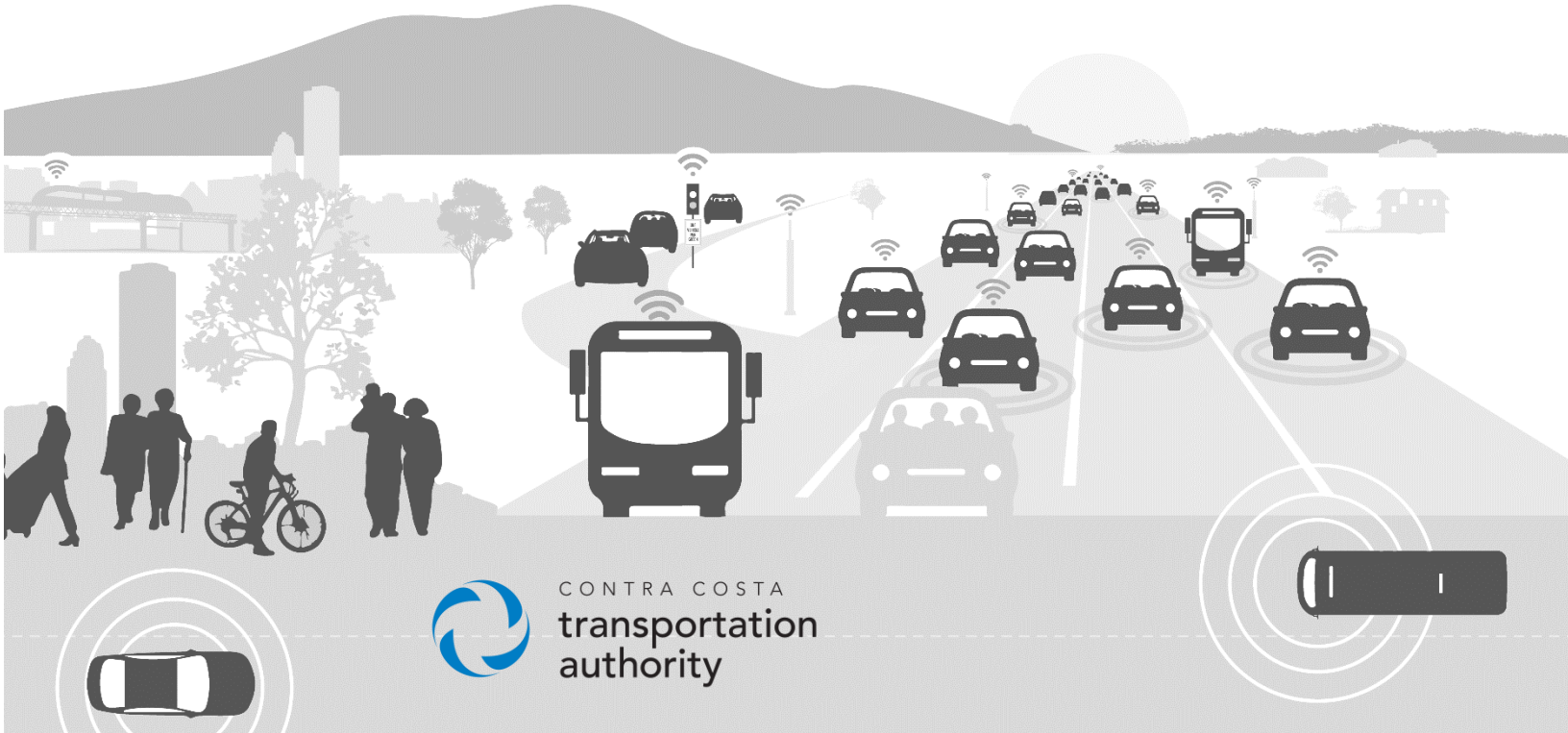
Multimodal Projects Discretionary Grant (MPDG)- Mega

Draft Data Collection Plan (DCP)

Date: 5/23/2022

680 FORWARD



CONTRA COSTA transportation authority

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Introduction

Purpose of this document

The purpose of this document is to provide a preliminary overview of the Contra Costa Transportation Authority (CCTA) proposed Draft Data Collection Plan (DCP) per requirements of the Mega funding of the Multimodal Project Discretionary Grant (MPDG) opportunity grant application. This draft submittal will be updated and finalized within 60 days after grant award and/or after release of the USDOT's proposed MEGA Grant Standard framework for standardized performance measures. This Draft DCP is prepared in accordance with the followings:

1. MPDG NOFO's Mega Data Collection Requirements;
2. Title 49 U.S.C 6701(g) requirements[1]; and
3. USDOT National Transportation Library's Data Management Plan (DMP) guidelines for extramural research activities[2].

This document describes how CCTA will handle data during and after the period of performance and provides a description of data that will be collected during the course of the project as part CCTA's 680 Forward Program. We will describe the plan for data gathering prior to construction to develop a baseline, performing data analysis to identify status of existing conditions, identifying Key Performance Indicators (KPIs) and impacts of the possible build of the project, monitoring accuracy of forecasted KPI measures through use of data analysis, simulation, and periodic updates to data to verify accuracy of KPI measures, and performing before and after-study reports to identify actual outcomes. We will propose the standards used and the access restrictions that will be applied to gathered data. We will also provide a description of how we intend to store and archive the gathered data.

Approach and Work Steps

Our proposed approach is to perform a before and after study and in between we will perform periodic monitoring of the status of predicted project characteristics and forecasted KPI measures with the actual outcomes to make sure we are on the right track. In addition, CCTA will perform monitoring of the project to achieve its high level goals and how it meets the Mega project high level requirements such as its ability to improve economy, mobility, and safety while being cost effective. Section 1.4 of Chapter 1 of this report identifies performance indicators related to project goals and maps them to criteria defined in the NOFO. Chapter 2 of this document describes the data types, standards, metadata, and data sources that will be used for gathering data before, during, and after the implementation of the project. Chapter 3 describes the process for data gathering and data collection. Chapter 4 describes the proposed approach for assembling and analysis of data including baseline, KPIs, predicted project characteristics, forecasted KPIs, simulation, monitoring, and generating report. Chapter 5 describes the access policies for access restriction or sharing. Chapter 6 describes the data storage location, policies, requirements, and tools.

Our approach includes following work steps:

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1 https://uscode.house.gov/view.xhtml;jsessionid=13F7049BF27B2AA627BAEA90117C795C?req=49&f=treesort&fq=true&num=3833&hl=true&edition=prelim&granuleId=USC-prelim-title49-section11145

