Connected Vehicle Pilot Deployment Program Independent Evaluation:

Program Evaluation Plan

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16. Abstract

This report summarizes the analysis plans that the Texas A&M Transportation Institute, in its role as the independent evaluator, will use to assess the program structure and process of the Connected Vehicle Pilot Deployment Program. This document summarizes the plans for:

- Assessing whether a performance-management focus of pilot deployments was beneficial.
- Estimating the total impacts, costs, and return on investment of the CV pilot program.
- Assessing if the CV pilot program achieved its vision cost effectively.

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Chapter 1. Introduction

The United States Department of Transportation (USDOT) connected vehicle (CV) research program is a multimodal initiative that strives to enable safe, interoperable networked wireless communications among vehicles, the infrastructure, and travelers' personal communication devices. Together, USDOT and other agencies and entities are sponsoring CV research to leverage the potentially transformative capabilities of wireless technology to make surface transportation safer, smarter, greener, and sustainable for the long run. This program is administered through the Intelligent Transportation Systems Joint Program Office (ITS JPO).

Task E of the USDOT Connected Vehicle Pilot Deployment (CVPD) Program Independent Evaluation—which is being conducted by the Texas A&M Transportation Institute (TTI)—involves investigating whether the CVPD Program structure and processes were effective in meeting the program's vision, goals, schedule, and roadmap structure.

Throughout the life-cycle of the CVPD Program, the initiative was planned and shaped by a set of fundamental hypotheses that were structured to achieve program goals. Some decisions related to program structure and process were made early, while other choices came later during the implementation of the CVPD. USDOT has provided TTI with the program structure and process foundational hypotheses that serve as the basis for the evaluation being performed in Task E (Email from Karl Wunderlich, Noblis. Received March 29, 2019.).

Connected Vehicle Pilot Deployment Program

Through the CVPD Program, USDOT initiated pilot deployments in three locations—Wyoming, Tampa, and New York City—to showcase the benefits of connected vehicles, mobile devices, and smart infrastructure data to improve safety, mobility, environment, and public agency efficiency (*1*). The CVPD Program works to achieve three goals focused on accelerating the deployment of interoperable CV technologies. These goals, as shown in Figure 1, are to spur innovation among early adopters of CV application concepts; demonstrate the potential safety, mobility, and environmental benefits associated with CV deployments; and create sustainable momentum for nationwide deployment of CV technologies.

Source: ITS JPO CVPD Program Website

Figure 1. USDOT CVPD Program Goals.

The objective of the task order discussed herein is to evaluate the extent to which the CVPD Program achieved the desired USDOT goals. The overall program evaluation will include three focus areas:

- Assessing the effectiveness of the performance-based approach used by USDOT to identify, select, and manage the CVPDs.
- Estimating the total impacts, costs, and return on investment (ROI) achieved by USDOT through the CVPD Program.
- Assessing if the CVPD Program achieved its overall vision cost effectively.

The intent of this overall evaluation is to determine whether ITS JPO's approach for the CVPD Program was effective at encouraging widespread deployment of CV technologies. The widespread deployment of CV technologies requires a significant investment to move from model pilot deployment to full-scale deployment, particularly from the standpoint of state and local governments. The CVPDs are intended to be a keystone effort in the USDOT ITS JPO program. These pilot deployments play a key role in accelerating deployment across the country, promoting interoperability, and generating enterprise data. They are likely to serve as models for widespread deployment and offer insight into how other regions can advance the deployment of CV technologies in their jurisdictions.

Using results from the site deployments and national evaluation, TTI will estimate the potential ROI and discounted net present value derived from the pilot deployments. TTI will also collect stakeholder feedback on the overall effectiveness of the program to spur widescale acceptance of the technology. Following appropriate Institutional Review Board procedures, TTI will use an interview format to solicit feedback and lessons learned information from CVPD Program stakeholders, including the following:

- USDOT CVPD Program manager and deployment teams.
- Site deployers.
- Safety evaluator (Volpe).
- Deployment site leads and evaluation team.
- Other critical stakeholders.

The program evaluation will be able to look at near-term outcomes/impacts with respect to encouraging CV deployments across the United States only. The team is unable to assess potential longer-term impacts of the program due to the timeframe for the evaluation.

