California
Road Charge

APPENDIX F:
Systems Engineering Management Plan

Systems Engineering Management Plan

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List of Acronyms and Abbreviations

Acronym	Term
AV	Autonomous Vehicle
BRD	Business Requirements Document
CalSTA	California State Transportation Agency
Caltrans	California Department of Transportation
CCO	Concept of Common Operations
ConOps	Concept of Operations
CTC	California Transportation Commission
EV	Electric Vehicle
FAST Act	Fixing America's Surface Transportation Act
FHWA	Federal Highway Administration
GIS	Geographic Information Systems
ICD	Interface Control Document
ISO	International Organization for Standardization
ITS	Intelligent Transportation Systems
NIST	National Institute for Standards and Technology
PATP/CP	Pay-at-the-Pump / Charge Point
PCI DSS	Payment Card Industry Data Security Standards
PII	Personally Identifiable Information
PMI	Project Management Institute
PMP	Project Management Plan / Project Management Professional
PRIME	Platform for Road charge Innovation and Mobility Evolution
RCPP	Road Charge Pilot Program
RTM	Requirements Traceability Matrix
RUC	Road Usage Charge
SB	Senate Bill
SEMP	Systems Engineering Management Plan
SEP	Systems Engineering Process
SLA	Service Level Agreement
SPPS	SharePoint ProjectSolve
SRS	System Requirement Specifications
STSFA	Surface Transportation System Funding Alternatives
TAC	Technical Advisory Committee
TBD	To Be Determined
TNC	Transportation Network Company
UBI	Usage-based Insurance
VMT	Vehicle Miles Traveled

Document Purpose

The California Road Charge Demonstration Project Systems Engineering Management Plan (SEMP) identifies and describes the processes to be used to accomplish the technical tasks and deliverables to be developed, delivered, integrated, verified and supported by the project.

1. Project Overview

1.1 Project Identification

Caltrans Project ID: 82A0038
Caltrans Program Manager: Lauren Prehoda
Caltrans Project Manager: *TBD*

WSP Project ID: 182974
WSP Project Manager: Mike Warren, PMP
WSP Technical Manager: Trey Baker
WSP Demonstration Lead: Markell Moffett

1.2 Background and Need

In 2014, the California Legislature passed Senate Bill (SB) 1077, authorizing the California Transportation Commission (CTC) to create a road charge technical advisory committee to study alternatives to the gas tax. SB 1077 emphasized mileage-based collection that responds to the public issues and concerns revealed by a technical and operational feasibility test – the Road Charge Pilot Program (RCPP). As the governing agency for all transportation related projects, the California State Transportation Agency (CalSTA) authorized the California Department of Transportation (Caltrans) to design, develop, deploy, and evaluate a 9-month demonstration pilot to test the feasibility and public opinion of road charge.

The 9-month pilot consisted of 5,000 participant vehicles and represented the unique demographic, geographic and socio-economic aspects of California. The RCPP tested various mileage reporting options, including time and mileage permits, odometer reading captures, and automated reporting (with and without location differentiation capabilities).

The RCPP's positive findings yielded opportunities for program refinement that led to Caltrans being awarded three subsequent federal grants to explore ways that road charge could be reported, assessed, and collected through existing telematics platforms and in-place markets that capitalize on telematics data. Due to high interest and Federal support, SB 1328, signed into law in 2018, continues CTC's Road Charge Technical Advisory Committee (TAC) efforts into exploring road charge feasibility until January 1, 2023.

1.3 Project Scope

Caltrans is pursuing a systematic approach to the issue of transportation revenue generation to enhance the state's existing RCPP, with the goal of implementing a phased demonstration in accordance with Fixing America's Surface Transportation (FAST) Act, Surface Transportation System Funding Alternative (STSFA) grant program. The demonstration includes the following phases:

1. **Pay-at-the-Pump/Charge Point (PATP/CP):** Demonstrate the technological device/point of sale options available for a PATP/CP road charge model through a geographically constrained demonstration in an urban area, which builds upon existing research activities.

2. **Usage-Based Insurance (UBI):** Demonstrate how auto insurance companies could provide road charge account management services using existing usage-based insurance platforms and accounts.
3. **Transportation Network Companies (TNCs):** Demonstrate the viability of collecting a road charge using technology already incorporated into real-time ridesharing vehicles and applications by TNCs.
4. **Autonomous Vehicles (AVs):** Partner with one or more AV operators to demonstrate the ability to collect vehicle and occupancy data from AVs for road charge purposes and identify road charge opportunities that stem from AV use.

For each phase of the demonstration, technology providers will collect travel data from participating vehicles, process data into transactions, apply the appropriate road charge rate(s) and calculate net road charge owed (simulated). Technology partners will transmit both detailed and aggregated/sanitized data to the demonstration data warehouse, otherwise known as the Platform for Road charge Innovation and Mobility Evolution ("PRIME").