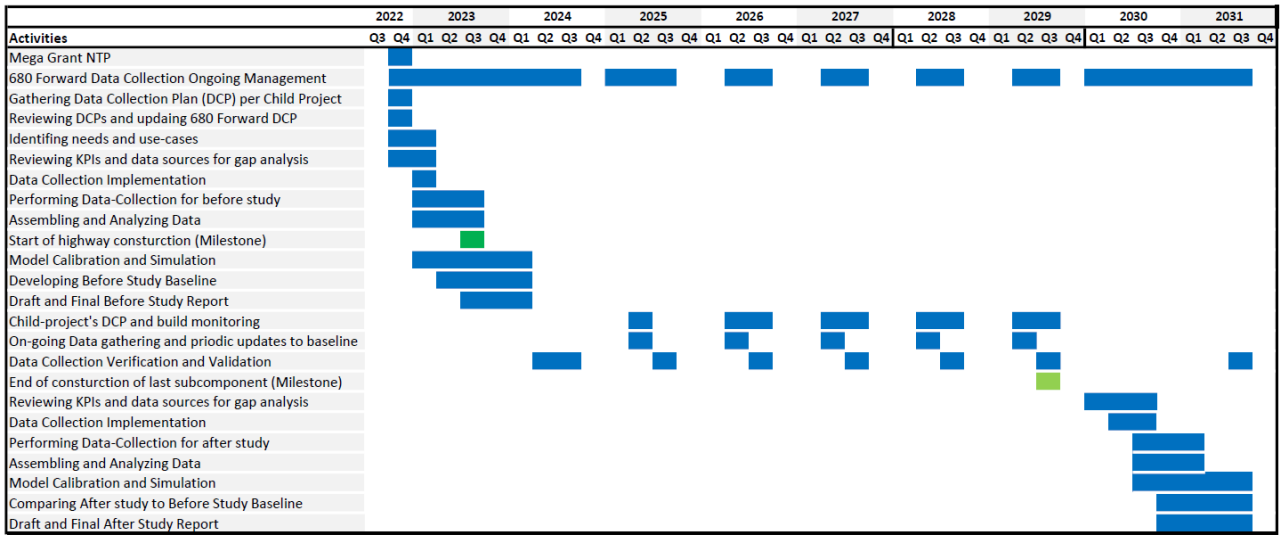
2 https://ntl.bts.gov/ntl/public-access/creating-data-management-plans-extramural-research

1. Update and finalize this plan within 60 days after award and/or release of USDOT's Mega Grant Standard framework.
2. Identify KPIs, data needs, types, formats, standards, sources, and gaps.
3. Identify data collection and data gathering steps needed.
4. Conduct Data Collection prior to implementation and/or construction of the project.
5. Perform data analysis and assembling data to develop baseline.
6. Identify predicted project characteristics and forecast methodology for KPIs.
7. Perform simulation and data analysis to verify accuracy of the forecasted KPIs.
8. Prepare Before Study report.
9. Perform periodic data gathering, simulation, forecasting, and monitoring accuracy of KPIs.
10. Perform monitoring of possible alternatives analysis if needed.
11. Identify steps needed to update data gathered within 5 years after completion of the project.ß
12. Perform data gathering within 5 years after completion of the project.
13. Perform data analysis and assembling data to compare with baseline.
14. Prepare After Study report.

As part of the work steps listed above, CCTA will perform and deliver followings reports:

1. Before Study (project baseline) report; before the start of construction of a project CCTA will submit a Before Study report providing baseline data for the purpose of analyzing the long-term impact of the project in accordance with the Mega Grant Standard framework established per Section 1.3 of this document.
2. After Study (Updated project baseline) report; Not later than 5 years after the date of completion of the project CCTA will submit an After Study report that compares the baseline data included in the Before Study report to project data collected during the following period:
   - beginning on the date that is not more than 3 years after the date of completion of the project; and
   - ending on the date which is not more than 4 years after the completion date of the project.

The high-level schedule of the main data collection activities is presented below; this schedule will be further expanded as described in Section 3.2 of this document. Please note that due to the varying schedules for delivery of the various project components, data collection milestones will vary child-project by child-project:



○ Mega Grant Standard framework

We understand that USDOT is planning to publish a more detailed framework for the performance measures and KPIs of this grant to standardize KPIs units to measure goals and/or targets that USDOT use internally. Upon release of the updated requirements, we will update this DCP to follow the future framework and we will follow the standardized forecasting and measurement approaches, data storage system requirements, and other applicable requirements proposed by USDOT under Mega Grant Standard framework accordingly.

○ Key Performance Indicators (KPIs) Mapping to Mega Grant Criteria

MPDG Mega Grant NOFO requires DCP to map KPIs to Mega Grant Criteria identified in Section E of the NOFO to identify the key performance measures that need to be verified in Before and After study for accuracy. The Grant does identify following key benefit criteria:

1. Safety
2. State of good repair
3. Economic impacts, Freight Movement, and Job Creation
4. Climate Change, Resiliency, and the Environment
5. Equity, Multimodal option, and quality of life
6. Innovation areas: technology, project delivery, and financing.

The following table summarizes project sub-components to their expected benefits and KPIs:

Project Subcomponent	Expected Benefits.	KPIs
Shared Mobility Hubs (SMH)	Improving mobility and safety, GHG reduction, improving travel time reliability, mode shift, affordable and accessible transportation	Percent accident reduction, percent increased transit usage, travel time savings, percent GHG reductions, percent change in VHD
Part Time Transit Lane (PTTL)/Transit Bus on Shoulder (TBOS) Implementation	Improving mobility and safety, GHG reduction, improving travel time reliability, mode	Percent accident reduction, percent increased transit usage, travel time savings,

Project Subcomponent	Expected Benefits.	KPIs
	shift, affordable and accessible transportation	percent GHG reductions, percent change in VHD
Express Bus Implementation: Implementation of one seat express bus service between Dublin/Pleasanton BART Station and Martinez Amtrak Station, including interim fleet, hydrogen fueling stations and fleet.	Improving mobility and safety, GHG reduction, improving travel time reliability, mode shift, affordable and accessible transportation, reduced operating costs	Percent accident reduction, percent increased transit usage, travel time savings, percent GHG reductions, percent change in VHD, percent reduction in operating costs
Iron Horse Trail (IHT) & Canal Trail Gap Closure	Improving mobility and safety, GHG reduction, improving travel time reliability, mode shift, affordable and accessible transportation	Percent accident reduction, percent increased transit usage, travel time savings, percent GHG reductions, percent change in VHD
Iron Horse Trail (IHT) POCs	Improving mobility and safety, GHG reduction, improving travel time reliability, mode shift, affordable and accessible transportation.	Percent accident reduction, percent increased transit usage, travel time savings, percent GHG reductions, percent change in VHD
NB680 Express Lane Completion (ELC) (Phase 1)	Improving mobility and safety, GHG reduction for Vehicles and Trucks, improving Travel time reliability, Accident and Collision prevention, improving System Operation, Economic Benefits and Freight Movement	Percent accident reduction, percent increased transit usage, travel time savings, percent GHG reductions, percent change in VHD, percent increase in freight volume, express lanes performance
I-680/State Route 4 Interchange Phases 1 and 2A	Improving mobility and safety, GHG reduction for Vehicles and Trucks, improving Travel time reliability, Accident and Collision prevention, improving System Operation, Economic Benefits and Freight Movement	Percent accident reduction, percent increased transit usage, travel time savings, percent GHG reductions, percent change in VHD, percent increase in freight volume.
Coordinated Adaptive Ramp Metering (CARM)	Improving mobility and safety, GHG reduction for Vehicles and Trucks, improving Travel time reliability, Accident and Collision prevention, improving Operation and Maintenance, Improving State of Good Repair for Ramp Meters sub-systems, Improving freeway's throughput for commute and freight movement, improving	Percent accident reduction, percent increased transit usage, travel time savings, percent GHG reductions, percent change in VHD