Organization of Report

This report is divided into five chapters. The titles of each chapter and the major topics covered are highlighted below:

- Chapter 1. Introduction—This chapter provides an overview of the CVPD initiative, a perspective of the program evaluation, and a quick guide to the topics covered in the individual chapters.
- Chapter 2. Hypotheses and Research Questions—This chapter lists the hypotheses and research questions to be tested/addressed as part of the program evaluation.
- Chapter 3. Methodologies and Analysis Tools—This chapter provides a summary of the approaches and data that TTI plans to use to assess the quality, impacts, and outcomes of the CV pilot program structure and processes. Methods include:
  - *Surveys and Interviews*—This section highlights the techniques and processes that TTI plans to use to conduct stakeholder surveys and interviews.
  - *Total Impacts Estimation*—This section describes the approach and methodologies to be used to estimate the total impacts, discounted net present value, and ROI of the program versus a no-pilot program case.
- Chapter 4. Evaluation Data and Data Management—This chapter provides a summary of the sources of data that TTI plans to use to conduct the program structure and process evaluation.
- Chapter 5. Risks and Uncertainties—This chapter discusses key risks and uncertainties that may impact the program structure and process evaluation effort.

Chapter 2. Hypotheses and Research Questions

This chapter provides a summary of TTI's plans to assess the impacts of the structure and process used to conduct the CVPD Program. The TTI team will focus on three areas: (a) assessing the effectiveness of the performance-based approach; (b) estimating the total impacts, costs, and ROI of the program; and (c) assessing if the program achieved its vision cost effectively.

USDOT provided 14 foundational hypotheses spanning 10 topic areas to TTI on March 23, 2019. Each hypothesis addressed a specific program structure or process activity that was related to the CVPD Program goals. In addition to these hypotheses, TTI added two other hypotheses based on discussions with and questions from USDOT. These two hypotheses addressed the overall program structure, vision, and goals.

On April 10, 2019, the list of 16 hypotheses, a description of data needs (many from USDOT), candidate questions for interviews, and other assumptions were submitted to USDOT. On April 23, 2019, USDOT agreed on the hypotheses, noting that the survey questions should be tailored to what the normal behaviors for deployment programs are, where possible, because there is no set template for deployment activity.

Table 1 lists the 14 foundational hypotheses that USDOT established when developing the CVPD Program (noted with an asterisk behind the hypothesis number), as well as the two additional hypotheses developed by TTI. The table also defines the rationale and the program structure and process activities each one supports. These 16 hypotheses comprise the full set of evaluation hypotheses that TTI will use to assess the effectiveness of the CVPD Program.

Table 1. Evaluation Hypotheses for Assessing USDOT's CV Pilot Program Effectiveness.

#	Program Overview Link	Topic Category	Topic	Evaluation Hypotheses	Background
1*	Stakeholder engagement roadmap activity	Solicitation Planning	Pre-solicitation outreach	Extensive pre-solicitation outreach would increase the number and enhance the quality of submitted proposals.	The CV pilot program committed a nine-month period prior to the initial solicitation that included a workshop, multiple webinars, and outreach efforts articulating the program vision.
2*	Pilot deployment roadmap activity	Solicitation Planning	Emphasize real-world problem-solving	Focus on real-world problem solving would lead to proposals/ projects where a definitive impact could be realized, even if only a limited total number of devices, vehicles, and technology might be deployed.	Pre-solicitation outreach and solicitation criteria emphasized that there must be a problem to be solved (rather than the technology to be deployed). Hypothetical deployment concepts illustrating a problem-focused approach were developed and used extensively in workshops, webinars, and other outreach. The goal was to avoid proposals for technology showcases or temporary field tests that would be dismantled at the end of the deployment period.
3*	Pilot deployment roadmap activity	Solicitation Planning	Two-phase solicitation structure	Using a two-phase process will expand the set of potential proposers to include agencies otherwise too small or with cumbersome contracting methods to respond to the pace of Phase 1 activity.	Phase 1—Broad agency announcement (BAA)/contracts with private- or public-sector leads, 12 months. Phase 2/3—Cooperative agreements with public-sector agencies (only), 38 months. The solicitation structure would allow agencies without the ability to contract/subcontract quickly to respond to the BAA as a sub to a private-sector entity (with presumably more nimble contracting capabilities). Once the deployment concept was fully vetted in Phase 1, then a cooperative agreement (with a longer lead time) could be put in place with a public agency.
4*	Pilot deployment roadmap activity	Solicitation Planning	Phases with consequential gates	The two consequential phase gates (one technical, the other operational) would provide USDOT with needed leverage to encourage	Teams that could not show progress toward a unified deployment concept or with fundamental flaws in institutional or technical planning could be dropped from the deployment program after Phase 1. Phase 1 costs were estimated to be roughly 12–20% of total deployment costs prior

