Agencies that provided informational briefings included: the Governor's Office of Information Technology, CDOT Chief Data Office, DRCOG and RTD. Four agencies participated in the interviews: CDOT, the Colorado Energy Office, DRCOG and RTD.

CDOT

The project team had a one-on-one conversation with CDOT Chief Data Office staff, and invited staff from the office to present to the Advanced Mobility Partnership Working Group. The CDOT Chief Data Office was developed in 2017 to support the data needs of the transportation system of the future. CDOT's Chief Data Office is a multidisciplinary team involved in data strategy, policies, governance, architecture and departmentwide collaboration. The Chief Data Office enables units across CDOT to think strategically regarding data efforts and encourage coordination to ensure advancement of data interoperability, break down silos within CDOT and maximize business insights through optimizing data use.

The following themes were discussed or presented with the CDOT Chief Data Office:

- Purpose of mobility data in an organization and the importance of use case development driving data needs.
- Data governance and maximizing data for use and insights.
- Digital architecture modernization efforts underway at CDOT.
- Preview of data in CDOT's cloud.

The Chief Data Office has managed the build-out of CDOT's digital modernization to the cloud, including CDOT's data lake (the Advanced Data Analytics Platform described here) and Real-Time Data Hub.

Various units within CDOT will generate, contribute and use the data made available in both the Real-Time Data Hub and the data lake. CDOT staff anticipates that the digital assets will serve as vital connections to CDOT's advanced traveler management system and advanced traveler information system, as well as make CDOT's data publicly available via publication and subscribe and API services.

Colorado Energy Office

The project team had a one-on-one conversation with the Colorado Energy Office, which is a state office dedicated to reducing greenhouse gas emissions and consumer energy costs by advancing clean energy, energy efficiency and zero-emission vehicles. In the last few years, the Colorado Energy Office has begun several efforts around transportation energy data. The project team met with staff from the Colorado Energy Office to better understand their current uses of mobility data and their future data plans.

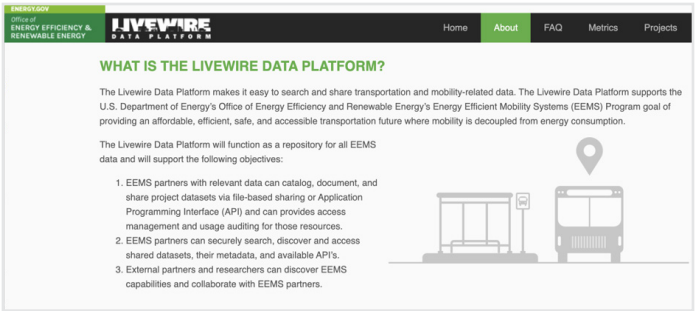
Members of the project team discussed the following themes with the Colorado Energy Office:

- Data management, collection, access and use.
- Data gaps and how the Colorado Energy Office fills those gaps.
- Barriers and challenges on approaches to data.
- A future mobility data wish list and needs.

The Colorado Energy Office has developed a publicly available dashboard for electric vehicle registrations across the state.[18] The dashboard, known as the EValuateCO, is made possible by a collaboration between the Colorado Energy Office, Colorado Department of Motor Vehicles, Colorado Interactive and Atlas Public Policy. The dashboard provides insights into the current state of vehicle electrification in Colorado and allows users to view information on electric vehicle deployment, current statewide vehicle infrastructure and details on charging use for select stations. The Colorado Energy Office has found that many utility companies and non-profit organizations are interested in using the dashboard.

DRCOG

As part of the discovery and initial planning phase, the project team engaged DRCOG staff from both the Transportation Planning and Operations and Regional Planning and Development divisions. The early 2021 discussions convened multidisciplinary teams to discuss DRCOG staff's vision for a regional mobility data platform and associated opportunities and challenges.



RTD

Staff from both CDOT and DRCOG engaged in preliminary discussions with RTD staff regarding their approaches to and uses of data as part of everyday operations. RTD presented its data management

18 https://energyoffice.colorado.gov/zero-emission-vehicles/evs-in-colorado-dashboard

approach during the December 2020 Advanced Mobility Partnership Working Group meeting. RTD collects data allowing it to provide with real-time information regarding transit service. RTD also leverages its data internally so its staff can better understand the performance of the transit system and improve operational efficiencies and the transit rider experience. RTD has several mobile applications (detailed earlier) and leverages data from community partners to enable greater levels of transit service. RTD provided a preview of possible future capabilities it is exploring such as an advanced third-party developer portal, voice recognition, text message, video analytics and alternative fare pricing models.