Project Subcomponent	Expected Benefits.	KPIs
	ability to recover after a major accident and benefits to improved infrastructure resilience, reduced operating costs	
In and near various cities, from Alameda County line to south of Waterfront Road/Marina Vista Avenue at various locations. Construct permanent Best Management Practices (BMPs) to achieve statewide National Pollutant Discharge Elimination System (NPDES) permit compliance units for trash capture and Total Maximum Daily Load (TMDL).	Improving safety, reduced operating costs, improving Operation and Maintenance, improving State of Good Repair.	Reduction in operating costs, increase capture of pollutants.
In and near Walnut Creek and Martinez, at Rudgear Road Undercrossing No. 28-0059 (PM R12.6), Olympic Boulevard Undercrossing No. 28-0161 (PM 13.9), and Mococo Overhead No. 28-0356R (PM 24.3). Apply polyester concrete overlay to bridge decks.	Improving mobility and safety, reduced operating costs, improving travel time reliability; accident and collision prevention, improving Operation and Maintenance, improving State of Good Repair, Improving freeway's throughput for person and freight movement.	Percent accident reduction, travel time savings, percent change in VHD, reduction in operating costs, percent increase in freight volume.
In San Ramon and Danville, from Alcosta Boulevard to north of Diablo Road. Rehabilitate pavement, upgrade guardrail, and upgrade facilities to Americans with Disabilities Act (ADA) standards.	Improving mobility and safety, reduced operating costs, improving travel time reliability; accident and collision prevention, improving Operation and Maintenance, improving State of Good Repair, Improving freeway's throughput for person and freight movement.	Percent accident reduction, travel time savings, percent change in VHD, reduction in operating costs, percent increase in freight volume.
In and near Concord and Pleasant Hill, from Route 242 to Solano County line. Rehabilitate pavement, upgrade drainage systems, install lighting, construct concrete barrier, and upgrade facilities to Americans with Disabilities Act (ADA) standards.	Improving mobility and safety, reduced operating costs, improving travel time reliability; accident and collision prevention, improving Operation and Maintenance, improving State of Good Repair, Improving freeway's	Percent accident reduction, travel time savings, percent change in VHD, reduction in operating costs, percent increase in freight volume.

Project Subcomponent	Expected Benefits.	KPIs
	throughput for person and freight movement.	
Automated Driving System (ADS)	Improving mobility and safety, GHG reduction, improving travel time reliability, mode shift, affordable and accessible transportation, reduce VMT, reduced operating costs	Percent accident reduction, percent increased transit usage, travel time savings, percent GHG reductions, percent change in VHD, percent reduction in operating costs
Mobility on Demand (MOD)	Improving mobility and safety, GHG reduction; improving travel time reliability, mode shift, affordable and accessible transportation, reduce VMT, reduced operating costs	Percent accident reduction, percent increased transit usage, travel time savings, percent GHG reductions, percent change in VHD, percent reduction in operating costs

Data Description and Requirements

As mentioned in Section 1.4 of this document, the I-680 Forward project has multiple subcomponents, some are traffic related, and some are transit related. For each subcomponent, CCTA will provide a description of the detailed data that will be collected and analyzed, including the nature and scale of data, the methods that will be used to assemble and analyze data, and methods that will be used to verify accuracy of the predicted outcome and forecasted KPIs. CCTA will assemble that information into a central repository that will be used to generate the before and after study reports required for the Mega Grant as identified in Section 1.2 of this document. The information included in this chapter such as the type of data, data sources, formats, and methods are the preliminary information that will be updated as the project progresses and during the finalization of this document.

Types of Data

CCTA will conduct the before and after study for the Mega grant spanning a broad array of topics related to improvements to Safety, Mobility, Economy, state of good repair; costs avoided by the prevention of closure or reduced use; reductions in maintenance costs; reduction of serious injuries and fatalities and related costs; improved person or freight throughput, including improved mobility and reliability; environmental benefits and health impacts, reductions in greenhouse gas emissions; air quality benefits; preventing stormwater runoff; and improved infrastructure resilience; technologies that will allow for future connectivity and automation; benefits users of multiple modes of transportation, including pedestrians; bicyclists; and users of nonvehicular rail and public transportation, including intercity and commuter rail; and improving connectivity between modes of transportation moving persons or goods.

The data that will be collected will vary by project components and their expected outcomes. The following is a preliminary list of data that will be collected:

1. Shared Mobility Hubs (SMH)
   - Accident and collision data.

- Transit ridership data.
- Travel time reliability and savings.
- GHG reduction for Vehicles, Transit, and Trucks.
- Traffic Volume and Density, Vehicles Hours of Delay (VHD).

2. Part Time Transit Lane (PTTL)/Transit Bus on Shoulder (TBOS) Implementation
   - Times of Operation (based on operational scenarios and actual operation).
   - Accident and collision data.
   - Traffic Volume and Density, Vehicle Miles Travel (VMT).
   - GHG reduction for Vehicles, Transit, and Trucks.
   - Transit ridership data.
   - Travel time reliability and savings.
   - Vehicles Hours of Delay (VHD).
3. Express Bus Implementation (One seat express bus service between Dublin/Pleasanton BART and Amtrak station in Martinez)
   - Times of Operation (based on operational scenarios and actual operation).
   - Accident and collision data.
   - Transit ridership data.
   - Travel time reliability and savings.
   - GHG reduction for Vehicles, Transit, and Trucks.
   - Vehicles Hours of Delay (VHD).
   - Operation cost.
4. Iron Horse Trail (IHT) & Canal Trail Gap Closure
   - Accident and collision data.
   - Events and Incidents data (related to the trail).
   - Transit ridership data.
   - Travel time reliability and savings.
   - GHG reduction for Vehicles, Transit, and Trucks.
   - Vehicles Hours of Delay (VHD).
5. Iron Horse Trail (IHT) POCs
   - Accident and collision data.
   - Events and Incidents data (related to the trail).
   - Transit ridership data.
   - Travel time reliability and savings.
   - GHG reduction for Vehicles, Transit, and Trucks.
   - Vehicles Hours of Delay (VHD).
6. NB680 Express Lane Completion (ELC) (Phase 1)
   - Accident and collision data.
   - Transit ridership data.
   - Travel time reliability and savings.
   - GHG reduction for Vehicles, Transit, and Trucks.
   - Vehicles Hours of Delay (VHD).
   - Freight volume.
   - Toll tags and Express Lane usage.

- Vehicle's occupancy and High-Occupancy Vehicles (HOV) count and volumes.

7. I-680/State Route 4 Interchange Phases 1 and 2A
   - Accident and collision data.
   - Transit ridership data.
   - Travel time reliability and savings.
   - GHG reduction for Vehicles, Transit, and Trucks.
   - Vehicles Hours of Delay (VHD).
   - Freight volume.
8. Coordinated Adaptive Ramp Metering (CARM)
   - Traffic Volume and Density, Vehicle Miles Travel (VMT).
   - GHG reduction for Vehicles and Trucks.
   - Travel time reliability.
   - Vehicles Hours of Delay (VHD).
   - Accident and collision data.
   - data related to collisions on the mainline and ramps, average number of vehicles per collision, and average number of victims per injury.
   - Operation and Maintenance cost.
   - Data related to Improving State of Good Repair for Ramp Meters sub-systems.
   - Data related to Improving freeway's throughput for person and freight movement.
   - Data related to ability to recover after a major accident and benefits to improved infrastructure resilience.
9. In and near various cities, from Alameda County line to south of Waterfront Road/Marina Vista Avenue at various locations. Construct permanent Best Management Practices (BMPs) to achieve statewide National Pollutant Discharge Elimination System (NPDES) permit compliance units for trash capture and Total Maximum Daily Load (TMDL).
   - Environmental Pollution-related data.
   - Operation and Maintenance cost.
   - Data related to Improving State of Good Repair.
10. In and near Walnut Creek and Martinez, at Rudgear Road Undercrossing No. 28-0059 (PM R12.6), Olympic Boulevard Undercrossing No. 28-0161 (PM 13.9), and Mococo Overhead No. 28-0356R (PM 24.3). Apply polyester concrete overlay to bridge decks.
    - Accident and collision data.
    - Travel time reliability and savings.
    - Vehicles Hours of Delay (VHD).
    - Operation costs.
    - Freight volume.
    - Operation and Maintenance cost.
    - Data related to Improving State of Good Repair.
    - Data related to Improving freeway and arterials' throughput for person and freight movement.
11. In San Ramon and Danville, from Alcosta Boulevard to north of Diablo Road. Rehabilitate pavement, upgrade guardrail, and upgrade facilities to Americans with Disabilities Act (ADA) standards.