#	Program Overview Link	Topic Category	Topic	Evaluation Hypotheses	Background
				sites to adhere to schedule, cost, and scope.	to the original solicitation, with the low-end figure for large deployments ($15 million–$20 million) and high-end figure for smaller deployments ($3 million–$7 million). The Phase 3 gate was not technical, but rather on a two-trigger decision (site and federal) to proceed to operations based on a risk assessment—will the deployments operate safely, securely, and as designed?
5*	Application and open source roadmap activity	Program Structure	Post-award collaboration among deployment sites, not competition	Collaboration among sites would provide more value than creating a competitive "funnel" program with roughly twice as many Phase 1 participants than Phase 2–3 awardees.	Cooperation/collaboration among site cohort, using positive peer pressure rather than competitive structure to ensure schedule/scope adherence and drive innovation.
6*	Stakeholder engagement roadmap activity	Program Structure	High rate of interaction post-award: meeting cadence and topics/roundtables	A set of regular structured topical roundtables plus monthly check-ins would ensure sites knew of each other's challenges, resolutions, and progress.	Related to Hypothesis 5, this decision was to engage the sites in a steady set of meetings and roundtables to encourage the sites to compare notes/progress.
7*	Application roadmap activity	Technological Maturity	CV tech mature enough to mount a successful deployment program	The level of CV readiness was high enough to mount a deployment program. Further, the deployment program would help the industrial base to make these technologies more robust and deployable.	The maturity of CV technologies and applications were known to be in a mixed state—some developed at a research level, and others available commercially but not yet deployed at scale or in combination.
8*	Pilot deployment roadmap activity	Dedicated Short-Range Communication (DSRC) Focus	DSRC an element of each deployment, but not a comprehensive requirement	Requiring sites to use DSRC in some way as a part of the deployment, but not requiring use for all applications, would allow more realistic, practical, and effective deployment concept.	The program wanted to encourage deployers to consider logical utilization of DSRC technologies, both to determine their level of readiness and to test utilizing the 5.9 GHz spectrum at a deployment-level scale.