National Renewable Energy Laboratory

CDOT staff had a discussion with the National Renewable Energy Laboratory regarding a shared interest in several components of mobility data both in Colorado and nationwide. As part of the Department of Energy's Energy Efficient Mobility Systems program, the National Renewable Energy Laboratory developed the LiveWire Platform. The publicly available platform collects data to support research and provide behavioral, experimental and analytical data regarding vehicles, travelers and the transportation system. The public can use the for mobility planning and energy efficiency analysis. The platform allows users to directly upload data to be made available to other users. Visit the National Renewable Energy Laboratory's LiveWire website for more information.[19]

19 https://livewire.energy.gov/

Next steps

Vision and concept refinement

During the discovery phase, it became clear to the project team that regional stakeholders and partner agencies are interested in how mobility data can support collaboration and coordination. Modernizing the region's mobility data-sharing approach and the tools to support increased coordination in planning, operations and analysis is a fundamental first step that supports many other Advanced Mobility Partnership efforts. While a regional mobility data platform has the potential to provide improvements to mobility data collection, sharing and analysis for regional stakeholders and the public, additional agency-specific steps will be necessary to make sure the increased access to mobility data is tied to specific use cases and decision-making processes. How agencies use a mobility data platform is what will ultimately affect the transportation system, not just the data alone.

The language initially proposed in the region's Mobility Choice Blueprint references the establishment of a "regional mobility data platform." As the project team moves from discovery into the visioning phase of tactical implementation of a regional mobility data platform, it intends to develop a holistic mobility data strategy including data discovery, management, governance and the tools to promote access to data. This will enable the region to use existing products and tools to innovate and adapt to a changing transportation sector. The project team considers flexibility to adapt to the changing mobility ecosystem to be paramount as new modes, specifications and tools are launched. Some capabilities could include data management, analytical tools and visualizations, and a collaborative governance structure.

The project team recognizes that creation of a regional mobility data platform is an arduous task and participants would need to devote a significant amount of effort to identifying and understanding the responsible parties, ownership and cost. The project team recommends focusing efforts on stakeholder collaboration, use case identification, data governance and product development to enable data sharing; leveraging existing toolsets and resources developed and maintained by program partners. Following the discovery phase, the project team will work with partner agencies and stakeholders to develop a vision for the platform including some key steps outlined as follows.

CDOT technology data scrum

A critical next step for the project team is to identify the use cases associated with the development of a comprehensive data strategy and associated tools. CDOT, with support from the Harvard Kennedy School, will host a workshop to better inform the visioning and roadmap development process in 2021. The workshop will solidify the user groups, identify the primary and priority use cases for the platform and begin to outline platform capabilities.

Federal Highway Administration data business plan workshop

Another next step is development of a regional data business plan into a tangible roadmap that clearly identifies the vision, principles, capabilities and various components required to successfully support regional mobility data sharing and governance in the region.

Appendix 1: Stakeholder survey report

January 2021

The Advanced Mobility Partnership's Data and Data Sharing Steering Committee developed a survey regarding a potential regional mobility data platform. When the survey closed in late 2020, 57 people from over 30 organizations, agencies and jurisdictions had responded. This Stakeholder Survey Report provides insights into the region's mobility data-sharing needs and insight into the steps that could be taken to fulfill them.

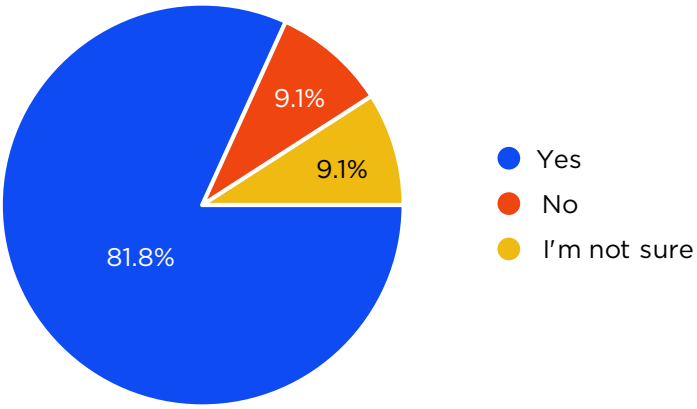
Stakeholder organization information

The Stakeholder Survey confirms that a wealth of existing mobility-related data could be included in a regional mobility data platform. Representatives from most of the organizations surveyed (81.8%) stated that they currently have dedicated resources for data management.