- Accident and collision data.
- Travel time reliability and savings.
- Vehicles Hours of Delay (VHD).
- Operation costs.
- Freight volume.
- Operation and Maintenance cost.
- Data related to Improving State of Good Repair.
- Data related to Improving freeway and arterials' throughput for person and freight movement.

12. In and near Concord and Pleasant Hill, from Route 242 to Solano County line. Rehabilitate pavement, upgrade drainage systems, install lighting, construct concrete barrier, and upgrade facilities to Americans with Disabilities Act (ADA) standards.
    - Accident and collision data.
    - Travel time reliability and savings.
    - Vehicles Hours of Delay (VHD).
    - Operation costs.
    - Freight volume.
    - Operation and Maintenance cost.
    - Data related to Improving State of Good Repair.
    - Data related to Improving freeway and arterials' throughput for person and freight movement.
13. Automated Driving Systems (ADS)
    - Travel time
    - Accident and collision data
    - GHG emissions
    - Operation and maintenance cost
    - Connected vehicle V2X data related to near misses.
14. Mobility on Demand (MOD);
    - Person Trips per mode
    - Total Vehicle trips.
    - Vehicle Miles Travel (VMT) changes.
    - Mode shift based on the MOD app usage.
    - Transit ridership changes (Rail and Bus).
    - Selective Survey responses.
    - Application usage

In addition to project's subcomponents specific data, there will be other data that will be collected and captured such as weather data, video, audio, subjective survey responses, and information from media and news for specific events and/or major or minor incidents that may have short term non-recurrent impact to the before and after study results. The data types will be further expanded during the data collection process and procedures related to assembling and analyzing data as described in the chapters 4 and 5 of this document.

Data Sources and Available Data

Data sources available to CCTA, Caltrans District 4, Metropolitan Transportation Commission (MTC), Transit Agencies including Bay Area Rapid Transit (BART), Contra Costa County Transit Authority (County Connection), Local Cities and Contra Costa County include: central systems such as Advanced Transportation Management Systems (ATMS), their Computer Aided Dispatch and Automated Vehicle Locations (CAD/AVL), their vehicle detection systems, radars, Closed Caption Television (CCTV) Cameras, traffic signal and ramp meter controllers, and other public or private data providers such as Regional Integrated Transportation Information Systems (RITIS), Caltrans Performance Measurement System (PeMS), Inrix, Google Map data, Ways Data, Verizon City Insight Data, Mobility on Demand (MOD) app data, subjective survey responses, local Automated Traffic Signal Performance Measures (ATSPM), Realtime General Transit Feed Specification (GTFS-RT) information, ridership and transit tickets, micromobility bike and scooters usage, local 511 Contra Costa bike mapper app's usage, Tri-Delta Transit and County Connection's connection protection system, and other applicable systems such as CCTA's Telegra's ATMS will be used as data sources and capturing data needed for before and after study from the freeway, local arterials, local transit, local streets, and trails.

In addition, carpool information, express lane usage, High Occupancy Vehicle (HOV) lane usage data will be captured from detectors and tolling systems where possible and through other surveys that will be completed.

Accidents and collision information and safety related reports will be gathered from California Highway Patrol (CHP) portals and other local PD and available sources.

Data related to improvements to environment, such as GHG emissions reductions will be gathered from Bay Area Air Quality Management District (BAAQMD), and other sources available to CCTA.

Changes to operations and maintenance costs will be gathered from public agencies financial reports.

Caltrans, MTC, local cities and transit agencies Asset Management Systems and Maintenance logs will be used to review improvements to State of Good Repair of the assets along the project area.

Multiple data sources will be used to measure improvements to economy such as sales tax, job creation, etc. CCTA will coordinate with the Bay Area Council in evaluating economic benefits from the improvements.

Data Gaps and Additional Data Needs

Data collected from various sources will be reviewed and studied to identify possible gaps and needs for additional information. If gaps in data are identified, other possible methods for gathering data such as placing temporary detection systems or manual data gathering using field surveys will be identified and implemented to capture data needed to cover the gaps.

As an example, we do anticipate a gap in data related to environmental improvements such as improvements to roadway pavement materials that are used in construction to reduce emissions or improve water drainage. CCTA will work with independent contractors to perform inspection and environmental studies such as sample material testing and collection to provide data and reports related to possible improvements in specific project location areas.

Data Format and Metadata Standards

Types of Data | In order to organize the data sets, we consider two kinds of data per USDOT ITS JPO that is generated from any extramural research. The first one is the primary research data and second one is the research results.

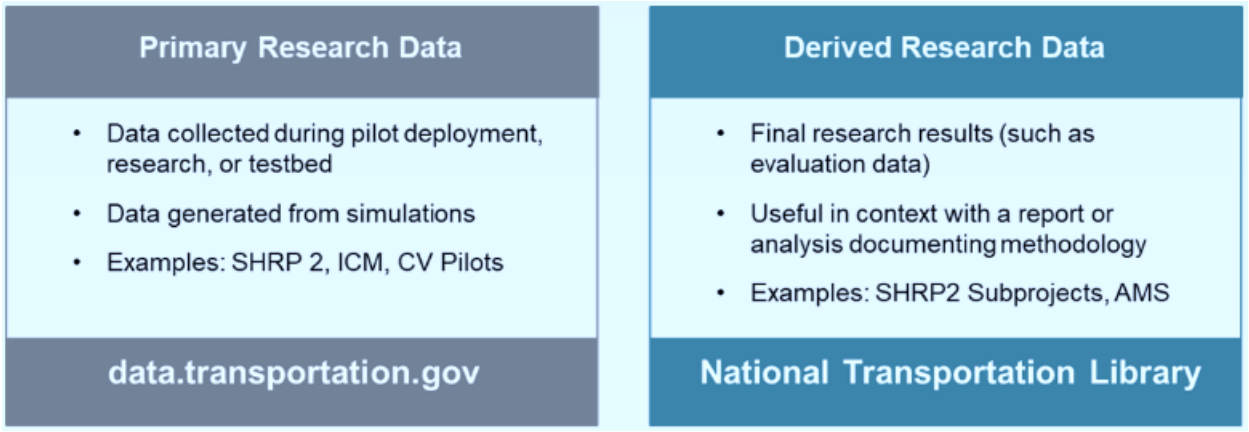


Figure 2: Mature Datasets[3]

The research results for this project are considered project reports. Chapter 3 of this document describes how reports will be gathered and maintained during the project as part of the DCP. Section 6 describes how the final publications of key deliverables can be posted to the National Transportation Library.

Scale of Data | It is our understanding that the data available through the various sources identified in Section 2.2 of this document may exceed the scale needed to perform the before and after study reports for this program. As a result, CCTA will work with the project's subcomponents team members and stakeholders to collect and capture data that will be required for the studies to support reports generated to measure accuracy of the KPIs.