Throughout the phased demonstration, the analytics and dashboarding capabilities of PRIME will be showcased, enabling Caltrans to make data-driven decisions, conduct predictive forecasting and enhanced modeling, and show how road charge data can be used to enhance asset management, improve network operations, and provide a model for other states to follow as they transition to the next model of road charge.

The key goals and objectives of the four-phased California road charge demonstration are to:

- Demonstrate the technical, budgetary, and political viability of road charge through four technology platforms.
- Establish a flexible, scalable, technology-agnostic platform for continual road charge evolution.
- Elevate the road charge discussion in California.
- Provide a comprehensive blueprint to advance road charge nationally.

These key goals and objectives will drive all aspects of the design, development, operation and evaluation of the demonstration and the next phase of road charge in the State of California.

1.4 Technical Scope

To successfully design, test, implement and operate all phases of the demonstration, WSP will perform technical design, certification and testing, and implementation and operation tasks under the following contract tasks:

- **Task 3 – Technical Design**: Development of the SEMP, Concept of Operations, functional architecture, business rules, system requirements, interface controls and PRIME data warehouse design specifications.
- **Task 6 – Demonstration Preparation**: Development of implementation and operations plans that detail the activities needed to prepare for, implement and operate the demonstration. Unit, integration and acceptance testing of all systems and processes for the demonstration, and a 2-week dry run to validate operational readiness prior to demonstration launch.

- **Task 7 – Demonstration Operations**: Operations of each of the four demonstration phases, as well as the overarching management of PRIME and administration activities necessary to meet demonstration objectives.

The remainder of the SEMP will focus on the tasks, activities and deliverables associated with contract tasks 3, 6 and 7.

The system will support open, standards-based platforms where relevant data can be collected and seamlessly shared with Caltrans and other key stakeholders without using proprietary protocols. This allows technologies, business models, and providers to enter and exit the market as the market and business needs evolve.

1.5 Technical Project Summary Schedule

The schedule below was developed based on the California Road Charge Demonstration project management plan (PMP). WSP will lead all technical tasks for the project.

Table 1: Preliminary Project Schedule – Technical Tasks

TASK / DELIVERABLE	DUE DATE
TECHNICAL DESIGN	
Task 3: Demonstration Specifications Technical Memorandum	01/09/2020
Task 3: Concept of Operations	02/28/2020
Task 3: Systems Architecture Diagram	02/07/2020
Task 3: Business Requirements	04/03/2020
Task 3: System Requirements	04/03/2020
Task 3: Interface Controls	04/24/2020
Task 3: Demonstration Database Design	05/22/2020
DEMONSTRATION PREPARATION	
Task 7: Participant and Incentive Payout Technical Memorandum	05/11/2020
Task 6: Implementation Plan	07/03/2020
Task 6: Operations Plan	07/03/2020
Task 6: Customer Support Plan	07/24/2020
TESTING AND CERTIFICATION	
Task 6: Certification Test Plan	06/12/2020
Task 6: Execute Unit Testing	08/03/2020 – 09/01/2020
Task 6: Unit Testing Results Report & RTM	09/11/2020
Task 6: Execute Integration Testing	08/19/2020 – 09/10/2020
Task 6: Integration Testing Results Report & RTM	09/18/2020
Task 6: Execute Acceptance Testing	09/02/2020 – 10/07/2020
Task 6: Initial Acceptance Test Results Report & RTM	10/14/2020
Task 6: Data Security Assessment	10/07/2020
Task 6: Execute Dry Run	10/08/2020 – 11/24/2020
Task 6: End-to-End / Acceptance (Dry Run) Results Report & RTM	12/01/2020

TASK / DELIVERABLE	DUE DATE
DEMONSTRATION OPERATIONS	
Task 7: Operations – Phase 1 PATP/CP	January – June 2021
Task 7: Operations – Phase 2 UBI	February – June 2021
Task 7: Operations – Phase 3 TNC	March – June 2021
Task 7: Operations – Phase 4 AV	April – June 2021
Task 7: PRIME Data Warehouse Management	January – August 2021
Task 7: Demonstration Progress Report Month 1	02/10/2021
Task 7: Demonstration Progress Report Month 2	03/10/2021
Task 7: Demonstration Progress Report Month 3	04/10/2021
Task 7: Demonstration Progress Report Month 4	05/10/2021
Task 7: Demonstration Progress Report Month 5	06/10/2021
Task 7: Demonstration Progress Report Month 6	07/10/2021
Task 7: Operations Closeout	07/01/2021 – 09/30/2021
Task 7: End of Demonstration Closeout Report	07/26/2021
Task 7: Participant Incentive Payment Receipts	09/30/2021

1.6 Relationship to Other Plans

The SEMP provides an integrated approach to the design and implementation of the California Road Charge Demonstration project. The primary documents that influence the technical tasks are identified in the table below.