Given that many of the respondents indicated a lack of development plans for their data management programs, the project team surmised that most organizations' resources serve to merely maintain existing data. Many respondents said that they either did not have any development plans (5), didn't know if development plans existed (3) or needed additional resources to begin such development (3). Other respondents indicated that their data management plans were in the beginning stages of development (2), or that they relied on other organizations for data management (2).

Does your organization have dedicated resources for data or data management?

55 responses



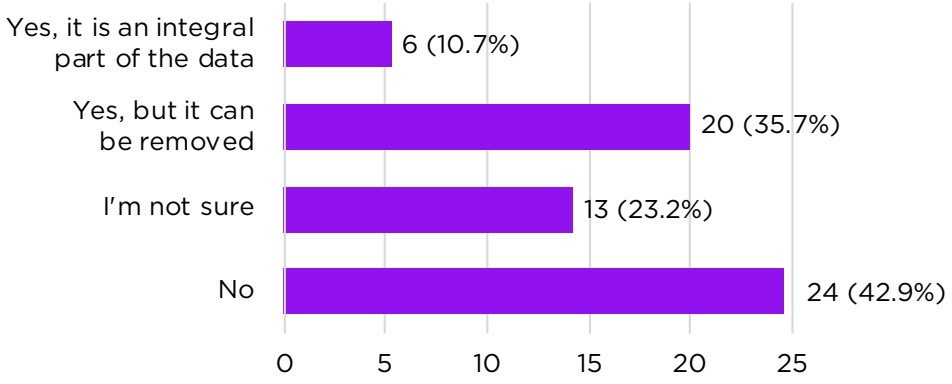
Sensitive data and privacy concerns

Complying with legal restrictions, open records requests and privacy policies is a key part of data management for any organization. At least half of the respondents' agencies collect personally identifiable or other sensitive information. Only 42.9% of respondents did not collect such information. A small percentage of respondents indicated that private information was an integral part of the data they collected.

Only 1% of respondents indicated that all of their data had legal or proprietary sharing restrictions. Of respondents, 59.6% indicated restrictions for some of their data.

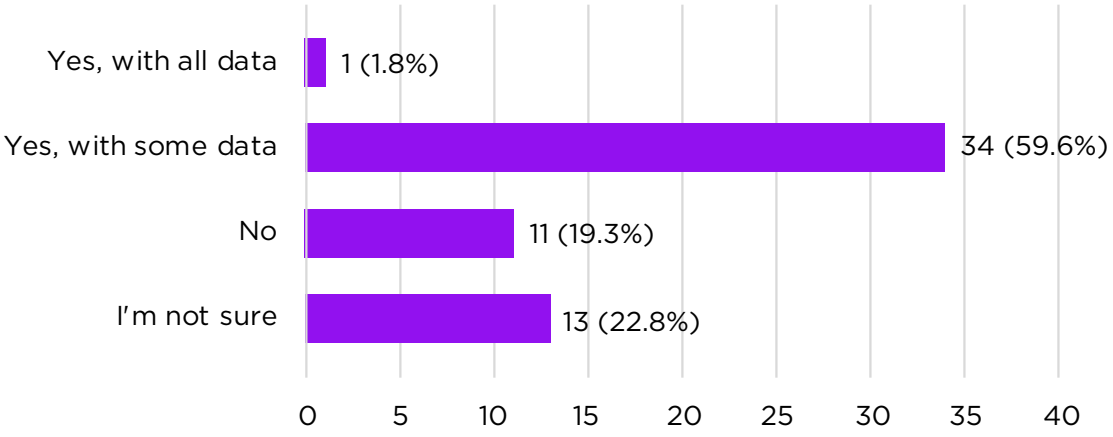
Is personal information or potentially sensitive information a part of the data you collect? Please select all that apply.

56 responses



Are there any proprietary or legal restrictions to sharing your data (with other partner agencies or the general public)? Please select all that apply.