Data Formats and Metadata Standards | CCTA will require data formats to be standard file formats such as CSV, text, excel file, word file, and pdf files to the extent possible. We do expect that the majority of the data formats needed for before and after studies will use non-proprietary formats; however, we do anticipate that some of the project subcomponents may utilize proprietary formats due to the nature of the technologies used in those sub-projects such as Automated Driving System (ADS)'s detection technologies. The ADS systems logs and data may need to be used to measure improvements to Safety. When the proprietary formats are used, we will work with an independent 3rd party to perform verification and validation of such formats and provide reports in non-proprietary formats such as PDF and word files.

CCTA will work with each project's subcomponent team members to describe the data process log to clarify the final version of data shared to the public, and that their alternative builds will be considered in the before and after study, identifying metadata schema and standards that can be used to properly measure KPIs and expected outcomes, indicating what additional tools and/or software may be required

[3] ITS JPO Data Access and Retention Policies, https://www.its.dot.gov/data/public-access/

to read and/or view data, and their quality control measures and conformance to the overall plans identified in this DCP.

Any document, plan, or drawing developed as part of this program will be recorded in document repository such as E-builder as identified in Chapter 6.

All the videos or photos taken from project demonstrations, images and conceptual diagram and device configurations that are necessary for setting up the demonstration event, and any numerical data, text sequence, data message set, and data logs gathered at the time of project implementation from the vehicles, communications infrastructure, and correspondence related to the event will be gathered, processed, and uploaded to the project SharePoint and E-builder for review by team members.

○ Data Collection Methodology

The data collection work steps are identified in Section 1.3 of this report and data sources are identified in the Section 2.2. The data will be gathered periodically from sources available and reviewed for gap analysis as identified in Section 2.3. CCTA will work with team members of each sub-component to gather data needed for studies related to each subcomponent and will gather them at a central repository.

Data Collection Planning | The Data Collection Plan described in this section will apply to all project sub-components identified in Sections 1.4 and 2.1. The CCTA team will update this Experimental Data Collection Plan (DCP), to ensure the capture of data sets that achieve the project goal. In the Plan, we will identify the experiment's operational condition(s) and the data that needs to be collected to characterize those conditions with the following objectives:

1. collecting all data required to perform its evaluation,
2. ensuring the quality of the data,
3. storing data for processing, and
4. preparing reports and data for transfer to USDOT.

The DCP will also identify data sets that are gathered manually or automatically in real-time. It will also identify if the data being gathered automatically can be checked with scripts (software codes) for quality in real-time.

Each subcomponent will have its data recording and maintaining records of data collection. At a minimum, the data collection procedure will include following:

1. Based on the operational scenarios, we will start with a baseline (test run) data collection period before the regular data collection is activated. The test run will be jointly carried out with the designer and contractor for each sub-component. The baseline data collection is necessary to ensure the data is available and to verify the data elements are captured correctly.
2. If there is a disruption of data or abnormality observed, we will work with the contractor and other agencies to capture a copy of logged or historical data from data sources identified in Section 2.2 where possible.

We will also monitor the operational conditions to check if any local conditions that may change over time can lead to effects in the before or after study. For example, roadway closures or reconfigurations may cause traffic patterns to change significantly. During this period, the data will be captured, processed and reviewed, giving us an updated status of conditions as well as an opportunity to verify the

quality and volume of data elements being collected. If we detect any inadequacy or abnormality in data, the problem will be rectified expediently to minimize any disruption to the data collection process.

To maximize the quality of data to be captured, our team will adopt several approaches that are comprehensive:

1. Diversity in driving environment; where we include ample examples of daily data in an urban setting, congested and free-flow, local streets and arterial (when applicable), and freeway driving environment;
2. Diversity in vehicle operation; for example, a mix of multimodal trips and personal-use vehicles;
3. Diversity in normal traffic and other road conditions.
4. Diversity in time of the day, weather, and lighting conditions.

In order to maximize the value of data and to investigate the accuracy of the KPIs, we plan to select a set of strategic locations for data collection. These locations will include intersections, junctions, middle-of-road segments, and passenger pickup and drop-off areas. We will work closely with managers subcomponents to review this strategy prior to data gathering. CCTA will also perform inspections and periodic monitoring and review of the captured data for accuracy.

Data Collection Testing and Verification | Our team will coordinate and collaborate with the project sub-components provider, team members, and stakeholders to establish an integrated approach to efficiently conduct the data collection tasks. In addition to requirements of data for later analysis, the team will identify subsets of data elements for operation. Subsequently, a pre-testing data effort will be carried out to verify the validity of data collection processes.

Development of Data Collection Plan | Our team will work with the project subcomponents team members, and stakeholders to renew the data elements identified in the experimental Data Collection Plan. In the process, we will carefully review how the data elements will be mapped onto the data analysis tasks, including the performance metrics, KPIs, and other measurable predicted outcomes expected per each subcomponent.

Pre-Construction Data Gathering for Before Study Baseline | The technical and managerial processes for gathering, storing, and archiving data from various sources and from infrastructure will be verified. This is necessary to make sure that no data losses occur. In the event losses do occur, we will identify the causes and assess the significance. This allows the team to identify any technical limitations, and to ascertain the efficiency and effectiveness of the collected data.

At the conclusion, the team will update and finalize this plan by identifying data needs, types, formats, standards, sources, and gaps. The team will identify methods to manually capture data for any data gaps, identifying data collection and data gathering steps needed and performing data gathering prior to implementation and/or construction of the project. The team will perform simulation and data analysis to verify accuracy of the forecasted KPIs prior to preparing Before Study report.

Monitoring and Frequent/Periodic Updates to Data | CCTA will work with project's sub-components team members to perform periodic updates to the data captured and monitor the accuracy of the KPIs and that the proposed build alternatives will be on target to reach the program goals. The simulation models will be updated on a periodic basis with updated data and a comparison will be performed as needed to identify impacts of different proposed alternatives for each project's sub-component.

Modify Data Collection Plan | Pursuant to the outcome of the baseline and or periodic monitoring, the project team will assess the effectiveness of the Data Collection Plan in generating the quality and quantity of data needed to provide a high confidence level that the KPIs meet the expected outcomes and data is available to properly support the studies.

The team will evaluate the data collection system and will consider remedies for any problems. Modifications and/or enhancements will be used to update this plan if needed.

After construction Data Gathering for After Study | CCTA will work with project's subcomponents team member to identify steps needed to updating data gathered within 5 years after completion of the project. CCTA will performing data gathering after completion of the project and performing data analysis and assembling data to compare with baseline to prepare After Study report.

Data Collection Process

All project documents including technical reports and research results, photos, images, and videos taken during the project will be considered project-generated data that will need to be tracked and maintained. Some of the work items may be considered deliverables or publications that will be submitted to the USDOT as described in Section 6 of this document. In order to maintain document control, we will implement a Control Plan (CP) to manage all documents. The CP would be a roadmap to track, add, archive, and remove documents from the system. Document control will largely focus on project documentation; however, it is intended to be scalable to accommodate both project and non-project information. Some examples of non-project documents include product manuals, stand-alone drawings, and various procedural manuals that apply broadly to the program that can improve assets State of Good Repair.

This CP shall identify both technical and administrative direction for the control of changes and integrity of the program data and documentation. The CP will identify the configuration of the software and hardware at given points in time, systematically controlling changes to the configuration, and maintaining the integrity and traceability of the configuration throughout the project's life cycle.

The Plan establishes a framework and workflow processes for managing documents, including:

1. Systematic capture filing, distribution, and archiving of project documents and data, and relevant non-project documentation;
2. Maintenance of a single-source of truth for documentation;
3. Indexing documents such that files are logically organized and easily retrievable;
4. Controlled distribution; and
5. Maintenance of historical files for defined time periods.