Table 2: Applicable Reference Documents

Document Name	Filename / Source
California Road Charge Demonstration Project Scope of Services	82A0038 Executed Agreement.pdf *A copy of this document can be found on the project SPPS site, as linked in the PMP.*
California Road Charge Demonstration Project Management Plan	Task1-ProjMgtPlan-RVA-08162019-CLEAN.docx *A copy of this document can be found on the project SPPS site, as linked in the PMP.*
California Road Charge Pilot Program Technical Documentation	PaythePumpConops_FINAL_Sept2018.docx PaythePumpDemonstrationPlan_FINAL_Sept2018.docx Exhibit E RCPP Business Rules v1 0a 151109.pdf T04D02 RCPP System Requirements Specification_v1.4.docx T04D03 RCPP Interface Control Document_v1.6.docx T04D04 Technical Lessons Learned_v02.docx *Copies of these documents can be found on the project SPPS site, as linked in the PMP.*
RUC West Regional Interoperability Pilot Design Phase Technical Documentation	FINAL_RUCWest_CCO_v1_02232018_CLEAN.docx FINAL_RUCWest_BRD_03262018.docx FINAL_RUCWest_SRS_20180328.docx FINAL_RUCWest_ICD_20180328.docx *Copies of these documents can be made available upon request to Caltrans Road Charge Program.*

2. Systems Engineering Process and Plan

The Systems Engineering Process (SEP) defines a formal framework for "systematically" executing a project, in its entirety, from project inception to project completion. The SEP divides the system lifecycle into several steps to create logical checkpoints to confirm expectations, assumptions, and scope to create documented baselines. These logical checkpoints also allow for issue identification and correction before getting too far ahead.

The Federal Highway Administration (FHWA) Intelligent Transportation Systems (ITS) Systems Engineering "V" Diagram depicts the SEP, technical activities and deliverables, and the connection between system development and system verification and validation. Figure 1 depicts the "V" diagram for the systems engineering model, as well as each SEP step as it correlates to project-specific technical documents and deliverables.

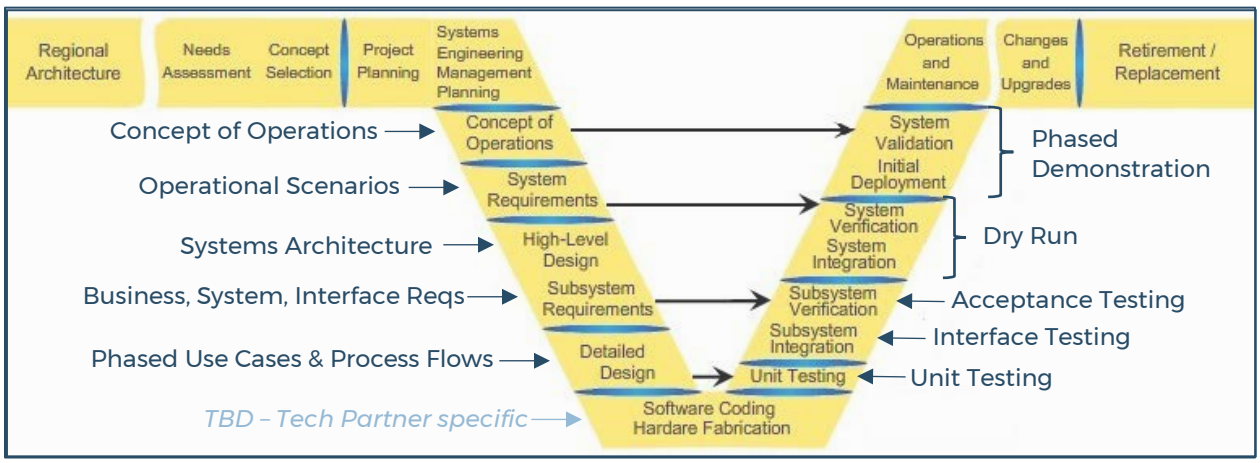


Figure 1: Systems Engineering "V" Diagram and Relation to Project-Specific Documents and Deliverables