57 responses



Platform vision, functions and roles

Many respondents indicated that it was challenging to formulate a vision for a potential mobility data platform. Those that responded with a proposed vision expressed a desire for a single organization to host a platform and be responsible for its functionality and granting access to users. The other partner organizations would supply data on a regular basis.

Some respondents envisioned a web-based platform, a data exchange catalog or a cloud-based system with real-time data. Respondents indicated that the resulting platform would preferably be integrated with existing open and agency data, easy to use, and include multimodal transportation and mobility data. Two respondents requested that an equity framework for the mobility data platform partnership be established. Generally, respondents wanted a single location where data could be accessed with a unified format and collection methodology. One respondent wrote: “It would be nice if it were centralized at DRCOG and shared in common data formats as opposed to being associated with a specific software. It would be ideal if it were able to be added into Google Maps or Google Earth.”

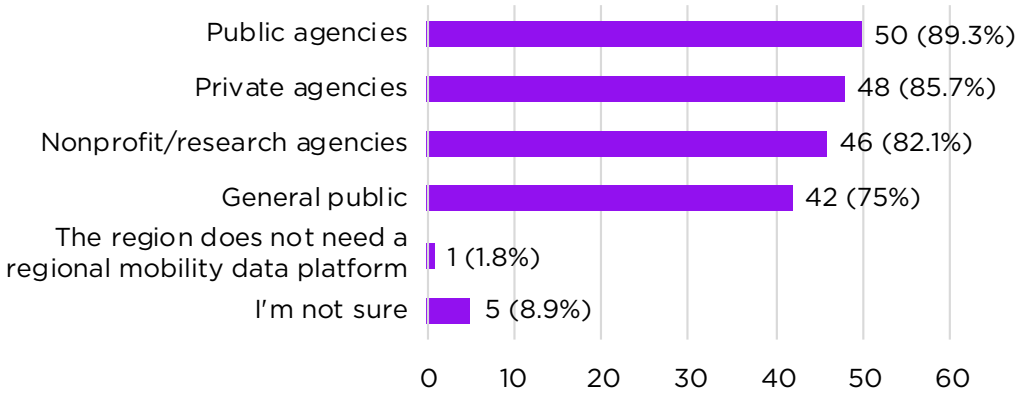
Data-sharing audience

Concerning who the regional mobility data platform could benefit, almost all respondents listed public agencies (89.3%), private agencies (85.7%) and nonprofit or research agencies (82.1%). Three quarters of respondents said they believed the general public could find such a platform useful. Only 1 respondent felt that a regional platform would benefit no one.

For data that could be legally and reasonably shared, respondents indicated their agencies planned to share data with public agencies (94%), nonprofit or research agencies (88.2%), private agencies (76.5%), or the general public (39.5%). The responses about agencies intent to share data are consistent with who the respondents identified could benefit from the platform (with the addition of nonprofit and research organizations).

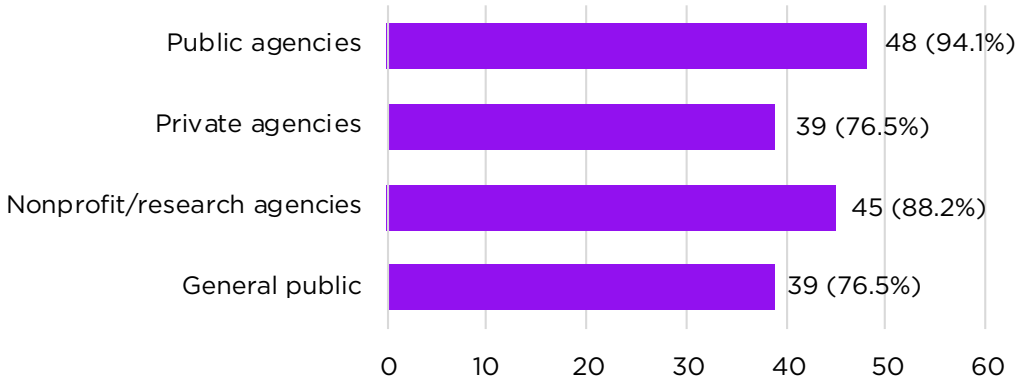
Thinking about the regional mobility platform you described in the question above, who do you believe would benefit from the data available in the platform? Please select all that apply.