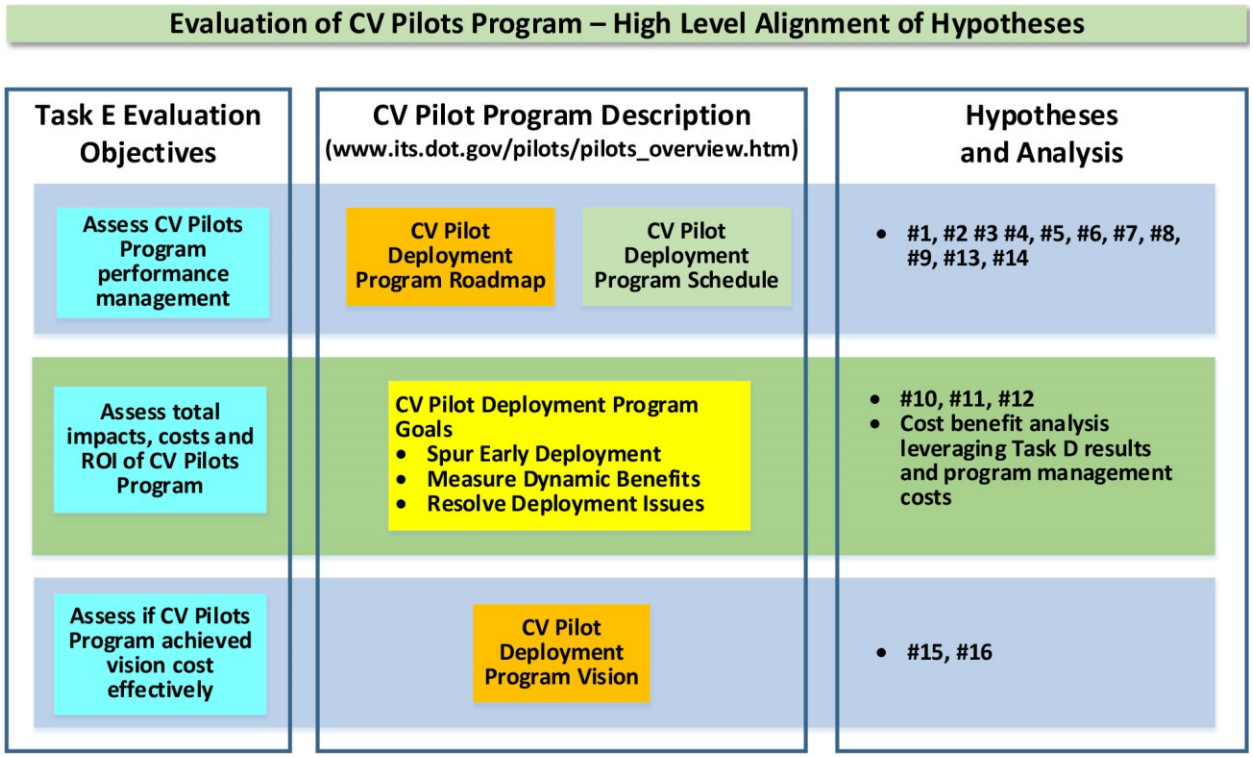
#	Program Overview Link	Topic Category	Topic	Evaluation Hypotheses	Background
9*	Application and open source roadmap activity	Open Data/ Open Source	Open data and open source a required element of all deployments	The open source/data requirement would not put off serious deployers, would not prove too onerous, and would assist in technology transfer to deployments outside of the CV pilot program.	The sharing of deployment-related data and code was required as a deployment element from pre-solicitation and through all three phases.
10*	Pilot deployment roadmap activity	Security/Privacy	Deployment cybersecurity and privacy protection emphasized early	An early emphasis on cyber security and privacy would reduce the risk of cyber- or privacy-related issues in the operational phase of the deployments.	Phase 1 deliverables on security and privacy would ensure that sites considered these topics early in the project, not afterwards.
11*	Pilot deployment roadmap activity	Security Credential Management System (SCMS)/ Certification	Certified devices connected with a credential management system required	Similar to the technical maturity hypothesis (#7), the dependence of the program on external certification and credential management would speed the maturation of these needed capabilities without the program itself having to directly finance/manage their creation.	The CVPD Program recognized the need for device certification and centralized credential management and made these requirements for the sites, although neither a proven certification process nor a large-scale SCMS existed.
12*	Pilot deployment roadmap activity	Financial/ Institutional Sustainability	Financial sustainability after federal funding ceased emphasized	By reiterating the need for long-term financial sustainability of the deployments, the program would reduce the risk of the deployed technologies being removed at the end of the funding period (as in field test) OR the risk of the sites developing a long-term need for federal funding to continue.	Phase 1 deployment concepts evaluated for a financial sustainability before Phase 2 funding. Independent evaluation of financial sustainability.
13*	Impact Assessment roadmap activity	Performance Measurement/ Evaluation	Sites required to implement a performance measurement capability	A performance measurement capability would reinforce a performance-driven management of the system, allowing impacts to be more easily observed and	Integrated performance measurement for sites was required, in addition to support of a supplementary independent evaluation.

#	Program Overview Link	Topic Category	Topic	Evaluation Hypotheses	Background
				quantified through an independent evaluation of near-term impacts.	
14*	Stakeholder engagement roadmap activity	Outreach/Other Early Deployers	Sites required to participate in a range of structured, coordinated outreach activities	Getting the word out in a variety of forms, but within a structured and coordinated construct provided by the program, would help USDOT and the sites transfer knowledge to other early deployers more efficiently.	Sites were required to participate in outreach events, conduct webinars/showcases, and document plans and findings in some detail so other early deployers would benefit.
15	Program vision	Program Structure	Overall program structure and process assessment	The overall effect of the program's innovative approaches and roadmap of activities resulted in outcomes that were positive to the USDOT team.	The CV pilot program structure is found at https://www.its.dot.gov/pilots/pilots_overview.htm.
16	Program vision	Program Vision and Goals	Overall program vision	The CVPD Program met the vision laid out at the onset of the program.	The CV pilot vision and goals are found at https://www.its.dot.gov/pilots/pilots_overview.htm.

* A foundational hypothesis provided by USDOT.

Source: Email from Karl Wunderlich, Noblis. Received March 29, 2019.

