

Connected Vehicle Pilot Deployment Program Independent Evaluation:

Financial Evaluation Plan

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Research Report – May 23, 2018
FHWA-JPO-18-673



U.S. Department of Transportation

Produced by Texas A&M Transportation Institute
U.S. Department of Transportation
Office of the Assistant Secretary for Research and Technology
Intelligent Transportation Systems (ITS) Joint Program Office

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Technical Report Documentation Page

1. Report No. FHWA-JPO-18-673		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Connected Vehicle Pilot Deployment Program Independent Evaluation: Financial Evaluation Plan				5. Report Date May 23,2018	
				6. Performing Organization Code	
7. Author(s) Philip Quebe (Cadmus Group), Kevin Balke (TTI), Beverly Storey (TTI), Johanna Zmud (TTI)				8. Performing Organization Report No.	
9. Performing Organization Name and Address Texas A&M Transportation Institute Texas A&M University System 3135 TAMU College Station, TX 77843-3135				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. DTFH6116D00045	
12. Sponsoring Agency Name and Address US Department of Transportation ITS Joint Program Office 1200 New Jersey Avenue, SE Washington, DC 20590				13. Type of Report and Period Covered Research Report	
				14. Sponsoring Agency Code	
15. Supplementary Notes Work Performed for Walter During (FHWA) and Angela Jacobs (FHWA)					
16. Abstract This report presents the analysis plan that the TTI CVPD Evaluation Team will use to conduct the financial evaluation of the Connected Vehicle Pilot Deployments. The purpose of the financial evaluation is to assess the changes in the financial settings, frameworks, models, elements and associated impacts from the planned and implemented CV deployments. This plan describes the framework that the TTI CVPD plans to use for evaluating the likelihood that each pilot site achieves financial sustainability, including identifying the key factors that influence financial sustainability and identifying key metrics for measuring and evaluating the achievement of financial sustainability. The plan also describes the process the Team will use to determine the condition at each pilot site for each financial factor identified, and evaluate the likelihood of each pilot site achieving financial sustainability based on each site's financial and business projections. The Team also plans to conduct periodical re-evaluations as to the likelihood of each pilot site achieving or maintaining financial sustainability due to changes in the underlying financial and business inputs.					
17. Keywords Connected Vehicle Pilot Deployment, Independent Evaluation, Financial, Evaluation Plan			18. Distribution Statement		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 36	22. Price

Acknowledgments

The authors would like to thank the following individuals for their assistance in developing this plan in support of the independent evaluation of the Connected Vehicle Pilot Deployment Program:

- Walter During, FHWA.
- Angela Jacobs, FHWA.
- Kate Hartman, ITS JPO.
- John Halkias, FHWA.
- Gabriel Guevara, FHWA.
- Jonathan Walker, ITS JPO.
- Govindarajan Vadakpat, FHWA.
- Douglas Laird, FHWA.
- Jimmy Chu, FHWA.
- Ariel Gold, ITS JPO.
- Tom Kearney, FHWA.
- James Colyar, FHWA.
- Robert Sheehan, ITS JPO.
- James Sturrock, FHWA.
- Marcia Pincus, ITS JPO.
- Volker Fessmann, FHWA.
- Emily Nodine, Volpe.
- Margaret Petrella, Volpe.
- Wassim Najm, Volpe.
- Karl Wunderlich, Noblis.
- Meenakshy Vasudevan, Noblis.
- Sampson Asare, Noblis.
- Kathy Thompson, Noblis.
- Peiwei Wang, Noblis.

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Chapter 1. Introduction

This task assesses the changes in the financial settings, frameworks, models, elements, and associated impacts from the planned and implemented connected vehicle (CV) deployments. An important aspect of this evaluation is to assess the likelihood of each pilot site achieving financial sustainability based on the planned and implemented deployments.

The objectives of this evaluation are to:

1. Develop a framework for evaluating the likelihood that each pilot site achieves financial sustainability, including identifying the key factors that impact financial sustainability and identifying key metrics for measuring and evaluating the achievement of financial sustainability.
2. Determine the condition at each pilot site for each financial factor identified.
3. Evaluate the likelihood of each pilot site achieving financial sustainability based on each site's financial and business projections.
4. Periodically re-evaluate the likelihood of each pilot site achieving or maintaining financial sustainability due to changes in the underlying financial and business inputs.

For the purposes of these objectives, the Texas A&M Transportation Institute (TTI) Connected Vehicle Pilot Deployment (CVPD) Evaluation Team defines financial sustainability as achieving net revenues sufficient to operate and maintain the CV applications over a seven-year period without additional CV federal grant money after the pilot deployment program ends at each site.

1.1 Summary of the Pilot Deployments

The following provides a brief summary of each of the CVPDs.

1.1.1 Tampa Connected Vehicle Pilot Deployment

The goal of the Tampa CVPD is to transform the experience of automobile travelers, transit riders, and pedestrian by preventing crashes, enhancing traffic flow, improving transit trip times, and reducing emissions of greenhouse gases in the downtown Tampa area (1). The Tampa Hillsborough Expressway Authority (THEA) and its partner entities will be equipping buses, streetcars, and privately owned vehicles with CV technologies that will allow them to exchange basic safety messages and travel condition information with each other and with the infrastructure, which the receiving vehicles use to generate alerts/warnings as necessary. The objectives of the Tampa CVPD are to:

- Reduce morning peak-hour delays and rear-end crashes on the Lee Roy Selmon Expressway's Reversible Express Lane (REL) exit to downtown Tampa.
- Reduce vehicle/pedestrian conflicts at a busy mid-block crosswalk near the Hillsborough County Courthouse.