56 responses



If my agency contributes data to the platform, we would like to share our mobility data with:

51 responses



Platform purposes and priorities

The survey asked respondents how they would use a potential regional mobility data. Respondents identified the following priorities:

High priority:

- Data discovery: to find other agency's data and/or metadata through a directory.
- Data visualization: to visually explore spatial and tabular data in the platform.
- Data processing: to automatically perform jobs like aggregating, summarizing, appending and transforming.
- Data analysis: to store analytics from the data.

Medium priority:

- Data distribution (to the public): to share our data with the public using the platform.
- Data distribution (to partners): to transfer our data to partners using the platform.
- Data storage: to store our clean, curated, enterprise data.

Similarly, the survey asked respondents to rate, in order of priority, what type of data could be included in the regional mobility data platform:

Must have (in order of priority):

- Static contextual data for understanding mobility (such as road network, sidewalk network and bicycle facility inventory).
- Historic/single point in time data (such as traffic counts).
- Historic transportation trip/vehicle data (such as shared micromobility origins or destinations).

Nice to have but not necessary (in order of priority):

- Historic transportation operations data (such as travel times).
- Real-time or near real-time trip or vehicle data (such as transit vehicle locations).
- Real-time or near real-time transportation operations data (such as speed or weather).

Roles and responsibilities:

While most respondents stated that they could contribute to the mobility data platform, a minority stated they could fund or host the regional mobility data platform. The following breaks down of how the organizations plan to contribute:

Higher probability:

- Use the platform (87.3%).
- Curate data for the platform (56.4%).
- Participate in ongoing governance/oversight (52.7%).

Lower probability:

- Contribute staff time to development (41.8%).
- Participate in maintenance of the platform (36.4%).
- Fund the development of the platform (12.7%).
- Host/own the platform (7.3%).

Finally, the organizations were asked to prioritize the values that a regional mobility data platform could represent. Respondents ranked most highly values dealing with project planning and improving operational performance. Information from the platform could help respondents' agencies develop future projects by streamlining communication among agencies and allowing for research coordination with external partners. As for existing programs, respondents indicated that the platform could help their agencies or organizations improve project monitoring and internal evaluation. Respondents ranked some ideas dealing with safety, right of way and public health as lower priority, although still valuable.

Values prioritized:

1) Provide better information to the general public (83%).
2) Evaluate transportation programs or policies (81.1%).
3) Conduct research and/or analysis (79.2%).
4) Coordinate with external partners (79.2%).
5) Prepare for upcoming programs or projects (73.6%).
6) Improve operations of the transportation system (71.7%).
7) Monitor performance of the system (69.8%).
8) Pilot new technologies or ideas (64.2%).
9) Coordinate internally at my agency (56.6%).
10) Transportation management center coordination (52.8%).
11) Operate components of the existing transportation system (52.8%).
12) Integrated corridor management (43.4%).
13) Regulate or administer programs (37.7%).
14) Manage right of way (28.3%).
15) Relate this data to public health issues (1.9%).
16) Public safety routing (1.9%).
17) Provide value to all identified stakeholders (1.9%).

Problem-solving capabilities

The project team observed common themes emerging from the survey results as many agencies experience similar challenges. Respondents indicated a desire for a regional mobility data platform to better understand the type, location and access to various mobility-related datasets and tools in the region available for use. This would eliminate the need to repeat requests for the same information. The enhanced information could be used to justify developing efforts (for example, efforts related to low-emission vehicles and zero-emission vehicles). Greater access to information would facilitate better evaluation of transportation needs in the region and equip stakeholders to develop new solutions and measure the effectiveness of existing and pilot programs.

Some respondents indicated that a regional mobility data platform could save agencies and organizations time and money. It could enable them to be proactive rather than reactive, increase the visibility of their projects and needs, help them save staff time used to respond to public inquiries, make better use of existing equipment and write better grant proposals.

Final questions

Toward the end of the survey, respondents were asked whether they would be willing to participate in further discussions about a potential platform. They were offered the opportunity to provide additional questions or concerns. Half of the respondents were willing to engage in future dialogue. A few respondents expressed uneasiness about data privacy and how the data would be used. One respondent was concerned with the platform's narrow focus, while another was worried about the quality of the data (for example, how recent and accurate the data would be). Other respondents raised concerns about access. One respondent wrote: “If we intend to share the data with private partners, it must also be made available to the public using the same means of access.”