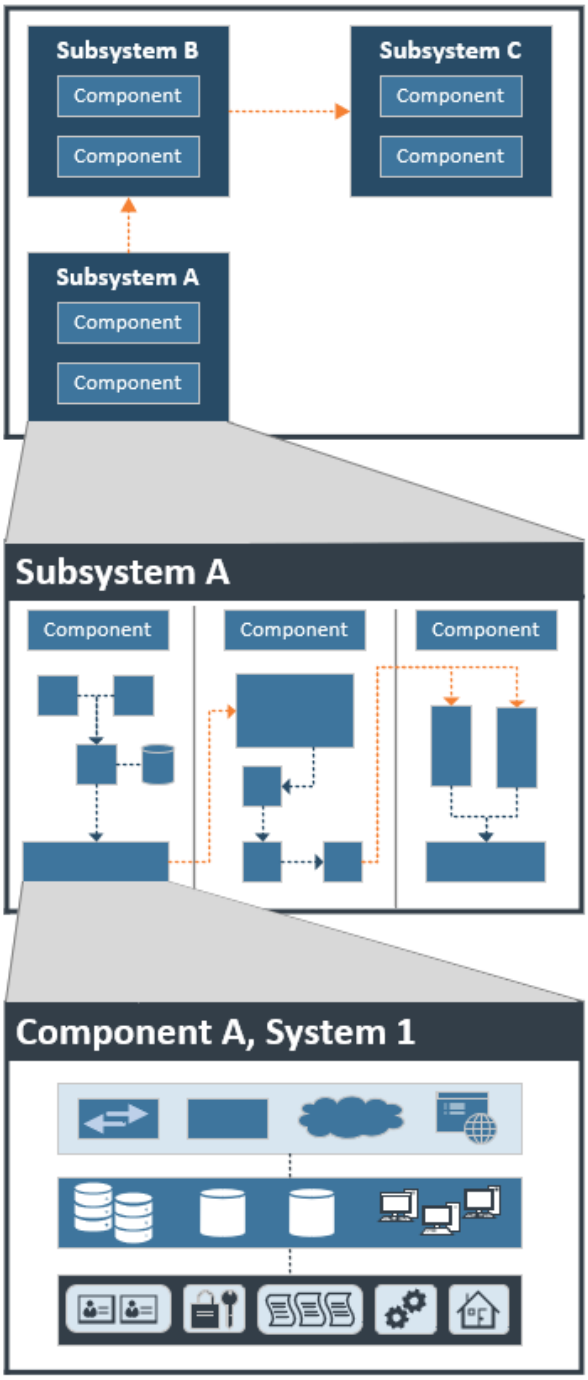
Key processes that will be used for the technical design, development, implementation and operations of the California Road Charge Demonstration project include:

- Identification and refinement of demonstration needs
- Development of operational concepts to satisfy each of the demonstration needs
- Development of systems architecture(s) to define each element of the system and how they interact with each other
- Business and systems analysis to derive business needs and design technical aspects of the project
- Development of technical documentation and components, using this SEMP as a guide
- Technical reviews of all technical documentation produced
- Risk identification, assessment, and mitigation
- System test, integration, and acceptance planning
- System validation and data security assessment

2.1 Demonstration Architecture

The architecture for the California Road Charge Demonstration project will be developed in three stages: Functional, systems, and technical.

Each stage of architecture will breakdown the system further to define subsystems, components, functionality and data flows. Figure 2 below depicts each architecture layer.



Functional Architecture

Defines key elements and functions of the system from a business perspective, through subsystem, component and interface definition.

Systems Architecture

Details the functionality within each subsystem's components and how data flows through the system.

Technical Architecture

Defines the technology stack and systematic components of a system. A technical architecture will be developed specifically for PRIME.

Figure 2: Demonstration Architecture Layers

2.1.1 Functional Architecture

A functional architecture will be developed to define the key elements, functions, and interfaces needed for the demonstration to operate in an efficient, standardized and repeatable way. The functional architecture will be created during the development of the Concept of Operations (ConOps) to establish the business and functional expectations for the system.

A preliminary functional architecture for the project has been developed as a starting point to drive ConOps discussions, as shown in Figure 3.