- Support traffic signal optimization on commuting corridors in downtown Tampa.
- Enhance transit signal priority in the Marion Street Transitway.
- Reduce vehicle and pedestrian conflicts with the TECO Streetcar line in downtown Tampa.

Figure 1 shows the corridors where THEA plans to deploy CV technologies in the downtown areas.

To support these objectives, THEA will be deploying the following applications as part of their CVPD (1):

- **End of Ramp Deceleration Warning** – This application warns drivers to slow down to a recommended speed as the vehicle approaches the end of a queue.
- **Wrong Way Entry** – This application warns drivers that enter the REL from the wrong direction. The application will also broadcast a warning to other equipped vehicles on the REL to be alert for wrong-way vehicles.
- **Mobile Accessible Pedestrian Signal System** – This application allows pedestrians equipped with a smartphone application approaching a crosswalk at a signalized intersection to request service from the traffic signal.
- **Pedestrian in a Signalized Crosswalk Vehicle Warning** – This application identifies potential conflicts between pedestrians in a crosswalk and approaching vehicles.
- **Pedestrian Collision Warning** – This application warns the driver when a pedestrian is using a crosswalk in the vehicle's projected path.
- **Pedestrian Transit Movement Warning** – This application warns pedestrians when a bus or streetcar is starting up or stopping at a nearby intersection.
- **Vehicle Turning Right in Front of Transit Vehicle** – This application alerts a streetcar operator when a vehicle is turning right at an intersection as the streetcar is approaching.
- **Intelligent Signal System** – This application optimizes traffic signal timing based on real-time CV data.
- **Transit Signal Priority** – This application gives buses priority at traffic signals to keep them running on schedule.
- **Forward Collision Warning** – This application warns drivers when a forward collision is imminent.
- **Emergency Electronic Brake Light Warning** – This application alerts drivers when vehicles ahead are braking hard.
- **Intersection Movement Assist** – This application warns drivers when it is not safe to enter an intersection.
- **Probe data Enabled Traffic Monitoring** – This application gathers traffic data from collected vehicles in real-time and provides the data to traffic managers to assist in optimizing traffic flow.

In the Tampa CVPD, THEA plans to deploy CV technologies in 1600 privately owned vehicles, 10 buses, and 10 streetcars. THEA also plans to install 40 roadside units at strategic locations in the downtown area to support the CV applications (1).



Source: (*Tampa Connected Vehicle Pilot*. Website. Available at <https://www.tampacvpilot.com>. Accessed August 13, 2017)

Figure 1. The Tampa CVPD deployment corridors.

1.1.2 New York City Connected Vehicle Pilot Deployment

The focus of the New York City CVPD is to improve the safety of travelers and pedestrians in support of the city's Vision Zero Initiative (3). Led by the New York City Department of Transportation, the goal of the pilot is to reduce crash frequency and severity, manage vehicle speeds, and assess the potential for deploying CV technologies in a dense urban environment. As shown in Figure 2, the deployment area encompasses three distinct areas in the boroughs of Manhattan and Brooklyn:

- A 4-mile segment of Franklin D. Roosevelt (FDR) Drive on the Upper East Side and East Harlem neighborhoods of Manhattan.
- Four one-way corridors (1st, 2nd, 5th, and 6th Avenues from 14th to 57th Streets).
- A 1.6-mile segment of Flatbush Ave in Brooklyn.



Source: (FHWA Connected Vehicle Pilot Deployment (CV Pilots) Program. NYC CV Pilot Deployment Presentation 9.30.2015. Available at https://www.its.dot.gov/pilots/pdf/02_CVPilots_NYC.pdf. Accessed August 13, 2017).

Figure 2. NYC CVPD deployment corridors

The NYC CVPD will support the following specific vehicle-to-vehicle (V2V) and vehicle-to-infrastructure applications (3):

- **Forward Crash Warning** – This application alerts drivers in the event of an imminent rear-end crash with a remote vehicle ahead.
- **Emergency Electronic Brake Lights** – This application alerts drivers of stopped or hard-breaking vehicles ahead of time to avoid a crash safely.
- **Blind Spot Warning** – This application alerts drivers when a remote vehicle is traveling in the adjacent lane near the CV and issues an alert to avoid sideswipe crashes.
- **Lane Changing Warning** – Similar to the Blind Spot Warning application, this application alerts drivers to conduct a lane change when another vehicle is in the adjacent lane in the same direction of travel.
- **Intersection Movement Assist** – This application alerts the driver attempting to cross or turn when it is not safe to enter the intersection.
- **Vehicle Turning Right in Front of Bus Warning** – This application alerts a bus operator if a remote vehicle attempts to pull in front of the bus to make a right turn.
- **Speed Compliance** – This application alerts drivers when they exceed the posted regulatory speed limit.

- **Curve Speed Compliance** – This application alerts drivers that are approaching a curve that they are exceeding the recommended advisory speed.
- **Speed Compliance in Work Zones** – This application alerts drivers that they are exceeding the regulatory speed limit of a designated work zone.
- **Red Light Violation Warning** – This application provides an alert to the driver of impending red-light violations.
- **Oversize Vehicle Compliance** – This application alerts commercial vehicle operators when their vehicle exceeds the height-restriction of roadway infrastructures, such as bridge or tunnel clearances.
- **Emergency Communications and Evacuation Information** – This application provides alerts to drivers of travel and evacuation information during emergency events.
- **Pedestrian in Signalized Crosswalk** – This application alerts drivers to the presence of pedestrians crossing at a signalized intersection.
- **Mobile Accessible Pedestrian Signal System** – This application informs a visually impaired or audibly impaired pedestrian of the signal status and provides orientation to the crosswalk to assist in crossing the street.