Stakeholders participated in this survey from a variety of agencies such as:

- Arapahoe County
- Arapahoe County Water and Wastewater Authority
- Boulder County
- City of Longmont
- City and County of Broomfield
- City and County of Denver
- City of Arvada
- City of Aurora
- City of Boulder
- City of Commerce City
- City of Federal Heights
- City of Lakewood
- City of Littleton
- City of Thornton
- City of Westminster
- Colorado Department of Public Health and Environment
- Colorado Department of Transportation
- Denver International Airport
- Denver Metro Chamber
- Denver Regional Council of Governments
- Denver Streets Partnership
- Douglas County
- mobilitynext
- National Renewable Energy Laboratory
- Populus
- Regional Transportation District
- State of Colorado, Governor's Office of Information Technology
- Town of Castle Rock
- Town of Frederick
- Town of Lyons
- Town of Superior

Appendix 2: Local and regional case study documentation

January 2021

Case study documentation

The Advanced Mobility Partnership identified the establishment of a regional mobility data platform as a priority tactical action. As part of the discovery phase, the project team conducted a desktop review of peer agencies and public materials to better understand the work being done in the regional mobility data platform space. High-level summaries of select efforts reviewed follow, including information such as overall vision and goals, planning context, capabilities and data governance. The case studies were selected to illustrate the range of options and approaches that peer agencies are using to implement shared data platforms.

Atlanta Regional Commission (Atlanta, Georgia)

Vision: The Atlanta Regional Commission's Transportation Systems Management and Operations vision presented in its Transportation Systems Management and Operations Strategic Plan includes five goals, including:

- Optimizing safety: Applying technology and context-sensitive approaches to achieve zero fatalities.
- Reliable travel times: Managing planned and unplanned disruptions to reduce unexpected delays.
- Efficient, seamless travel: Coordinated systems across jurisdictions and modes, and accessible, real-time travel information.
- Equitable access: People of all ages, abilities, languages, backgrounds and incomes have access to safe, reliable, efficient mobility options.
- Environmental benefit: Applying technology to reduce energy consumption, improve air quality and reduce greenhouse gas emissions.[1]

Achieving these goals is based on four foundational elements:

- An operations philosophy focused on moving people and goods, rather than vehicles.
- Collaboration across jurisdictional boundaries and sectors.
- Data sharing across public and private providers and users.
- Fostering a culture of innovation and adaptability to change.[2]

Capabilities: While the upgraded data hub is not yet operational, the Transportation Systems Management and Operations describes future intended capabilities: "A centralized data hub creates easier access to curated data for regional planning, system management and operations, and performance assessment. The hub serves as both a data warehouse and a data broker for all data collected and shared in the region including from local agencies, transit agencies, other transportation organizations, and private sector data providers. This effort can build on the existing foundation of an emerging platform for sharing data, using existing infrastructure, data ingestion, and analysis tools."[3]

1 https://cdn.atlantaregional.org/wp-content/uploads/arc-tsmo-strategic-plan-final-2020.pdf#page=5
2 https://cdn.atlantaregional.org/wp-content/uploads/arc-tsmo-strategic-plan-final-2020.pdf#page=6
3 https://cdn.atlantaregional.org/wp-content/uploads/arc-tsmo-strategic-plan-final-2020.pdf#page=41

Guiding documents:

- 2019 Data Governance Best Practices Report.
- 2020 Transportation Systems Management and Operations Strategic Plan.

Governance: The Transportation Systems Management and Operations Strategic Plan recommends the creation of a data governance charter, Data Stewardship Steering Committee and using a data management maturity model to assess participating agencies' capabilities.[4]

Smart North Florida (Jacksonville, Florida)

Smart North Florida is a collaborative effort among public and private agencies and companies in the Jacksonville metro area to implement smart city technologies at the regional level. The effort's founding partners include the North Florida Transportation Planning Organization, City of Jacksonville, City of St. Augustine, Jacksonville Chamber of Commerce, Jacksonville Transportation Authority and JEA (water, sewer and electric utility).