Document management is the process of organizing, storing, protecting, and sharing documents. The CP describes how to manage documentation and provide a consistent approach to the creation, update, and distribution of material. The CP provides an overview of the organization, activities, tasks and objectives of the project and identifies the roles and responsibilities of Configuration Control Board (CCB) members and Configuration Management Office (CMO). The CCB will be led by CCTA as the supervising agency and the CMO tools (E-builder) will be used by all and maintained by staff. The processes defined in this CP will remain in place for the life of this program.

The document control measures will ensure that all documents are properly stored and versioned, accessible to authorized users, distributed based upon approved distribution lists, and properly secured and archived. The documents will be stored on E-builder platform provided by CCTA for the life of this program.

The following figure illustrates the Document Control and Configuration Management process that will be in place during the life of the program.

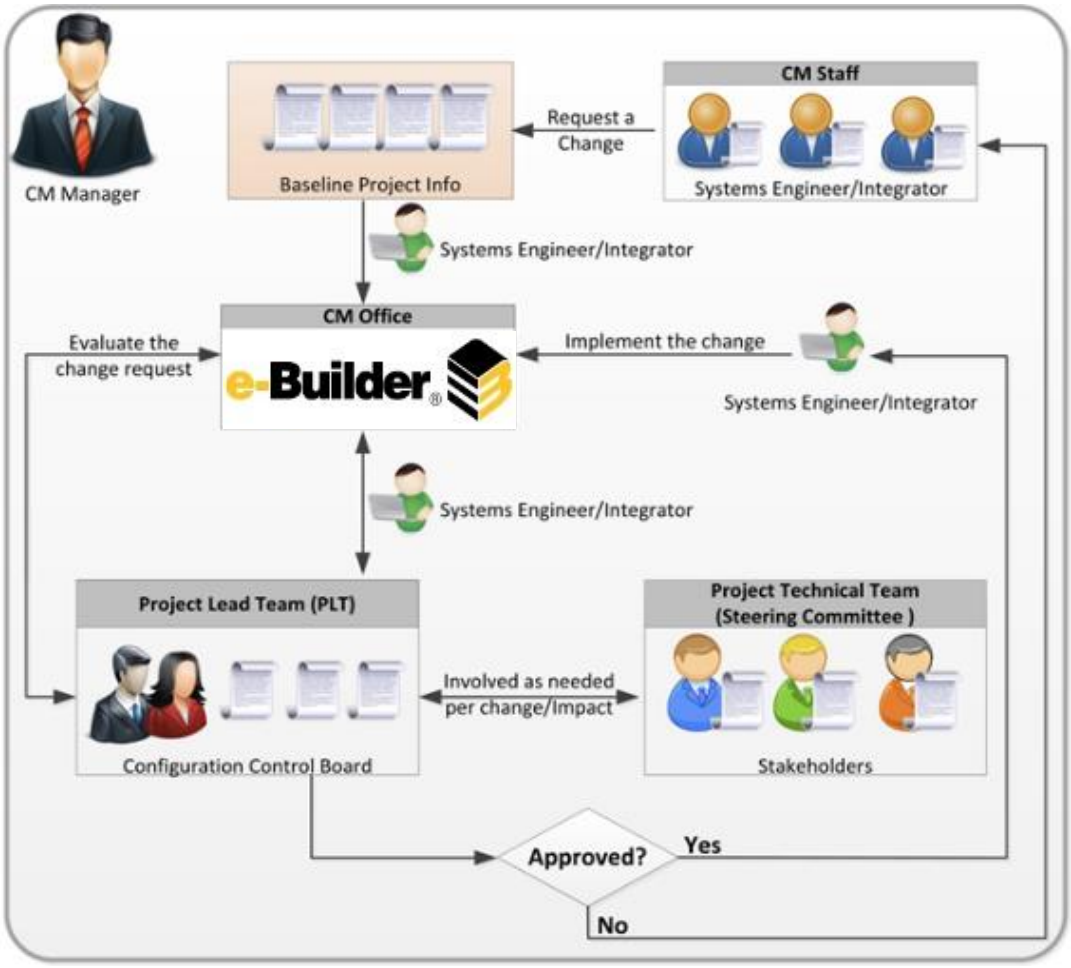


Figure 1 : Document Control Process

Data Collection per child project

Based on the methodology described in Section 2.5 of this document for data collection, CCTA will work with each project subcomponent's team members to provide their plan for before and after study in accordance with this DCP. Each project sub-component that receives funding from this grant, will be required to prepare and submit a DCP to CCTA. CCTA will then gather all the DCPs for each sub-component and generate the overall DCP for the 680 forward program. As mentioned in Section 1.3 of this document, this section may be updated upon release of Mega Grant's standard framework. Each DCP for each sub-component will need to include the followings in their plan:

Child-Project Overview | There will be an introduction section that describes each child project that is also known as sub-component. It will include a summary and purpose of the child project, its goals and objectives, its overall schedule from planning to deployment and its expected benefits and KPIs. It will also identify if the project is purely construction or if it will improve traffic conditions, transit, environmental, economic, or it is a mix of few areas and what are the characteristics of child project in terms of cost saving and improving assets and state of good repair in the area.

Data Collection Plan Overview | There will be a section describing how the child project will handle digital data during and after the child project is deployed and delivered. This section will include a 2-3 pages narrative describing following:

1. The final child-project data to be produced in the course of the project.
2. The expected outcome of the child-project and how it can be monitored and/or verified.
3. How the data can be used to perform before-after study and verifying accuracy of the KPIs and benefits expected from the child-project's outcome.

Data Description | There will be a section to further describe the data that will be gathered in the course of child-project that can be used to perform before and after studies and verify the accuracy of the KPIs and expected benefits of the child-project. In addition, it will include the followings:

1. Describe the nature, scope, and scale of the data that will be collected.
2. Identify types of data (e.g., numerical data, images data, text sequences, video, audio, database, modeling data, source code, etc.)
3. Describe the characteristics of the data, their relationship to other data, and provide sufficient detail so that reviewers can understand any disclosure risks that may apply. Discuss value of the data over the long-term.
4. Describe methods for creating the data (e.g., simulated, observed, experimental, software, physical collections, sensors, enforcement activities, researcher-generated database, tables, and/or spreadsheets, instrument generated digital data output such as images and video; etc.)
5. Describe the period of time data will be collected and frequency of update.
6. If existing data is used, what is the relationship between the data that the project will collect and the existing data.
7. Indicate the sources of the data and the party responsible for managing the data.

Standards Used | There will be a section that identifies metadata standards used as well as anticipated formats that child-project data and related files will use. If non-proprietary formats and tools are used, this section will identify them and the rationale for using such tools.

1. Identify format(s) of the child project's data that will be collected for the before and after study and if they are open or proprietary.
   - If proprietary data formats are used, discuss the rationale for using those standards and formats.
   - Describe alternatives and how the data in proprietary and non-standard formats can be documented in sharable and reusable format.
   - Indicate what tool or software is required to reach or view the data.
2. Describe how versions of data will be signified and/or controlled.
3. Identify documentations that will be created as part of the child project that can be used to make the data understandable to others for the purpose of before and after study and measuring KPIs and expected outcome of the project.
4. Describe the quality control measures and how child project will verify accuracy of the collected data.
5. Identify standards and metadata schema that are used to collect, managed, and store data.