In addition to testing these applications, equipped vehicles will integrate with existing infrastructure detection to provide information to New York City's Midtown in Motion adaptive traffic signal system.

The New York City CVPD will be deploying CV technologies in up to 8,000 vehicles, including 5,850 taxis, 700 MTA buses, 400 UPS fleet vehicles, 800 New York City Department of Transportation (NYCDOT) fleet vehicles, and 250 Department of Sanitation fleet vehicles. NYCDOT also plans to install roadside units at approximately 310 signalized intersections, eight on FDR Drive, and 36 support locations (such as river crossing, airports, vehicle garages, etc.) throughout the city (3).

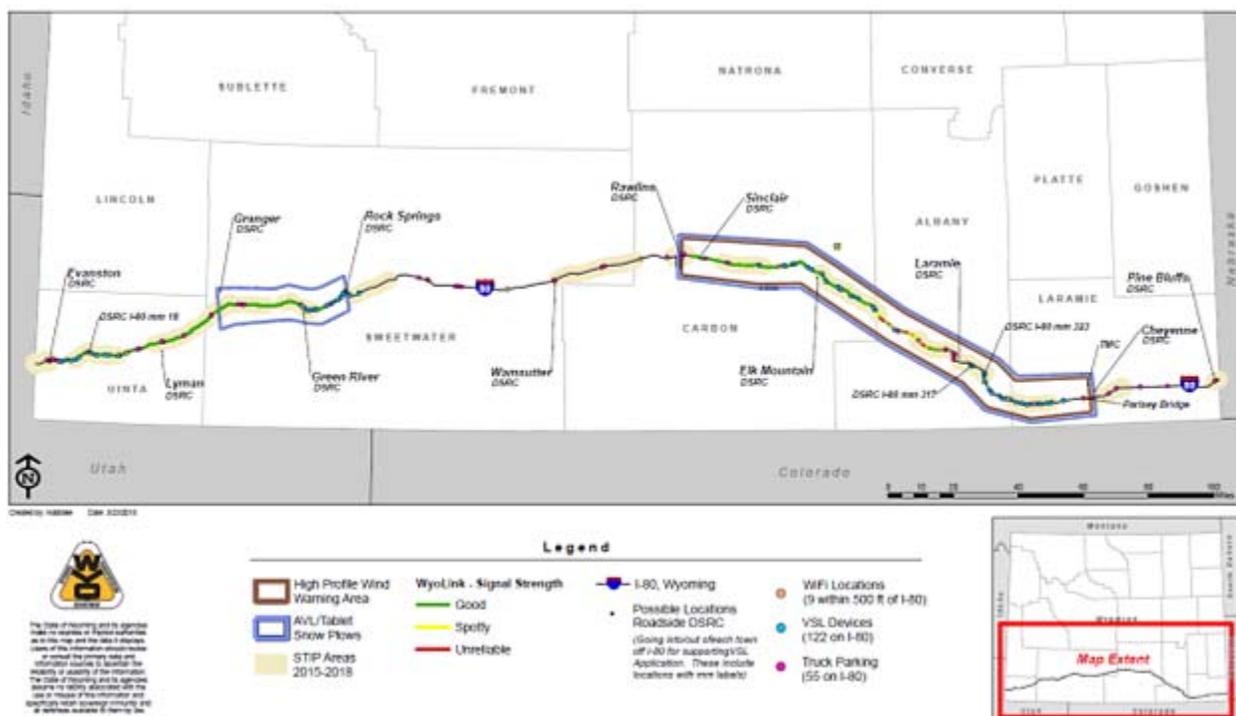
1.1.3 Wyoming Connected Vehicle Pilot Deployment

The goal of the Wyoming CVPD is to improve driver safety, particularly for commercial vehicle operators, on I-80 (5). I-80, which runs the entire length of the southern edge of the state, is susceptible to multivehicle collisions and roadway closures during winter weather due to icy roads and low visibility from blizzard conditions. These events can result in fatalities, extended closures, and significant economic loss. The Wyoming CVPD includes a variety of applications to support a range of existing and new services, including traveler information, roadside alerts, and dynamic travel guidance for freight and passenger travel. These applications include the following (5):

- **Forward Collision Warning** -- Using V2V communications, this application issues warning to drivers if another CV ahead is going in the same travel lane and direction. This application will help drivers avoid front-to-rear vehicle collisions by detecting when other vehicles are stopped or moving slowly ahead of the vehicle.
- **Infrastructure-to-Vehicle (I2V) Situational Awareness** – This application allows CVs to receive information about downstream conditions that may affect their travel. This application would provide drivers with information about downstream road conditions, weather alerts, speed restrictions vehicle restrictions, incidents, parking, and road closures.

- **Work Zone Warning** – This application extends the I2V Situational Awareness application to provide information to vehicles approaching work zones. The approaching CV will receive information about work zone conditions, including obstructions in the travel lane, lane closures, lane shifts, speed reductions, and vehicle entering and exiting work zones.
- **Spot Weather Impact Warning** – This application broadcasts localized road condition information to drivers. The purpose of this application is to alert drivers of fog and icy roads that may exist only at isolated locations on I-80.
- **Distress Notification** – This application enables CVs to communicate a distress message if the vehicle’s sensors detect an event that might require assistance from others or if the driver initiates a distress request.