Vision: The overall smart region vision has five core objectives:

- Eliminate fatalities: Provide a safer transportation network to work toward a goal of zero deaths.
- Improve travel time reliability: Provide a transportation network that is consistent and reliable for users.
- Reduce greenhouse gas emissions: Provide multimodal options and reduce congestion.
- Provide ladders of opportunity: Provide multimodal options that are accessible, reliable and affordable for individuals with varied needs.
- Grow North Florida: Provide a transportation network that encourages commerce and presents business opportunities through Smart Region implementation.[5]

Capabilities: The Smart North Florida Integrated Data Exchange serves as an open data portal for datasets ranging from transportation to health. The Smart Region Master Plan calls for the future incorporation of real-time mobility-related datasets into the data exchange including traffic signal, bicycle and pedestrian detection, rail crossing, bridge failure, street flooding, automated vehicle locations, bus rapid transit crash avoidance system, transit signal priority, truck and public parking, smart street light, and corridor management data. Some of this data would be publicly available or available to third-party app developers, while other data would be shared among operations agencies to manage the transportation system. A publicly available multimodal traffic and trip planner app would also tie into the data provided through the system.

Guiding Document:
North Florida Smart Region Master Plan

Governance: The Master Plan calls for creation of three task forces: Data Policy (coordinates shared security and privacy concerns and sets shared data standards and policy direction for shared data), Regional Connected Vehicle (coordinates infrastructure improvements to accommodate connected vehicles)

4 https://cdn.atlantaregional.org/wp-content/uploads/arc-tsmo-strategic-plan-final-2020.pdf#page=40
5 https://smartnorthflorida.com/images/uploads/Smart_Region_Report_Final_Report_Reduced_(1).pdf#page=13

and Automated Vehicle (considers possible disruptive effects of automated vehicles and works to set policies to mitigate them).[6]

Plan Hillsborough (Tampa, Florida)

Vision: The vision for Plan Hillsborough's data platform is provided in an overview presentation on the platform. The vision is "To use 'big data' to optimize mobility movement across the region, inform our future planning strategies and drive efficiency savings, this vision will be enabled by a proof of concept pilot project and then a series of projects as defined on the overall roadmap."[7]

Capabilities: The ClearGuide platform is a proprietary product from Iteris and is not publicly available for review. Using publicly available information, the project team discovered that it appears to have significant traffic data analytics capabilities. Plan Hillsborough is considering the possibility of incorporating crash, transit and micromobility data as well as a publicly accessible data portal or data dashboards into the platform.

Guiding Document:
Federal Highway Administration Data Business Plan

Governance: ClearGuide appears to currently be solely hosted and managed by Plan Hillsborough, which makes data available to staff of authorized partner agencies. The Federal Highway Administration Data Business Plan describes a formal structure for a Mobility Data Subcommittee of the Regional Intelligent Transportation Systems Committee which would set the policy constraints for a shared regional data system. Proposed committee members include local governments, tollway authority, transit agencies, the U.S. Environmental Protection Agency, Florida Department of Transportation, port authority, state department of health and an academic partner in the three Hillsborough, Pasco, and Pinellas metropolitan planning organization areas. The Data Business Plan also recommends the creation of a Data Governance Manual as well as a Data Catalog of data sources available in the region and their managing agencies.[8]

San Diego Association of Governments (San Diego, California)

Vision: The vision for the San Diego Association of Governments' Next Operating System is described below:

- Visibility: Enhanced data management and analytics allow for more informed and responsive planning and decision making about public infrastructure investments.
- Optimization: Advanced analytics, combined with user incentives and engagement, balance supply and demand across modes and services.
- Collaboration: Streamlined collaboration and operations across agencies and mobility service providers (public and private) make operations more efficient and provide a smooth transportation experience for people and goods.
- Equity: Through partnerships, Next Operating System can help improve equitable access to a wide range of transportation services throughout the region.
- Cost reduction: Centralizing operations can lead

6 https://smartnorthflorida.com/images/uploads/Smart_Region_Report_Final_Report_Reduced_(1).pdf#page=35
7 http://www.planhillsborough.org/wp-content/uploads/2020/08/Overview-of-ClearGuide.pdf#page=3
8 http://www.planhillsborough.org/wp-content/uploads/2016/12/FHWA-Data-Business-Plan-DRAFT_DEC.pdf#page=34

to reduced costs that can result from efficient management of resources, improved utilization and coordination across siloed systems, and the ability to roll out services that are coordinated across agencies faster and easier. Better access to a wide range of public and private transportation services can also reduce transportation costs for users.