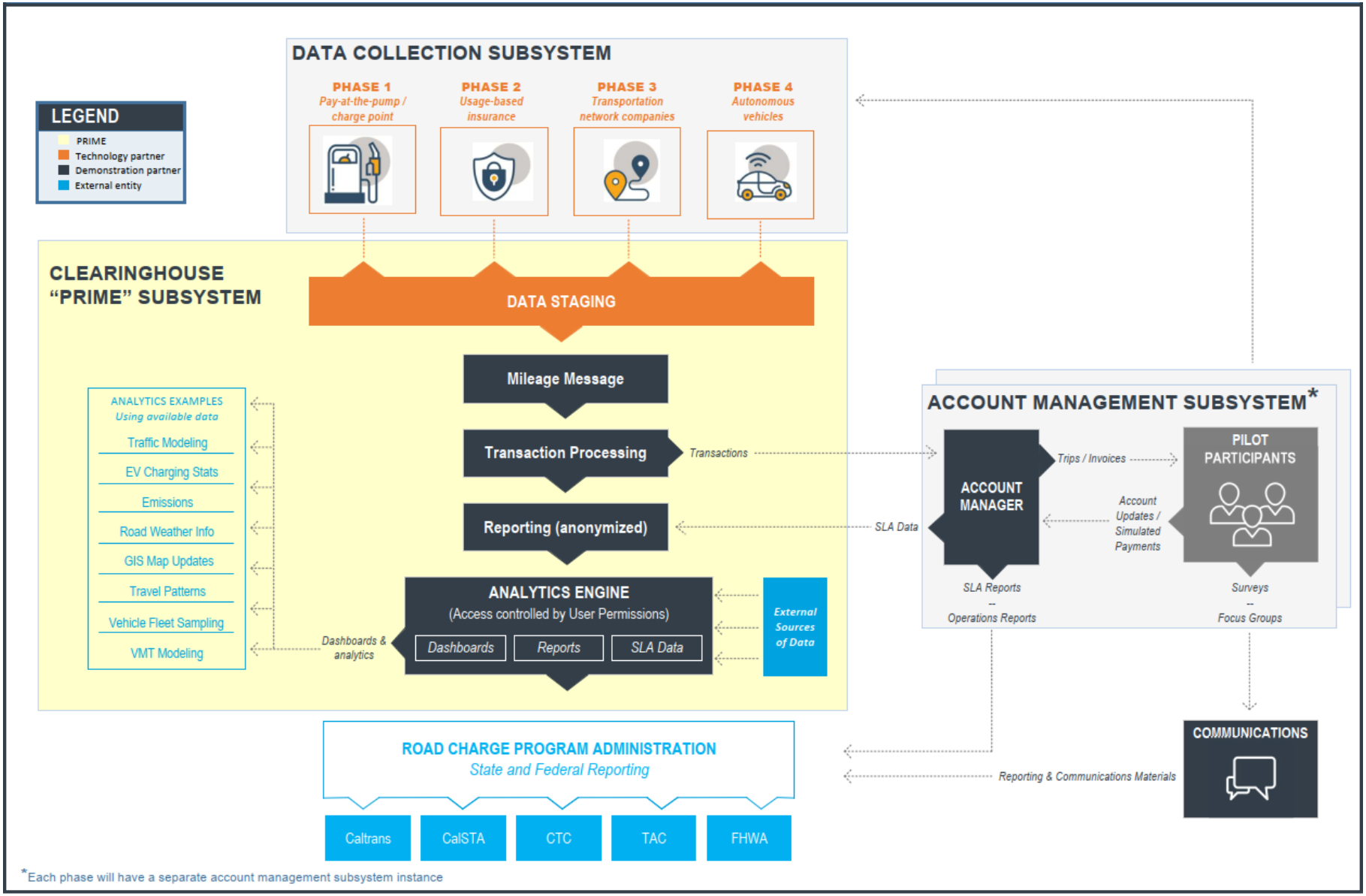


Figure 3: California Road Charge Demonstration Preliminary Functional Architecture

2.1.2 Systems Architecture

Following completion of the ConOps and approval of the functional architecture, a systems architecture will be developed to define the lower-level details of the key elements, functions and interfaces needed for the demonstration. The systems architecture breaks down each subsystem defined in the functional architecture to define how each subsystem's components are expected to function, demarcation points for data aggregation and/or transmission, and how information will flow through each major subsystem and component.

The systems architecture will be used to develop detailed business requirements, system requirements, and interface controls.

2.1.3 Technical Architecture

The development, implementation, and operations of the PRIME will be the direct responsibility of the project team. A technical architecture will be developed for the PRIME, to detail the technical and systematic components, such as:

- Database design and data modeling information
- Security protocols and configuration
- Communications protocols and configuration
- System access parameters

The PRIME technical architecture will be used to configure and maintain the PRIME, as well as for troubleshooting user and system issues.

2.2 Analysis and Design

Business and systems analysis will be conducted throughout the system lifecycle to continually evaluate how the solution is meeting business needs and system expectations. Business analysis, as defined by the Project Management Institute, is "the set of activities performed to support delivery of solutions that align to business objectives and provide continuous value to the organization."[1] Systems analysis will focus on how each system component is designed to meet business needs, and creates the technical blueprints for those designing, developing and operating the system to understand how the system is expected to function. The efforts conducted under business and systems analysis will result in a system design that meets expectations, confirms assumptions and produces a stable, reusable system.

[1] Project Management Institute, *The PMI Guide to Business Analysis*. (2018). Retrieved from https://www.pmi.org/pmbok-guide-standards/foundational/business-analysis

Business analysis processes, tools and techniques will be used to evaluate the system, ensuring that all business needs and objectives are being met, and that the system is designed without superfluous elements.

- Why does a certain component exist – what business need is it satisfying?
- Why is one component collecting a certain set of data over another?

Systems analysis processes, tools and techniques will be used to design components and functionality to specifically meet business needs, as outlined in the ConOps, requirements and other related technical documentation.

- How does one component collect the required data?
- How is a specific subsystem meeting industry standards for data security?

The key business and system analysis processes, tools and techniques that the technical team will use to design the system are detailed below.

2.2.1 Business Process Mapping

The technical team will conduct varying levels of business process mapping through the system lifecycle, such as the As-Is / To-Be business process mapping technique. As-Is / To-Be mapping and analysis will assist the technical team in evaluating the previous road charge technical documentation, determine where there are gaps and where changes may be needed to meet business needs and objectives. Business process mapping will help stakeholders visualize how the demonstration will be conducted.

2.2.2 Concept of Operations

A ConOps will be developed to define the California road charge demonstration system from various stakeholder points of view, such as the administrative entity (Caltrans), partners and technology providers, and users. The technical team will conduct a series of information gathering sessions, including evaluating previous California Road Charge Program technical documentation to capture demonstration project goals and objectives, system needs and assumptions.

Through development of the ConOps, the technical team will develop a high-level, initial design and architecture concept to aid design decision-making for the demonstration to best meet project business needs.