To support this pilot, Wyoming Department of Transportation (WyDOT) is deploying 75 roadside units in various sections of I-80 that can receive and broadcast messages using dedicated short range communication. WyDOT will install these roadside units at locations upstream of identified hotspot areas. Through their collaboration partners, WyDOT will also equip 400 vehicles that regularly use I-80 with onboard equipment designed to provide CV information and to receive alerts and advisories issued by WyDOT. A portion of the equipped vehicles will have additional capabilities to collect and transmit environmental and road weather conditions information through mobile weather sensors (5). Figure 3 shows the deployment corridor.



Source: *Connected Vehicle Pilot Deployment Program: Wyoming (WY) DOT Pilot*. Web Site. Available at https://www.its.dot.gov/pilots/pilots_wydot.htm. Accessed August 13, 2017).

Figure 3. Wyoming CVPD deployment area

1.2 Coordination with CVPD Deployment Teams

Coordination with the local site deployment teams is critical in the collecting and analyzing financial and institutional information. As part of the Task B #0003, the TTI CVPD Evaluation Team is developing interview guides and survey instruments to collect financial, institutional, and stakeholder acceptance information from stakeholders. The TTI CVPD Evaluation Team is developing procedures and protocols that are sensitive to the needs and requirements of the local partners. The TTI CVPD Evaluation Team will coordinate the collection of financial and institutional information from the sites. The TTI CVPD Evaluation Team will work with the local site deployment teams to identify key personnel and stakeholders to participate in the surveys and interviews. The TTI CVPD Evaluation Team will coordinate meeting and workshop times and locations across the local sites to minimize the time commitment required by the local partners. The TTI CVPD Evaluation Team will establish and follow rules approved the Texas A&M University Institutional Review Board to ensure that personally identification information is protected at all times.

1.3 Organization of Report

The TTI CVPD Evaluation Teams has organized this report as follows:

- Chapter 2 provides a brief overview of the process that the TTI CVPD Evaluation Team will follow to conduct the planned assessment of the financial and economic sustainability of each of the CVPD sites.
- Chapter 3 identifies the factors that could influence the financial outcomes of the pilot deployments. This chapter also discusses the evaluation criteria that the TTI CVPD Evaluation Team will use in the assessment.
- Chapter 4 describes the approach that the TTI CVPD Evaluation Teams will use to develop the analytical model for assessing the financial sustainability of each deployment.
- Chapter 5 provides an overview of the information and data that will be required of each pilot site to conduct the financial evaluation, as well as how the TTI CVPD will collect it.
- Chapter 6 describes that process that the TTI CVPD Evaluation Team will use to analyze and report the findings of the financial evaluation.
- Chapter 7 lists the references that the TTI CVPD Evaluation Team used in preparing this report.

Chapter 2. Overview of Process

This chapter provides an overview of the process that the TTI CVPD Evaluation Team will use to complete the Financial Evaluation for each site.

2.1 Analysis Approach

The TTI CVPD Evaluation Team proposes a four-step process to meeting the objectives of this task. Figure 4 illustrates the four-step process that the TTI CVPD Evaluation Team will use to perform the financial analysis for each of the deployment sites.

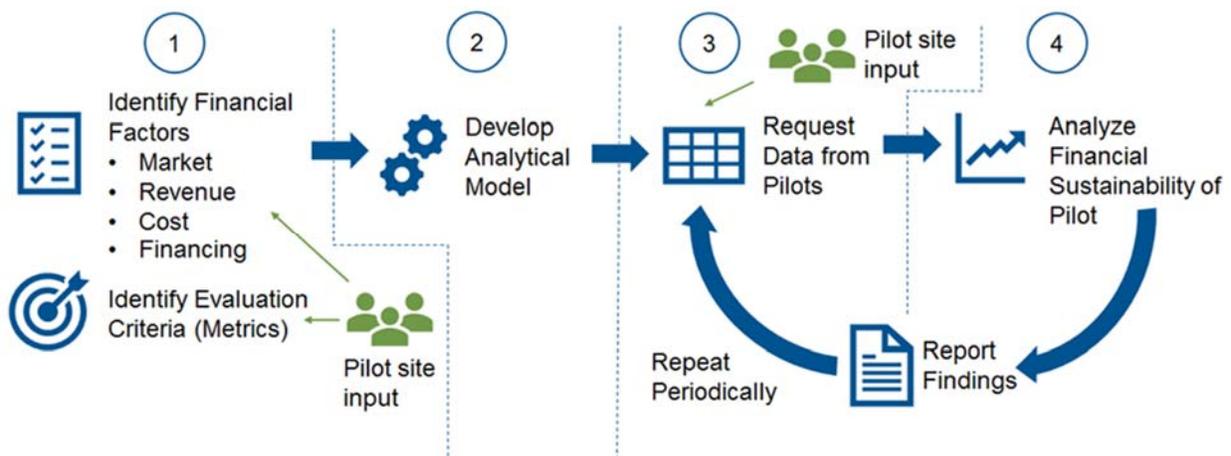


Figure 4. Four-step process for achieving project objectives

The steps in the process are as follows:

- **Step 1.** The first step is to identify the factors that impact financial sustainability and to formalize the evaluation metrics that will be used to determine if financial sustainability has been achieved. The pilot sites will be asked to provide input for this step.
- **Step 2.** The second step is the development of an analytical model that will take the financial factor inputs and produce output metrics that measure financial sustainability.
- **Step 3.** The third step will be a data request to the pilot sites for detailed financial information, based on the factors identified in Step 1.
- **Step 4.** The fourth step will be to analyze the data provided by the pilot sites using the analytical model and to report the findings.