- User experience: Travelers and operators benefit from real-time information, including the ability for travelers to seamlessly plan, book, pay for and receive rewards for trips across multiple public and private modes of transportation.[9]

Capabilities: As described in the Next Operating System Concept White Paper, Next Operating System would serve multiple functions including as a catalog of datasets from around the region, data analytics, an integrated fare pricing and payment system, and shared permitting and contracting management. The resulting platform would allow for a multimodal trip planning and fare payment app for public use, as well as enhanced traffic operations management and connected and autonomous vehicle preparedness.

Guiding Documents:
Next Operating System Concept White Paper

San Diego Forward Regional Plan (currently being drafted)

Governance: The San Diego Association of Governments proposes a distributed governance model through which the platform is built and maintained by the San Diego Association of Governments while the datasets and mobility solutions within the platform are governed by their respective stakeholders. Policies such as governance and data standards would be set by the San Diego Association of Governments Board of Directors and overseen by the existing Cities/County Transportation Advisory Committee. Individual stakeholders would be responsible for providing data that adhered to the regional standards. A new staffing group within the San Diego Association of Governments would operate and maintain the platform. Ad hoc working groups of stakeholders could work with staff to develop mutually beneficial solutions. The white paper also recommends evaluating a third-party data steward (such as a lab or university partner) to govern and manage the data on behalf of the San Diego Association of Governments.[10]

Smart Columbus Operating System (Columbus, Ohio)

Vision: The vision for the Smart Columbus Operating System is as follows:

"The Operating System is the essence of Smart Columbus – it brings to life the innovation. The Operating System is designed and built to collect data from a variety of inputs; including public, nonprofit, education-based, and private sector contributors. These inputs may come from other systems, devices, and people. All of which are a critical part of building this ecosystem of innovation. Data is available for analytics and visualization as well as for artificial intelligence required by various smart city applications. The Operating System is a platform designed for big data, analytics, and complex data exchange. It captures the data and provides a means for multitenant access to aggregate, fuse, and consume data.

"Datasets housed in the Operating System include the

9 https://www.sdforward.com/docs/default-source/2021-regional-plan/san-diego-forward_next-os-concept-white-paper.pdf?sfvrsn=9499fe65_2#page=11
10 https://www.sdforward.com/docs/default-source/2021-regional-plan/san-diego-forward_next-os-concept-white-paper.pdf?sfvrsn=9499fe65_2#page=31

Smart Columbus demonstration projects, traditional transportation data, and data from other community partners, such as food pantries and medical services. The Operating System is scalable and demonstrates the potential for serving city and private sector needs well beyond the life of the Smart City Challenge award period."[11]

Capabilities: The Smart Columbus Operating System currently houses more than 3,000 datasets on a range of topics of interest to municipal government and civic-minded residents and companies, including several real-time and near real-time datasets. Built-in visualization tools allow quick and easy data interpretation. APIs are available for third parties to use data to develop of apps, dashboards and websites. The source code for the operating system is open-source and is available for other agencies to access and use.

Guiding Document:
Data Management Plan

Governance: City staff curate the data and provide technical support to the platform. External data providers sign agreements related to data regulation management policies and standards.

Chicago Open Data Portal (Chicago, Illinois)

Vision: The vision for Chicago's Open Data Portal is provided in the preamble to the Open Data Executive Order:

"When coupled with an interactive mechanism that will enable the public to provide feedback to the City on the quality of its published information and enable the City to respond to the feedback it receives, the timely online publication of public data will empower Chicago's residents by providing them with information necessary to participate in government in a meaningful manner, to assist in identifying possible solutions to pressing governmental problems, and to promote innovative strategies for social progress and economic growth."[12]

Capabilities: The Chicago Open Data Portal's functions are similar to many other municipal, regional and state open data portals around the country. It provides public access to approximately 600 datasets, primarily from city agencies. This data portal also includes several near real-time data sets that are publicly accessible. Data dashboards and mapping tools allow for easy data interpretation, and APIs allow for third-party access to this data for the development of apps for public use.

Guiding Document:
Open Data Executive Order

Governance: City staff curate the data and provide technical support to the platform. An Open Data Advisory Group made up of the data officers of every city agency provides oversight and coordination on data management.

11 https://www.smartcolumbusos.com/images/2020/PDF/SCC-E-DataManagementPlan-Update-v1.pdf#page=11
12 https://www.chicago.gov/city/en/narr/foia/open_data_executiveorder.html

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