The ConOps will also document expected operational scenarios for each demonstration phase, as well as overarching demonstration processes (e.g. PRIME). The ConOps will be used as the starting point for the rest of the demonstration design, such as driving the development of the architecture and requirements.

2.2.3 Use Cases

Use cases detail how a particular process may operate, from the perspective of one or more of the system's users. Use cases help stakeholders visualize how the system will function, how data flows between its subsystems, and how each user type will interact with it. Developing and analyzing use cases will assist the technical team in identifying potential gaps or issues within the system design, and present a visualized representation of the system to users and stakeholders.

The technical team will develop system use cases based on the operational scenarios defined in the demonstration ConOps.

2.2.4 Requirements

Requirements will be developed to detail *what* the system must do, and *how* the system is expected to meet those needs. Business requirements will be the outcome of business analyses, focusing on how the system aligns with project objectives and stakeholder needs. System requirements will be the outcome of systems analyses and will focus on defining how the system will meet the business requirements.

The requirements for this project will be broken down to decompose the system into its individual components, so that the technical team can verify how each component functions on its own as well as how it interacts with other components.

The anticipated breakdown of requirements is as follows:

- Type (business or system)
    - Subsystem (e.g. data collection)
        - Component (e.g. data processing)
            - Function (e.g. aggregate data into logical transactions)
                - Requirement (e.g. If the data processing component receives data for multiple vehicles from one mileage reporting method, each vehicle's data shall be aggregated into separate transactions)

The business and system requirements will be developed with an "open system" concept in mind, promoting that the requirements allow for varying implementations of each component and subsystem, not restricting innovative approaches to system design. Requirements will focus on the concept *that* a component must perform a function more than exactly *how* that component must perform the function. This approach also allows the system to scale out, with subsystems and components able to interchange and 'break apart' based on business need.

To support the open system requirements, certain interfaces between subsystems or components will be standardized to enable data to flow through the system without reliance on proprietary protocols, promoting scalability and interoperability. The data set, format and communications protocols for these standardized interfaces will be outlined in an Interface Control Document.

Business and system requirements will comply with all applicable federal and state laws and industry standards.

2.2.5 Requirements Traceability Matrix

A requirements traceability matrix (RTM) will be created to map each requirement to one or more project needs or objectives. The RTM will also be used to track system verification (testing) and how each requirement is met in the ultimate system design and execution.

Each requirement will be assigned a unique identification number and include a form of verification (inspection, testing, deliverable). The verification matrix will also include a field for confirming compliance, or for noting issues or other notes related to final acceptance of each requirement.

2.3 System Development

Following system analysis and design, WSP and its technology partners will develop each component of the system.

2.3.1 Technology Partner Development

Technology partners will develop new or modify existing systems, subsystems, components and processes to support demonstration operations. All new or modified functionality must meet the requirements as defined by WSP and approved by Caltrans. The WSP project technical team ("technical team") will provide oversight and support to technology partners during the system development period to ensure that needs are being met and that any risks or issues are caught and mitigated early.

2.3.2 PRIME Data Warehouse Development

The technical team will develop the PRIME data warehouse to support data loading and unloading, processing, transformation, and reporting. The technical team will conduct, at minimum, the following development activities:

- **Data modeling and database (storage) design and development**: Defining how data should be decomposed into logical groupings for efficient processing, mapping data relationships, and creating the data storage and management structure itself.
- **Virtual warehouse design and development**: Defining and creating the mechanisms to provide front end data access and manipulation for data processing.
- **Query and view design and development**: Defining and creating the rules for handling, manipulating and parsing data to apply to virtual warehouse data processing.
- **Data loading and unloading design and development**: Defining how data can come in to PRIME for storage and processing and how data can go out of PRIME for further analyses, and establishing the protocols and configurations for data input and output.

- **Data sharing planning and configuration**: Defining how data can be shared, who it can be shared with, parameters and restrictions for sharing, and setting up the sharing connections.
- **System configuration and management**: Configuring the system to manage access, resource monitoring, usage controls, security, etc., as well as establishing procedures for monitoring and managing system configurations.

2.4 System Verification and Validation

All systems, technologies, and processes that will be used during the demonstration will be tested prior to launch. Testing will include:

- **Unit Testing:** Detailed testing of each individual component to make sure it meets all requirements.
- **Integration Testing:** How components work together and are able to communicate with each other.
- **Acceptance Testing:** Comprehensive, end-to-end verification of the systems and processes that will be in place for the demonstration.
- **Demonstration Dry Run:** Full end-to-end systems dry run with the project team to validate the onboarding, scheduling, operations, transaction processing, invoicing, reporting, and data analytics for each of the four phases.
- **Data Security Assessment:** Validation that all systems and interfaces are using industry standards for security and data privacy.

A comprehensive test plan will be created and maintained, detailing the demonstration testing strategy, methodology, test stages, roles & responsibilities, and test scenarios. The test scenarios will simulate operational expectations for each demonstration phase, and will be used as the base for unit, integration, and acceptance test scripts. All test scripts will be clearly traced back to requirements and business rules through the Requirements Traceability Matrix (RTM).