Since the objectives of the task include a periodic re-evaluation of the financial sustainability of the pilot sites, Steps 3 and 4 will be repeated at pre-determined intervals. The following chapters of the Financial

Evaluation Plan provide a detailed discussion of the four steps, with each chapter (Chapters 3 through 6) corresponding to a step in the process.

2.2 Task List and Schedule

This section provides a timeline for the proposed tasks. Some aspects of the schedule are tied to the pilot project phases and will need to be flexible to accommodate changes in the phase timelines:

- Step 1: Identification of Factors and Evaluation Criteria – **April 2018.**
- Step 2: Development of the Analytical Model – **May 2018–July 2018.**
- Step 3: Data Collection – **Duration: 1 month, beginning at the conclusion of each pilot site’s Phase II.**
- Step 4: Analysis and Reporting – **Duration: 2 months from the conclusion of data collection.**
- Subsequent Evaluation (Corresponding to pilot implementation Phase III).
 - Repeat Step 3: Data Collection – **Duration: 1 month, beginning 3 to 6 months prior to the conclusion of each pilot site’s Phase III.**
 - Repeat Step 4: Analysis and Reporting – **Duration: 2 months from the conclusion of data collection.**

Chapter 3. Identification of Factors and Evaluation Criteria

The first step in assessing financial sustainability is to identify the factors that could affect the financial outcomes of the pilot projects. This section of the plan contains an initial list of potential financial factors that influence or are influenced by the CV pilots and could impact financial sustainability. This section also describes the process for obtaining input by the CV pilots on the list of factors.

3.1 Identification of Potential Financial Factors

Potential financial factors have been grouped into four key areas: Market Factors, Revenue Sources, Capital and Operating Costs, and Funding and Financing Options.

3.1.1 Market Factors

A market factor is an external agent or condition that influences or drives demand for a good or service. Market factors determine the magnitude of many of the cost and revenue values that are critical to the functionality of the financial evaluation model discussed below in Chapter 4.

Market factors can be divided into two categories: primary factors and secondary factors. Primary factors directly impact the revenue or costs associated with a project. Secondary factors influence (positively or negatively) primary factors, and therefore indirectly impact revenues and costs. An example helps illustrate the distinction between primary and secondary factors. A pilot site might incur a unit cost (financial impact) when installing equipment in a participating vehicle. Determining the total cost of equipment installations in a given year requires a projection of how many vehicles are likely to participate in the program. In this case, projected participation is a primary market factor. A related secondary market factor might be the existence of a law or an incentive, which increases participation in the program. The incentive (a secondary factor) drives participation (a primary factor), which in turn drives program cost.

Primary market factors will be considered quantitatively as direct inputs into the evaluation model. Secondary market factors will be considered only qualitatively for their potential impacts on primary market factors.

Table 1 provides an initial list of potential primary market factors, while Table 2 lists secondary market factors for consideration by the pilot sites.

Table 1. Description of primary market factors

Primary Factors	Description
Technology Adoption	The rate at which a certain technology is adopted in the marketplace. Could be measured in installations, vehicles, etc.
Participation	The number of participants in the pilot program. Might be measured in people, vehicles, organizations, etc.
Usage	How often or how much the pilot program is used. Might be measured in vehicle miles traveled, number of trips, etc.

Table 2. Description of secondary market factors

Secondary Factors	Description
City or State Laws	A city or state law that mandates technology adoption, participation, or usage related to the pilot. This could take the form of a universal mandate, percentage quotas, or some other form of requirement.
Voluntary Commitments	Similar to city or state laws, but voluntary. May take the form of voluntary standards, public commitments, etc.
Incentives	Incentives can vary widely from preferred tax treatment, rebates, reductions in fees and other monetary incentives, to preferential treatment such as HOV exemptions.
Restrictions/Penalties/Fees	The opposite of incentives. Penalties and fees can take the form of monetary assessments, additional requirements, or limitations on usage or access. An example would be a fee assessed on non-participants.

3.1.2 Revenue Sources

Revenue is broadly defined as “the income produced by a given source or the gross income returned by an investment” (11). In other words, revenue is a measure of the amount of money that an organization receives in exchange for the sales of goods or services, licensing fees, and interest on investments, etc. For a project to be independently financially sustainable, it must, at a minimum, cover its costs through revenue generation.

Table 3 provides an initial list of potential revenue sources for consideration by the pilot sites.

Table 3. Description of revenue factors

Factors	Description
Taxes	Gas tax, local taxes, etc.
Fees	Registration fee, participation fee, non-participation fee, usage fee, equipment rental fee. Can be one-time or reoccurring.
Tolls	Usage toll.
Value-added Services	Pay for access, pay for service, or pay for information. Could be monthly or on-demand.
Monetization of Data	Sales of data or subsequent analysis to interested parties such as equipment providers, planners, transportation firms, etc.
Budget Allocations	Operational or capital budget allocations of other government department.