Figure 2 is a high-level depiction of how the hypotheses and financial analysis relate to key elements of the program and to the Task E evaluation objectives. The figure shows the primary alignments. Some objectives may be informed by multiple hypotheses. However, only primary relationships are shown in the figure for ease of conceptual understanding. Many of the hypotheses respond to the objective of determining if the CV program's performance-management focus was beneficial. These hypotheses include processes in the pre-procurement planning phase, as well as considerations about the program structure, technology maturity, DSRC, data, performance measurement, and outreach. Other hypotheses are related to the goals of the program, including those associated with credential management and financial stability. Two hypotheses pertain to the CVPD Program's vision. The financial effectiveness of the program informs the program goal of measuring benefits.



Source: Texas A&M Transportation Institute

Figure 2. Program Evaluation and Hypotheses Relationships.

Chapter 3. Methodologies and Analysis Tools

This chapter provides a summary of the approaches and data that TTI plans to use to assess the quality, impacts, and outcomes of the CV pilot program structure and processes. Table 2 shows the performance measures, data sources, and analyses that TTI plans to use to assess the effectiveness of the USDOT CVPD Program.

Assessing Performance-Management Focus of Pilot Deployments

Performance-based management involves using a systematic approach to improve performance through an ongoing process of establishing strategic performance objectives; measuring performance; collecting, analyzing, reviewing, and reporting performance data; and using that data to drive improvement. The performance-based management process involves providing answers to the following questions:

- What are the needed capabilities?
- What are the technical and operational requirements?
- What are the costs and schedule?
- What are the periodic measures of performance?
- What are the impediments to progress?

TTI will document and assess how the Federal Highway Administration's (FHWA's) use of performance-based management processes helped facilitate the spread and use of CV technologies. TTI will assess how effective the program was at spurring growth of the CV applications and technologies, as well as identifying and overcoming technical, institutional, and financial constraints to deployment of this new technology. TTI will assess the extent to which the pilot deployment integrated CV research concepts into practice and enhanced existing operational capabilities. TTI will also assess how these pilot deployments encouraged partnerships of multiple stakeholders (e.g., private companies, States, transit agencies, commercial vehicle operators, and freight shippers) to deploy applications utilizing data captured from multiple sources (e.g., vehicles, mobile devices, and infrastructure). TTI will also examine how the pilot deployments helped inform the state of the practice about the broader cost benefits associated with deploying CV concepts and technologies in a region or metropolitan area.

Table 2. Performance Measures, Data Sources, and Analysis Types to Assess USDOT Program Effectiveness.

#	Hypothesis	Performance Measures	Data Sources	Analysis Type
1	Extensive pre-solicitation outreach would increase the number and enhance the quality of submitted proposals.	• Perceived impact/ effectiveness of pre-solicitation outreach activities.	• Interviews and surveys conducted as a part of Task E. • Documentation of pre-solicitation outreach activities. • USDOT estimate of investment in pre-solicitation outreach. • Typical number of sites proposing on a similar, traditional project without the extended pre-solicitation phase. • Typical time (should be less than nine months) and effort (cost, labor, and other engagement resources) for pre-solicitation activity for a similar traditional project.	• Qualitative perception data from surveys. • Quantitative data from pre-solicitation activities.
2	Focus on problem-solving would lead to proposals/projects where a definitive impact could be realized, even if only a limited total number of devices, vehicles, and technology might be deployed.	• Perceived impact/ effectiveness of problem-solving focus.	• Interviews and surveys conducted as a part of Task E. • Description of pre-proposal instances where focus of outreach material and conversation were addressed to problem solving during the pre-solicitation phase. • Description of proposal and project instances where the USDOT team recognizes that definitive impacts were realized.	• Qualitative perception data from surveys. • Quantitative data regarding instances of impacts.