The technical team, in concert with the technology providers, will conduct testing of each demonstration phase individually to ensure the goals of the specific phase are being met. The team will then test the overall systems integration, validating that disparate data collection methods can be integrated into a single, seamless platform to support data analytics and dashboarding efforts. The testing will culminate in the overall Acceptance Test which will test the entire end-to-end functionality. The successful completion of each progressive test stage will serve as the entry criteria for the next stage. Only when all tests are successfully executed and Caltrans has signed off on test results will the systems, technologies, and processes for the demonstration be considered ready for launch.

2.4.1 Certification Test Plan

A certification test plan will be developed that outlines the methodology and strategy used for evaluating all systems, processes, and interfaces needed to operate the demonstration, to ensure alignment with requirements. The certification test plan will include details for each test stage (including test cases and evaluation criteria), testing roles and responsibilities, exit criteria for

each stage of testing, and any potential risks and mitigation strategies. The certification test plan will follow objectives and requirements outlined in the project scope, as well as industry best practices and standards.

WSP and the technology providers will establish dedicated test environments for conducting all test activities.

Following development and approval of the certification test plan, the technical team will conduct two steps of system testing: verification and validation.

The distinction between the two terms is largely to do with the role of specifications. Validation is the process of checking whether the specification captures the project's needs, while verification is the process of checking that the system meets the specification. The sections below define the activities and requirements of the verification and validation steps of project testing.

2.4.2 System Verification

Once systems are prepared to meet the needs of the demonstration, the technical team and the technology providers will conduct system verification to confirm all components and interfaces within the system meets system needs as defined in the requirements.

2.4.2.1 Unit Testing

The technical team and technology providers will conduct unit testing of any systems and processes to be used during the demonstration, necessary to prove compliance with all requirements in the requirements documents. Unit testing will include data collection, transaction processing, account management, reporting and simulated financial reconciliation.

The technical team and technology providers will document unit testing results of each component and how it meets related requirements, documented in the RTM. The technical team will review documented unit testing results in the RTM to verify that all requirements are met through verified testing of one or more system components.

2.4.2.2 Integration Testing

The technical team and technology providers will conduct integration testing of all demonstration interfaces. Integration testing will include generating each of the required reports, validating the format of each report, and transmitting each report to the appropriate repository or partner, as defined in the requirements documents. The technical team will coordinate integration testing activities with each technology provider to ensure the proper systems, interfaces, protocols and formats are used to verify interface connectivity and compliance with requirements.

2.4.2.3 Initial System Acceptance Testing

Following successful completion of unit and integration testing, the technical team and technology providers will conduct systems acceptance testing of all systems, interfaces and processes to be used during demonstration operations. The systems acceptance test will include

a short, simulated real-world test, verifying that all individual components and interfaces interact properly with one another as expected and defined in the requirements.

2.4.2.4 Punchlists

In the event a test is not successfully executed, or a requirement is not fully met through one or more tests, the technical team will evaluate the level of criticality the item has on the remainder of testing and ultimately demonstration operations launch. If an item is not critical to overall operation of the system, the technical team will flag the item as "punchlisted", allowing the progression of testing without fully completing the stage the item was flagged in. All punchlisted items will be reviewed with Caltrans at time of assignment to the punchlist, and will be reviewed on regular check-ins with Caltrans and with technology providers to evaluate the progress of further testing to move the item into compliance.

2.4.2.5 Data Security Assessment

Data security assessments will be conducted during the testing phase of the project to ensure that Personally Identifiable Information (PII) is protected, data is encrypted and secure both in transit and at rest, and that the integrity of data is being upheld through the entire process. The technical team will conduct a data security audit of all systems to validate the demonstration systems are compliant with the latest security standards including: ISO 27001, PCI DSS 3.2, and NIST 800-53 (where applicable). The technical team will compile a list of audit criteria, validate the security processes and protocols in place, and conduct penetration testing where appropriate, and documented in a Data Security Audit Report.

2.4.3 System Validation

Following successful completion of all system verification activities, the technical team will conduct system validation to confirm at an end-to-end level that the system meets customer needs.

Once the system is ready for Caltrans acceptance, and before the launch of the demonstration, the project team will conduct a 2-week end-to-end Dry Run test of the demonstration. The Dry Run will validate every operational and administrative scenario expected from the demonstration and documented in the ConOps, requirements, and plans. The Dry Run will validate the onboarding, scheduling, operations, transaction processing, invoicing, reporting, and data analytics for each of the four phases. The project team will select a group of test participants, focused on one unique phase each, and then coordinate with each technology provider to launch the testing of each phase simultaneously to ensure that every phase is ready to launch. At the end of the Dry Run, the technical team will compile the results, identify any encountered issues, and then conduct a "hot wash" with all participants and vendors to discuss outstanding issues, proposed changes and updates, and the potential impacts of any changes.