3.1.3 Capital and Operating Costs

Capital costs are typically one-time investments in assets such as land, buildings, and equipment. Operating costs are ongoing expenses associated with the day-to-day operation of the completed project. For a project to be financially sustainable, it must be able to both recover its capital investment and continue to pay for ongoing expenses. Capital costs can be paid all at once or spread out over the lifetime of the asset using a financing mechanism, as described in the next section.

Table 4 provides an initial list of potential capital and operating cost factors for consideration by the pilot sites.

Table 4. Cost factors

Factors	Description
Capital Costs	Equipment costs. Design, installation/construction, and testing costs.
Operational Costs	Utilities, labor, rents, other fees, leases, training, etc.
Maintenance Costs	Replacement parts, labor, contracted repairs, etc.

3.1.4 Financing/Funding Options

Financing and other funding sources play a critical role in financial sustainability. The upfront capital for a project often comes from a mix of finance (loans, bond issuances, etc.) and external funding (such as grants and budget allocations). Accessing financing may increase the overall cost of a project but allows that cost to be expensed over a longer period. Other funding sources, such as a grant, can help lower the overall cost of a project.

Public-private partnerships are also a common business model. For the purposes of the financial evaluation, a proposed public-private partnership would be evaluated from the perspective of the pilot site as a combination of existing revenue, cost, and funding factors.

Table 5 provides an initial list of potential financing and funding-related factors for consideration by the pilot sites.

Table 5. Potential financing and funding-related factors

Factors	Description
Debt	Interest rate, term (length), amount, and transactional costs
Equity	Amount, expected return, and other obligations
Grants	Source and obligations

3.2 Identification of Metrics for Evaluating Financial Sustainability

As noted in the introduction, the TTI CVPD Evaluation Team defines financial sustainability as achieving net revenues sufficient to operate and maintain the CV applications for some period into the future without additional CV federal grant money after the pilot deployment program ends at each site.

However, beyond the need for additional federal funding, there are other important and commonly used metrics for evaluating financial performance. Since no single metric determines financial sustainability, the TTI CVPD Evaluation Team proposes using multiple metrics to paint as broad of a picture as possible.

Table 6 provides an initial list of the potential financial sustainability evaluation metrics for consideration by the pilot sites.

Table 6. Financial sustainability metrics

Metrics	Description
Annual Cash Flows	Looks at whether, in any given year, projected inflows of cash are insufficient to cover expenses. This situation can happen even when an overall project generates a positive return.
Net Present Value	The sum of all cash flows discounted to the present day using a specified rate, typically a required rate of return.
Internal Rate of Return	The expected annualized percentage rate of return on an initial investment.
Payback/Break-even	The amount of time required for a project to recover its initial investment.

Common thresholds for financial sustainability include a net present value that is positive, an internal rate of return that exceeds an organization's desired target (often their cost of capital), a payback or break-even period that is less than the expected life of the equipment, and sufficient cash flows to maintain ongoing operations.

3.3 Process for Verifying and Obtaining Input from Pilot Sites

The financial factors and metrics identified in this section will form the basis for the analytical model (see Chapter 4) and the data collection request (see Chapter 5). As such, input from the pilot sites on the financial factors and metrics is critical to ensuring a useful analytical model.

To solicit feedback, the TTI CVPD Evaluation Team will provide pilot sites with the preliminary financial factors and evaluation metrics outlined in this plan in advance of a roundtable meeting. The TTI CVPD Evaluation Team will then facilitate a discussion with the pilot sites regarding the financial factors and evaluation metrics to understand their perspective on financial sustainability. See Chapter 5: Data Collection for additional detail.

Output from the roundtable discussions will be integrated into the final list of financial factors and evaluation metrics used as the basis for the analytical model.

Chapter 4. Development of the Analytical Model

The second step in assessing the financial sustainability of the deployments is to develop the analytical model. This section describes discounted cash flow (DCF) modeling and how it will be used to evaluate the financial sustainability of each pilot. It also describes the proposed approach to model development and testing. Finally, this section maps how the financial factors and metrics identified in the previous sections relate to the model.

4.1 Assessment Methodology—Discounted Cash Flow Modeling

The TTI CVPD Evaluation Team will use a DCF as the valuation method to determine the financial viability of a potential project. DCF looks at future cash flows (money in and out of a project) and discounts them back to present value using a specified rate of return.

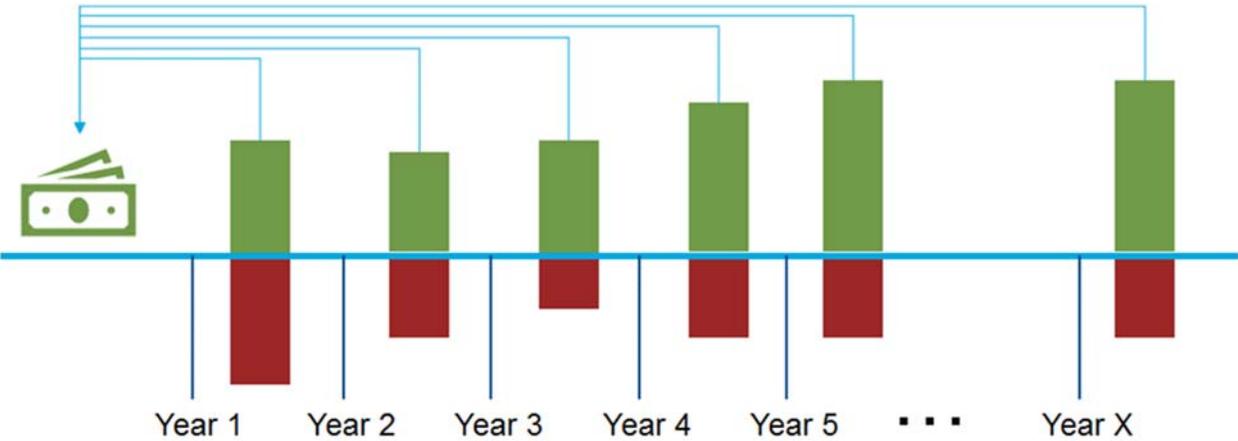


Figure 5. Conceptual diagram of DCF model

The present value estimate is then used to assess the attractiveness of the investment. If the present value of future cash flows exceeds the cost of the initial investment, then the project is determined to be financially viable. The DCF is calculated using the following equation:

$$DCF = [CF1/(1+r)^1] + [CF2/(1+r)^2] + [...] + [CFn/(1+r)^n]$$

Where:

- DCF = Discounted Cash Flow.
- CF = The sum of all cash flows in a given year. Example: CF1 is the sum of all cash flows in year 1.
- r = Discount rate.
- n = Year.

In addition to the basic present-value DCF metric, the creation of the DCF model framework allows additional metrics (as described in Chapter 3, Table 6) to be calculated and displayed, such as internal rate of return, payback, and break-even point.

4.2 Model Development

The TTI CVPD Evaluation Team will build the DCF model in Microsoft Excel. The structure of the model will mirror the factors and metrics identified during the implementation of Step 1 of the plan. Generally, we anticipate that there will be a tab for inputs, a tab for the calculation of the cash flows, and a tab to display the selected evaluation metrics. Importantly, the model will be constructed in a way that the pilot sites can input their own parameters and inputs as needed.

In order to streamline the development of the DCF model, we propose the creation of a single universal model that can be applied to all three pilot sites. However, given the diversity of the pilot projects, both in terms of technologies and business models, the DCF model inputs will need to be designed with flexibility in mind.

The DCF model will be capable of assessing projected financial sustainability of a project for up to a seven-year timeframe. The model will also include the ability to run sensitivity analysis on select variables.

Before deployment, the TTI CVPD Evaluation Team will run the model through full quality assurance testing, ensuring that input cells and calculations are clearly marked, explanatory comments are clear, calculations are functioning properly, and that there are no internal errors or hardcoded assumptions.

4.3 Model Input/Output Mapping

Figure 6 shows how each of the financial factors identified above feeds into the DCF model, which in turn produces the evaluation metrics.

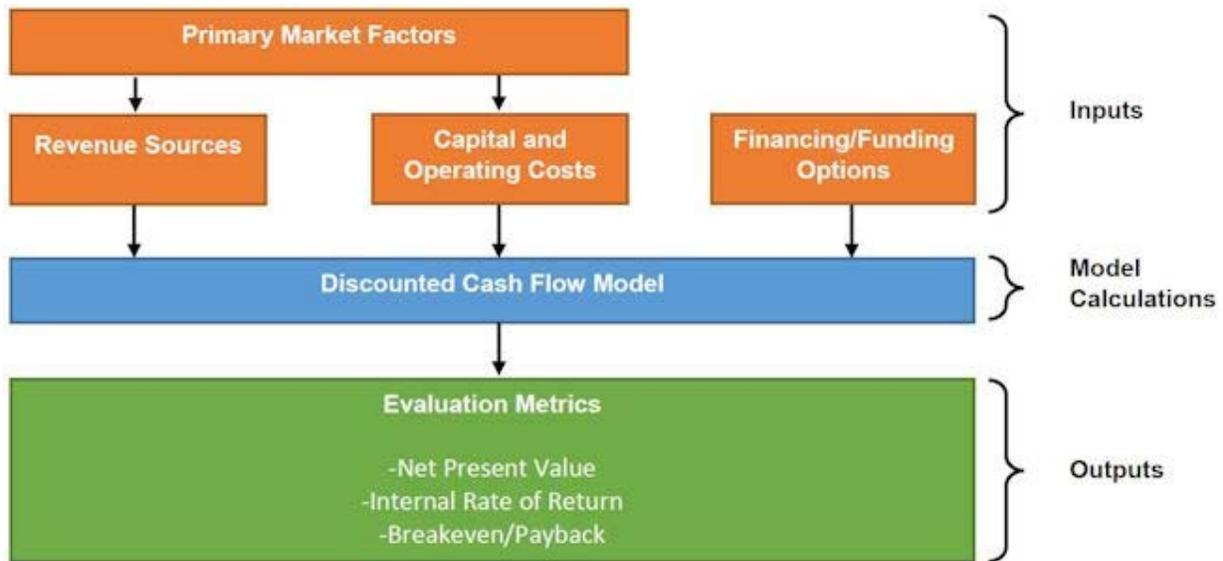


Figure 6. Analytical model conceptual diagram showing flow of inputs, calculations, and outputs

Chapter 5. Data Collection

After developing the analytical model, the next step in the process is to collect the necessary data for completing the analysis. This section provides an overview of the information and data that will be required of each pilot site to conduct the financial evaluation, as well as how it will be collected. The TTI CVPD Evaluation Team will coordinate with the broader interview/survey effort to gather high-level information about financial planning and business models at each pilot site. The TTI CVPD Evaluation Team also envisions collecting non-survey/interview feedback and data from pilot sites at two distinct points during the model development and evaluation process.