#	Hypothesis	Performance Measures	Data Sources	Analysis Type
3	Expand the set of potential proposers to include agencies otherwise too small or with cumbersome contracting methods to respond to the pace of Phase 1 activity.	• Perceived change in smaller and contract-challenged proposers.	• Interviews and surveys conducted as a part of Task E. • Description of the expected smaller and contract constrained proposers that could be engaged by a two-phase solicitation structure.	• Qualitative perception data from surveys.
4	The two consequential phase gates (one technical, the other operational) would provide USDOT with needed leverage to encourage sites to adhere to schedule, cost, and scope.	• Perceived impact/ effectiveness of two-phase solicitation structure.	• Interviews and surveys conducted as a part of Task E. • Program schedule adherence.	• Qualitative perception data from surveys. • Quantitative data regarding program schedule adherence.
5	Collaboration among sites would provide more value than creating a competitive "funnel" program with roughly twice as many Phase 1 participants than Phase 2–3 awardees.	• Perceived impact/ effectiveness of post-award work collaboration.	• Interviews and surveys conducted as a part of Task E. • Examples of sites cooperating that adds value to the program. In addition to the exchange of data this added value could be expressed by avoidance of mistakes, purchasing at reduced costs, sharing of local community outreach information, identification of effective operations procedures.	• Qualitative perception data from surveys. • Quantitative data describing collaboration.
6	A set of regular structured topical roundtables plus monthly check-ins would ensure sites knew of each other's challenges, resolutions, and progress.	• Perceived impact/ effectiveness of topical roundtables.	• Interviews and surveys conducted as a part of Task E. • Listing of post-award roundtable meetings and monthly check-ins including a quantification of the attendees.	• Qualitative perception data from surveys. • Quantitative summary of costs for the topical roundtables and other meetings.

#	Hypothesis	Performance Measures	Data Sources	Analysis Type
7	The level of CV readiness was high enough to mount a deployment program. Further, the deployment program would help the industrial base to make these technologies more robust and deployable.	• Perceived impact/effectiveness of CV readiness and value to industrial base.	• Interviews and surveys conducted as a part of Task E. • Description of CV deployments based on readily accessible data market data. • Examples communicated to USDOT where industry acknowledged that the CV pilot program advanced the marketplace.	• Qualitative perception data from surveys. • Quantitative description of CV deployments.
8	Requiring sites to use DSRC in some way as a part of the deployment, but not requiring use for all applications, would allow more realistic, practical, and effective deployment concept.	• Perceived impact of having DSRC requirement for only a limited number of apps instead of having it stipulated for the full range of apps.	• Interviews and surveys conducted as a part of Task E. • Listing of communications technologies used at each CV pilot site including DSRC, cellular V2X, and others.	• Qualitative perception data from surveys. • Quantitative description of communications technology choices.
9	The open source/data requirement would not put off serious deployers, would not prove too onerous, and would assist in technology transfer to deployments outside of the CV pilot program.	• Perceived impact/effectiveness of open source data requirement and usefulness in technology transfer.	• Interviews and surveys conducted as a part of Task E. • Identification of any known serious deployers that would not engage in the pilot deployments despite their interest because of the open data source requirements. • Examples of use of open source data in technology transfer to deployments outside of the CV pilot program. • Data from the number of downloads of CVPD applications on Open Source	• Qualitative perception data from surveys. • Quantitative description of open source data uses.

#	Hypothesis	Performance Measures	Data Sources	Analysis Type
			Application Data Portal (OSADP).	
10	An early emphasis on cyber security and privacy would reduce the risk of cyber- or privacy-related issues in the operational phase of the deployments.	• Perceived impact/effectiveness of cyber risk and privacy reduction attributed to cyber security requirement.	• Interviews and surveys conducted as a part of Task E. • Description of cyber security and privacy issues in the operational phase of CV pilots.	• Qualitative perception data from surveys. • Quantitative description of cyber and privacy issues.
11	Similar to the technical maturity hypothesis, the dependence of the program on external certification and credential management would speed the maturation of these needed capabilities without the program itself having to directly finance/manage their creation.	• Perceived impact/effectiveness of external certification and credential management on program delivery.	• Interviews and surveys conducted as a part of Task E. • Status of USDOT funding for creation of resources and tools associated with certification and credential management during the course of the program. • Dates of when devices were certified to see how many devices were certified before vs. after the pilots from OmniAir site.	• Qualitative perception data from surveys. • Quantitative description of resources used for certification and credential management.
12	By reiterating the need for long-term financial sustainability of the deployments, the program would reduce the risk of the deployed technologies being removed at the end of the funding period (as in field test) OR the risk of the sites developing a long-term need for federal funding to continue.	• Perceived impact/effectiveness of emphasis on long-term financial stability with regard to continued operation after program completion without federal funding.	• Interviews and surveys conducted as a part of Task E. • Uses of federal funding to continue operation of the sites and examples of assets being decommissioned after completion of the project.	• Qualitative perception data from surveys. • Quantitative description of technology status at the end of the CVPD period.
13	A performance measurement capability would reinforce a performance-driven management of the system, allowing impacts to be more easily	• Perceived impact/effectiveness of performance	• Interviews and surveys conducted as a part of Task E.	• Qualitative perception data from surveys.