Access Policies | This section will describe if data needed from the child-project to perform before and after study can be publicly shared or if it may include personal identifiable information, confidential business information, and/or classified information. This section will also describe the process for access restriction that may apply to the child-project data, the process to make data anonymized and/or

sharable to others including a 3rd party, CCTA, and USDOT for the purpose of re-use and/or verification in terms of accuracy and performing before and after study.

Re-Use, Redistribution, and Derivative Products Policies | This section will describe who holds the intellectual property rights for the data created by child-project. Describes whether those rights will be transferred to a data archive, and will identify any applicable copyrights to the data, in a case where copyrighted instruments are used. It will also describe if data needed for the before-after study can be reused or there are needs for data citation through a license and if there are terms of use or other policies that may apply.

Archiving and Preservation Plan | This section will identify where the child-project's data will be archived and when the data will be available and provided to CCTA and USDOT designated storage and archive locations for the project delivery. In addition, this section will describe the following:

1. Identify where data will be stored prior to being sent to an archive.
    - Describe how back-up, disaster recovery, off-site data storage, and other redundant storage strategies will be used to ensure the data's security and integrity.
    - Describe how data will be protected from accidental or malicious modification or deletion prior to receipt by the archive.
    - Discuss data archive policies and practices for back-up, disaster recovery, off-site data storage, and other redundant storage strategies to ensure the data's security and integrity for the long-term.
2. Indicate how long the chosen archive will retain the data.

Data Collection Schedule

A high-level schedule for the data collection plan is included in the Section 1.2 of this document. As part of the program, CCTA will develop detailed schedule for data collection and to identify when each child project's DCP will be developed, what are the end dates for each child project and identifies the time needed for before study and development of the baseline and what is the schedule for after study. The schedule will be included in the appendix of this document and will be frequently updated as the project progress.

Data Management Strategies

CCTA will gather each child project's DCP and review them to identify strategies for managing each child project's data collection process, to collect, prepare, store, assemble, analyze, and distribute data needed for the before and after study, periodic monitoring, frequent updates, and development of the reports needed as part of this program. CCTA will also review child-projects DCPs to identify if there are duplicate efforts in gathering data. CCTA will work with each project's subcomponent team members to identify the schedule for the data collection and if efforts can be combined or coordinated in a way to perform data gathering more cost effectively while maintaining or improving the quality, scale, and accuracy. CCTA will also implement processes and procedures for data quality control and data archiving where applicable.

Assembling and Analyzing Data

As described in Chapter 3 of this document, CCTA will ask each child project or subcomponent team member to prepare a DCP for that child project. Then CCTA will be work with them and gather data to a central storage and use the data to assemble and identify if there are gaps in the data and if there are duplication of data. CCTA will work with each team member to identify approaches to fill in the gaps and/or reduce the chance of duplicate efforts where not needed.

CCTA will review the types of data identified in each child project DCPs and will identify sources and areas that can be used to generate a simulation model for the existing condition, forecasting the KPI measures, and also being updated in the future when the actual after study data is collected. In this process, CCTA will review the needs to identify the type of simulation model needed for majority of the KPIs that need to verified and validated. The existing CCTA multimodal transportation simulation models and the process to exchange data between them and whether a microsimulation model, a macroscopic simulation model, a hybrid mesoscopic model is needed that can best represent the project characteristics including vehicles, transit, bike, peds, etc. or stand-alone studies are needed for some of the child projects due to their characteristics such as being purely construction with environmental impact, minor traffic improvements and major improvements to transit or environment.

It is expected that multiple simulation models will be created, one will represent the existing physical geometry of the roadways such as freeway's existing number of travel lanes, shoulders, HOV/HOT lanes, ramps, auxiliary lanes, acceleration/deceleration lanes, grade, curvature, etc. and arterials number of lanes, lane usage, length of turn pockets, grades, turning restrictions, and parking locations. Similar simulation models will be created with the proposed physical geometry that represent the after build conditions with forecasted data and demand to represent the future build conditions to verify and monitor the expected outcomes and measure accuracy of the estimated KPIs. Similar simulation models will be used for after study with physical geometry information based on the as-built and field surveys after the built to verify and validate the outcomes and KPIs.

In addition to physical geometry, the traffic control system's will be added to the simulation models such as ramp meters, metering rates, adaptive algorithms, variable speed limits, lane use signs, and detectors that may result in local, several segments, or system-wide control of freeway, arterials signal systems, controller types, phasing, detector types and placements, signal settings, signal timing plans, transit signal priority systems, and other applicable control systems. Similarly, there will be minimum of three simulations models that will represent existing conditions, forecast conditions, and after build conditions.

The next step will be to add travel demand information to simulation models such as link/segment's volume, density, speed, traffic composition, on ramp/off ramp volumes, turning movement counts, vehicle and person trip tables, express buses, tolling systems, incident detection and response plans, and other applicable response plans from a central or regional TMC that may accrue in specific pre-defined conditions.

The process to calibrate the simulation models will also include analysis of the quantity of the data needed, accuracy of the data, and a quality check of the data. This process will also identify gaps that may need to be addressed through other means of data collection such as manual, surveys, and/or temporary detections, video recordings, etc.

The ability of the simulation model to be calibrated to use transit data such as schedules, stop locations, ridership information will also be considered. Another factor that will be considered is the ability of the simulation model to use different vehicle characteristics, considering that the future vehicles may have different technology and physical characteristics. Currently the national data obtained from car manufacturers are available through Environmental Protection Agency and FHWA. However, the ability of the simulation model to update the vehicle characteristics in the future will be considered as well, and may better represent the future build needed for after study.

The simulation models will be used by traffic engineering experts along with the guidelines from USDOT guidebooks and handbooks, Highway Capacity Manual (HCM), Caltrans Corridor System Management Plan (CSMP) processes, MTC's regional transportation studies, and other local and county wide best practices to study, analyze, and reference where applicable to measure KPIs and monitor and verify accuracy of travel time improvements, safety improvements, throughput improvements, etc. The use of the USDOT's ITS4US complete trip will be considered by CCTA during data assembling and analysis. CCTA will consider the possibility of using ITS4US complete trip data and information related to mobility challenges for all travelers with a specific focus on underserved communities, including people with disabilities, older adults, low-income individuals, rural residents, veterans, and limited English proficiency travelers.

The USDOT FTA recommended approach for use of Data for Transportation Performance Management (TPM) studies related to transit's set performance targets and reports on safety, transit asset stats of good repair, system performance, freight, air quality, and infrastructure conditions such as pavement, bridge, and transit signal priorities will be considered during the process of assembling and analyzing data needed for before and after study for this program. Where applicable, the data from existing TPM reports will be reused to generate the baseline data and analysis needed to examine accuracy of KPIs related to transit improvements. Similarly, existing Transportation Demand Management (TDM) studies will be reviewed, and data will be reused where it can be considered for addressing needs other bicyclists, pedestrian, and other transportation users in the project area as applicable.

Additional data analysis is expected to develop baseline for other aspects of the benefits expected from the project such as environmental benefits, quality of life improvements, air quality improvements, transit ridership improvements, state of good repair, operation and maintenance cost, cost effectiveness, technology usage (e.g., MOD app), etc.

The safety related studies and their associated KPIs may include more than one baseline. For example, one set can be include the baseline for measuring safety related KPIs with the simulation models specifically related to roadway improvements such as bridges or roadway grades and turning angles; where another set will involve spreadsheets with data sets from CHP, local PDs, and first responders to study number of accidents, collisions, incidents, etc. at a specific project location area. Another baseline may be related to vehicles and ADS that is by itself a different method and approach to measure how safety will be impacted and/or improved by new technologies similar to CV2X and ADS vehicles.