The Dry Run is the final step to validate the system is ready to launch into demonstration operations.

2.5 System Quality Assurance and Control

The project team will execute quality assurance and quality control principles and processes to ensure that quality is built-in to technical tasks and deliverables from the beginning, and that any defects or issues are caught and mitigated early in the process. Three key processes will be used to manage quality of technical aspects of the project – risk management, technical reviews, and change management.

2.5.1 Risk Management

The objective of risk management is to develop and maintain a registry of program and project risks, and to develop mitigation measures for these risks. Proper use of risk analysis and management processes will help the project team identify technical risks and potential issues early and often, and develop mitigation strategies to resolve or transfer the risks as soon as they arise. Risk analysis and management will be structured in two phases:

- Risk analysis, which involves the identification, definition, estimation and assessment of risks; and
- Risk management, which covers the activities involved in the planning, monitoring and controlling of actions which will address the threats and problems identified, to improve the likelihood of the project achieving its stated objectives.

Technical risk management will follow the approved risk management process defined in Section 4.5 of the California Road Charge Demonstration Project Management Plan.

2.5.2 Technical Reviews

Technical reviews provide an additional layer of quality to technical deliverables, ensuring experts beyond those that developed the deliverable review to catch potential errors and to add an additional lens of technical expertise. Technical reviews will be conducted on all technical deliverables and artifacts developed for the project, including those submitted by technology providers (e.g. Unit Testing) to ensure accuracy, quality and applicability. Technical reviewers will be identified during the drafting of each technical deliverable, and will include at least one subject matter expert on the deliverable topic, and may also include other technical WSP staff, the project manager, the technical manager, and/or the demonstration lead.

2.5.3 Change Management

Change management represents the process of assessing impacts of potential changes to a system. It provides a mechanism for evaluating the comprehensive effects of potential changes to a design or system. The process provides a control for changes and minimizes negative impacts to a system as a result of changes. In the event changes are required to technical deliverables and artifacts, either by identification of defect or requested change by Caltrans or key stakeholders, the changes will follow the approved change management process defined in Section 4.6 of the California Road Charge Demonstration Project Management Plan.

3. System Implementation and Operations

Once all systems are successfully verified and validated, the project team will coordinate with Caltrans, technology providers and delivery providers to implement and operate the demonstration.

3.1 Implementation

In preparation for launching and operating all phases of the demonstration, WSP will develop comprehensive implementation and operations plans that details how WSP and its partners will prepare for, implement, and operate the demonstration.

3.1.1 Implementation Plan

The Implementation Plan will outline technology provider setup and configuration steps and expectations, participant recruitment and onboarding procedures, customer service and support information, communication and coordination protocols, and a detailed schedule of all testing, implementation, and initial operations activities. An implementation checklist will also be developed, to track the execution of the Implementation Plan and schedule, validate critical tasks such as clearing systems of test data, publish demonstration websites, and initialize the call center.

3.1.2 Operations Plan

The operations plan will detail how WSP and its partners will operate each phase of the demonstration, with roles and responsibilities of all participating entities, communications activities such as surveys and focus groups that will be conducted during the demonstration, and how data will be secure and protected throughout the demonstration.

3.1.3 Demonstration Launch

Following completion of the Dry Run, the technical team will perform the tasks necessary to prepare all systems, components, interfaces and processes to launch and operate the demonstration. The implementation checklist defined as part of the Implementation Plan will guide demonstration launch activities.

Each phase of the demonstration may launch at different times. The implementation checklist will be reused for launching each phase of the demonstration, updated with any revisions based on lessons learned from previous phase launches.

3.2 Operations

Throughout demonstration operations, all systems, components and interfaces will be monitored for compliance with requirements and demonstration expectations. WSP will provide Caltrans monthly demonstration operations reports, to include the following data points for all phases of the demonstration:

- Current Activity Status
- Upcoming Activities
- Call Center Activity and Metrics
- Monthly Operations Report Submission Status and Date
- Fault Log Item Status
- System Downtime (if any) and Resolution Path – Scheduled Maintenance and Unanticipated
- Requirements Compliance Status (RTM counts of compliant, non-compliant, punchlist)

3.2.1 PRIME

The technical team will also operate the PRIME data analytics platform throughout the entirety of the demonstration, providing real-time dashboards to highlight ways road charge data can support operational planning and transportation network improvements. The technical team will perform data warehouse maintenance and updates as needed, and will provide monthly database summary reports.

3.2.2 Operations Closeout

Following completion of the 6-month demonstration operations period, technology providers will perform demonstration operations closeout activities to terminate data collection, transaction processing, account management, reporting and simulated financial reconciliation activities specific to demonstration operations. Any data collected specifically for the demonstration that contains personally-identifiable information will be purged from technology providers' systems within one month of demonstration operations completion, as defined in contract.

The technical team will coordinate closely with all technology providers to ensure these closeout activities are successfully completed. WSP will also coordinate with Caltrans to determine how best to handle data management, retention and purging for data residing in PRIME for analytics purposes.