#	Hypothesis	Performance Measures	Data Sources	Analysis Type
	observed and quantified through an independent evaluation of near-term impacts.	requirements on sustained performance-driven management of the systems.	• Examples of sites using performance-management capabilities throughout the deployment and after the completion of the independent evaluation.	• Quantitative description of uses of performance measurement capabilities.
14	Getting the word out in a variety of forms, but within a structured and coordinated construct provided by the program, would help USDOT and the sites transfer knowledge to other early deployers more efficiently.	• Perceived impact/effectiveness of USDOT program outreach activities as a means for sites to more effectively manage their outreach actions.	• Interviews and surveys conducted as a part of Task E. • Estimates of requests for information from sites and an assessment of how many were repetitive.	• Qualitative perception data from surveys. • Quantitative estimates of information requests from the sites.
15	The overall effect of the program's innovative approaches and roadmap of activities resulted in outcomes that were positive to the USDOT team.	• Perceived impact/ effectiveness of overall program's innovative approaches to structure.	• Interviews and surveys conducted as a part of Task E.	• Qualitative perception data from surveys.
16	The CV pilot program met the vision laid out at the onset of the program.	• Perceived impact/ effectiveness of program achieved vision laid out at the onset of the program.	• Interviews and surveys conducted as a part of Task E.	• Qualitative perception data from surveys.

The TTI team will use the following process to collect the data for this evaluation. The team will first check if the data needed are available through information posted on the JPO CVPD website, including site documents (e.g., Phase 1–3 deliverables, lessons learned logbooks, and presentations). After this initial review, the team will construct interview questions tailored to address specific needs. After this step, if there are still needs that cannot be addressed rapidly through surveys/interviews, the team will forward those needs to USDOT/Noblis for processing.

Review Documentation

The first step in the analyses will be to review all the existing literature and documentation produced by the USDOT ITS JPO related to the project. This review will include the information and reports published on the CVPD Program website (*1*), including reports and articles on the following:

- Success stories and lesson learned by USDOT and sites throughout the planning and deployment process.
- Responses to the CVPD Program's Request for Information (RFI).
- Reports, webinars, and presentation materials on the site experiences during the preliminary planning phase of the pilot deployments.
- USDOT guidance documents related to the planning and design for the CVPD sites.

The purpose of this review is to obtain necessary information related to how USDOT structured the project and gain insight into the processes and procedures that USDOT used to develop, promote, and manage the site selection, planning, and deployment process. A review of lesson learned documentation will also allow TTI to obtain insight into the issues and solutions that USDOT faced throughout the pilot deployment process.

Surveys and Interviews

Most of the data TTI plans to use in this assessment will come from surveys and interviews. This section highlights the techniques and processes that TTI plans to use to conduct stakeholder surveys and interviews.

Stakeholder Data Collection Plan

The purpose of the stakeholder evaluation is to gather information to assess the benefits and challenges of the CVPD Program structure and process. The types of information to be gathered are guided by a predetermined set of hypotheses and data needs as noted in the program evaluation plan. The results will be of value to other entities seeking to undertake a similar large-scale pilot program in the future. The stakeholder data collection will implement qualitative interviews and a workshop at the end of the evaluation. Qualitative interviews are well-suited for examining and exploring contextual issues related to solicitation planning, program structure, technology issues, security and privacy, financial and institutional sustainability, and outreach as well as overall perspectives on the vision, goals, and desired impacts of the program. The workshop will bring together key stakeholders at USDOT to review and discuss the findings of the interviews and to provide strategic and operational recommendations (and lessons learned) for subsequent activities.

Target Stakeholders

For the purposes of this program evaluation plan, a "stakeholder" is a person at USDOT or one of the three pilot sites who is directly responsible for planning, managing, and guiding the CV pilot deployments. USDOT stakeholders are staff of ITS JPO, FHWA, and Volpe, as well as CV pilot USDOT team contractors from Noblis. Stakeholders also include the CV pilot site deployment managers and team members; however, their input on the program structure and process will be gathered as part of the stakeholder satisfaction and acceptance surveys/interviews (Task C). To the extent possible, the TTI team will ensure that the wording of questions asked in both the stakeholder satisfaction and acceptance surveys/interviews and the program evaluation are the same.