As described in the chapter 3 of this document, as an added value, CCTA will utilize E-Builder to maintain a copy of the project deliverables and reports including plan sheets, test results, and other data applicable to the project and program.

In addition, as an added-value and innovative approach, CCTA will try to utilize practices recommended by FHWA related to Building Information Modeling (BIM)[4]. This will include object-based data modeling techniques and open data standards-based methods to implement and better use assets such as drawings, as-builts, devices, configurations, and asset networks. This effort may assist with the data sharing and exchange between the team members and verifying benefits of BIM related to the construction related projects.

Maintaining Baseline data

As mentioned above, CCTA anticipates multiple baseline data categories will be needed for this program. As part of the process, CCTA will gather, combine, and link the different baselines and store them into a central repository for this program and perform periodic updates and maintenance to the one combined baseline in a report format. Once ready, the report will be shared with USDOT that represents the before study and baseline data for the entire program including all the subcomponents and child projects awarded as part of the Mega Grant.

Monitoring Key Performance Indicators per Project

The currently anticipated KPI measures are listed in Section 1.4 of this document that may be updated once the child-projects provide their DCP as mentioned in chapter 3 of this document. CCTA will continue monitoring and performing periodic updates to the baseline data and report and monitor accuracy of the expected outcomes and KPI measures as the program and project progress. If there were discrepancies that were identified or if there were changes to the project and subcomponents builds due to alternatives analysis and/or other design related changes, CCTA will update the existing conditions reports, baseline, and update the KPI measures expected outcome and provide an updated before study report to USDOT.

Forecasting and Simulating data

The methods that will be used for forecasting data needed for the simulation and or prediction of expected outcome of the KPI measures will be documented in the before and after study reports. The methods will be mainly based on the guidelines, handbooks, and best practices as described earlier in Chapter 4. If there are changes due to unforeseen circumstances or newer forecasting methods , CCTA will work collaboratively with USDOT to make necessary adjustments and changes to the forecasted data used in simulation and studies for predicting KPIs and will provide updated before and/or after study reports.

Monitoring and updating data

The methods used for gathering and capturing data that will be necessary for the before and after study may include automated, semi-automated, and manual processes and procedures. To the extent possible, CCTA will perform periodic updates to the data and rerun the simulation models and recalculate the baseline, as needed, to verify accuracy of the KPI measures and verify that program is in right track.

Generating data reports

CCTA will perform and deliver followings reports:

[4] https://international.fhwa.dot.gov/pubs/pl21024/fhwa_pl21024.pdf

1. Before Study (project baseline) report; before the date of construction of a project CCTA will submit a Before Study report providing baseline data for the purpose of analyzing the long-term impact of the project in accordance with the Mega Grant Standard framework established per Section 1.3 of this document.
2. After Study (Updated project baseline) report; not later than 6 years after the date of completion of the project CCTA will submit to an After Study report that compares the baseline data included in the Before Study report to project data collected during the following period:
   - beginning on the date that is 5 years after the date of completion of the project; and
   - ending on the date on which the updated report is submitted.

Access Policies and Sharing

Policies for access and sharing

CCTA anticipates that the before and after study reports developed as part of this project can be shared publicly. CCTA will work with each project subcomponents team member to identify if any portion of the data cannot be shared publicly and may require having access restrictions due to presence of confidential or privacy related data. If access restrictions are necessary, CCTA will work with a 3rd party to perform data anonymization prior to sharing the data with public.

It is expected that the project managers will ensure protection of privacy and confidential information is addressed prior to archive or public release of data.

Policies for re-use and redistribution

It is expected that the researchers performing the before and after study reports to measure ability of the project to meet the expected KPIs, will cite their data sources and license under which they used the data in the reports. It is also expected that researchers will describe if they are transferring rights to the data archive and the process and methods used to perform the calculations to be available for reuse and redistribution.

CCTA will work with each project subcomponents team member to identify who has the right to manage the data, indicate who holds the intellectual property rights to the data, list any copyrights to the data and indicate who owns them, discuss any rights to be transferred to a data archive, and to describe how data will be licensed for reuse, redistribution, and derivative products.

At this time, CCTA anticipates that almost all the data needed to perform the before and after study will be collected from publicly available sources with few minor exceptions to the data related to MOD users, ADS vehicles, and similar technologies.

Plans for archiving and preservation

CCTA will expect all the data gathered and collected under this program's project subcomponents will be archived on storage locations identified in Chapter 6 of this document. The data that will be used to generate the before and after study reports required by Mega Grant will also copied to a different archive repository that will conforms to the USDOT data repository requirements. The data will be duplicated on regular periodic basis to prevent catastrophic loss of information. Information will be backed up and mirror at another site to provide means of recovery in case of disaster.

Data Storage

As part of this program, series of data storages will be used to store gathered data, reports, documents, and work in progress data that is being assembled, analyzed, and archived. The contractors may include a copy of the data that they need for their work on their file storage systems, they are required to provide a copy of the raw data, processed, assembled, analyzed, and forecast data to CCTA in near real-time and always keep an updated copy available to CCTA. Contractors will be required to upload a copy of the data to following storage locations and CCTA will perform periodic verification of accuracy and completeness.

3. CCTA's E-Builder is cloud-based system that will be used for storage of information related to construction projects including all the information related to planning, design, procurement, construction, and operations, including the projects schedule, and budget.
4. SharePoint Online on Microsoft Azure 365 Cloud;
    - Project reports and technical documents may be stored on CCTA and/or AMG's SharePoint for sharing data and work-in-progress technical reports between project team members for collaboration. Draft and Final documents and their backup data will be copied to CCTA's E-Builder.
5. Telegra Advanced Transportation Management System (ATMS) Local Storage servers at CCTA's IT Room;
    - Realtime and historical data gathered from infrastructure and devices along the freeway and arterials will be stored on the Telegra ATMS SQL Server database. This raw data will be gathered and used to generate reports where needed.
6. CCTA's Amazon Web Services (AWS) Cloud services and tools;
    - CCTA's AWS services will be used to store specific tools and data gathering components needed for gathering information related to Transit, Ridership, Transfers between modes via Connection Protection, etc. This raw data will be gathered and used to generate reports where needed.
7. Verizon City Data Insight Platform leverages Amazon Web Services (AWS) cloud;
    - Realtime data and historical data gathered from V2X and vehicle's onboard devices and data gathering tools, including detection of pedestrian and bikes at major intersections will be stored on Verizon's City Data Insight. This raw data will be gathered and used to generate reports where needed.
8. IBM's Engineering Lifecycle Management (ELM) system;
    - Information such as project goals, objectives, user stories, functional and performance requirements, system and subsystem requirements, design requirements, test requirements, test procedures, test results, and verification and validation processes will be stored on ELM in addition to the requirements traceability matrix for various components of the projects. This information will be used to assist with preparation of Systems Engineering Documentations following FHWA's guidebook for Systems Engineering.
9. USDOT and National Library Websites for Data Sharing;
    - CCTA will work with USDOT to provide a copy of project related Publications, and technical data to applicable USDOT websites where needed.

Policies for data storage

All the data storages used for this project will tmeet or exceed the USDOT's data storage requirements.

It is expected that the data storage used for the purpose of this program will allow access control and access restriction to the data where needed and will allow public access to the data as well. The storage systems will also meet or exceed the expected cyber security requirements and are protected with proper security features such as SSL certificates and/or encrypted VPN connections to prevent unauthorized access or modification to the archived reports and their data.