5.1 Survey and Interview Integration

TTI CVPD Evaluation Team anticipates including financial questions in the following planned interviews, as defined in *Connected Vehicle Pilot Deployment Independent Evaluation: Stakeholder Acceptance/Satisfaction Evaluation Plan (7)*:

- Pre-deployment Interview.
- Near-term Post-Deployment Interview.
- Long-term Post-Deployment Interview.

Questions in the pre-deployment interview will be aimed at establishing each site's planned approach to long-term financial sustainability and will include:

1. In your opinion, is there a shared commitment among stakeholders to the financial sustainability of the CV pilot and how to achieve it?
 - a. If YES: Please describe the shared commitments from the various stakeholders. How were these shared commitments achieved?
2. Are you familiar with the long-term plan for funding/financing the CV pilot?
 - a. If YES: Please describe.
3. Are you aware of the existence of a business plan or business planning process for the CV pilot?
 - a. If YES, please describe.
4. Have projections for future market participation, revenue, and cost associated with the CV pilot been developed?
 - a. If YES: Can you provide detail on that process? Outcomes?
 - b. If NO: Are there plans to do this in the future?

The questions for the near-term and long-term post-deployment interviews will be developed in response to the outcomes of the initial interviews and financial evaluations.

At this time, the TTI CVPD Evaluation Team does not anticipate that any financial questions will be required in the post-deployment **survey** that will be sent to fleet operators and supporting agencies.

For additional detail on structure, timing, and stakeholders targeted by these surveys, see the *Connected Vehicle Evaluation Pilot Deployment: Survey and/or Interview Guides* for each site (8,9,10).

5.2 Feedback on Financial Factors and Evaluation Metrics

While this plan offers some initial categories and suggestions for potential financial factors and evaluation metrics, it will be important to obtain feedback from the pilot sites on these factors and metrics before development of the financial evaluation model begins. The TTI CVPD Evaluation Team proposes dedicating a segment of one of the regularly occurring roundtable discussions to collect input from the pilot sites. This plan (or the relevant portions of it) will be sent to the pilot sites in advance of the roundtable discussion with context and instructions, so that the pilot sites can review and come to the roundtable prepared to discuss. The TTI CVPD Evaluation Team envisions that these discussions will last approximately two hours and anticipates that staff members of the pilot sites who are familiar with the financial planning of the CV pilots will be present. The TTI CVPD Evaluation Team will focus the discussion on confirming the following aspects of the financial factors and metrics:

- Do any of the currently proposed financial factors need additional definition?
 - a. Are the definitions clear?
 - b. Should the definitions be expanded or changed to include something we did not consider?
 - c. Is the way that they are defined the best way to define/measure some of these factors?
- Are the currently proposed financial factors relevant? Should any be removed?
- Are there additional financial factors that should be considered or added?
- Do any of the currently proposed evaluation metrics need additional definition?
 - a. Are the definitions clear?
- Are the currently proposed evaluation metrics relevant? Should any be removed?
- Are there additional evaluation metrics that should be considered or added?

5.3 Financial Evaluation Data

As outlined in the plan section on schedule, evaluations will be conducted at the end Phase II and Phase III at each site.

The data required to conduct these evaluations will align with the financial factors identified in Step 1. The TTI CVPD Evaluation Team will prepare a financial evaluation data collection worksheet for each site, which will be sent via email to the appropriate point of contact at the pilot sites. It will request specific information for both historic and projected market, revenue, cost, and financial data for the full period of the financial evaluation.

As part of the Phase II data collection effort, the TTI CVPD Evaluation Team will also request any plans or documents created during the pilot site's Phase I that estimated anticipated project costs. These will be used to compare how actual Phase II costs compared to Phase I estimates as part of the Phase II evaluation report. See Chapter 6 for more detail.

In order to expedite the subsequent Phase III data collection, the original data collection responses will be retained and used as the basis for the Phase III data collection. The pilot sites will only need to update any financial factor information that has changed between Phase II and Phase III. This may be done via email or, if more practical, as part of the planned post-deployment workshop.

Chapter 6. Analysis and Reporting

Once the financial evaluation data have been collected from the pilot sites, the TTI CVPD Evaluation Team will enter them into the financial evaluation model and record the resulting evaluation metric results. As noted above, since each pilot site is unique, this process may require some interaction between the TTI CVPD Evaluation Team and the pilot sites regarding how to interpret the data. However, we expect the interaction to be minimal, mostly related to structuring the model for the initial Phase II evaluation.

Subsequent evaluations should simply be updates to the initial evaluation.

The TTI CVPD Evaluation Team will produce a report highlighting the results of the financial evaluation. The report will include the following sections:

- A qualitative description of the pilot site's current business plan approach (as gathered from interviews, data collection effort, and roundtable discussions).
- A list of the relevant financial factors that were evaluated along with the current data associated with each, as provided by the pilot sites.
- A list of any assumptions made as part of the analysis.
- An overview of the financial evaluation model results, including the identified metrics and an interpretation of whether the site is projected to achieve financial sustainability as currently modeled.
- Suggestions for factors that could be changed/improved in order to improve financial performance.
- For the Phase II evaluation report only: A summary of the change in estimated costs between Phase I and Phase II.
- For the Phase III evaluation report only: A summary of the change in the financial sustainability of the pilot since the previous Phase II evaluation period.

The objective of these reports will be to provide the pilot sites with information regarding the sustainability of their current financial approach, as well as a comparison to past evaluations to see if financial strength has improved over time.

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