Data Collection Design

Qualitative interviews with USDOT stakeholders will be conducted in two phases. Phase 1 interviews will take place in Fall 2019 and will cover topics mainly related to solicitation planning and other pre-deployment topics. Phase 2 interviews will cover all other topics and will take place after the deployments are completed. See Table 3 for the topics and associated hypotheses that will be covered in each phase.

Table 3. Interview Topics and Hypotheses Covered in Each Phase of USDOT Stakeholder Interviews.

Interview Phase	Topic	Structure and Process Activities	Foundational Hypothesis
1	Solicitation Planning	Pre-Solicitation Outreach	#1—Extensive pre-solicitation outreach will increase the number and enhance the quality of submitted proposals.
1	Solicitation Planning	Emphasize Real-World Problem-Solving	#2—Focusing on real-world problem-solving will lead to proposals/projects where a definitive impact could be realized, even if only a limited total number of devices, vehicles, and technology might be deployed.
1	Solicitation Planning	Two-Phase Solicitation Structure	#3—Expand the set of potential proposers to include agencies otherwise too small or with cumbersome-contracting methods to respond to the pace of Phase 1 activity.
1	Solicitation Planning	Phases with "Go, No-Go" Gates	#4—Two-phase gates (one financial, the other operational) would provide USDOT with needed leverage to encourage sites to adhere to schedule, cost, and scope.

Interview Phase	Topic	Structure and Process Activities	Foundational Hypothesis
2	Program Structure	Post-Award Collaboration among Deployment Sites, Not Competition	#5—Collaboration among sites would provide more value than creating a competitive "funnel" program with roughly twice as many Phase 1 participants than Phase 2–3 awardees.
2	Program Structure	High Rate of Interaction Post-Award: Meeting Cadence and Topics/ Roundtables	#6—A set of regular structured topical roundtables plus monthly check-ins would ensure sites knew of each other's challenges, resolutions, and progress.
1	Technological Maturity	CV Tech Mature Enough to Mount a Successful Deployment Program	#7—The level of CV readiness was high enough to mount a deployment program. Further, the deployment program would help the industrial base to make these technologies more robust and deployable.
1	DSRC Focus	DSRC—Element of Each Deployment but Not Requirement	#8—Requiring sites to use DSRC in some way as a part of the deployment, but not requiring use for all applications, would allow more realistic, practical, and effective deployment concept.
1	Open Data/Open Source	Open Data and Open Source Required of All Deployments	#9—The open source/data requirement would not put off serious deployers, would not prove too onerous, and would assist in technology transfer to deployments outside of the CV pilot program.
2	Security/ Privacy	Cybersecurity and Privacy Protection Emphasized	#10—An early emphasis on cyber security and privacy would reduce the risk of cyber- or privacy-related issues in the operational phase of the deployments.
1	SCMS/ Certification	Certified Devices Connected with a Credential Management System Required	#11—Similar to the technical maturity hypothesis (#7), the dependence of the program on external certification and credential management would speed technology maturation without the program itself having to directly finance/manage their creation.

Interview Phase	Topic	Structure and Process Activities	Foundational Hypothesis
2	Financial/ Institutional Sustainability	Financial Sustainability after Federal Funding Emphasized	#12—By reiterating the need for long-term financial sustainability of the deployments, the program would reduce the risk of the deployed technologies being removed at the end of the funding period (as in field test) and the risk of the sites developing a long-term need for federal funding to continue.
2	Performance Measurement/Evaluation	Sites Required to Implement a Performance Measurement Capability	#13—A performance measurement capability would reinforce a performance-driven management of the system, allowing impacts to be more easily observed and quantified—even after a transient, complementary independent evaluation was completed.
2	Outreach/ Other Early Deployers	Sites Required to Participate in a Range of Structured, Coordinated Outreach Activities	#14—Outreach in a variety of forms, but structured and coordinated by the program, would help early deployers and shield the sites from numerous repetitive information requests.
2	Program Vision and Goals	Overall Program Structure and Process Assessment	#15—The overall effect of the program's innovative approaches and roadmap of activities resulted in outcomes that were positive to the USDOT team.
2	Program Vision and Goals	Overall Program Vision	#16—The CV pilot program met the vision laid out at the onset of the program.

Source: Karl Wunderlich, Noblis.

Qualitative interviews with the pilot site deployment managers and team members will take place in conjunction with the Task C data collection. The interview guides already contain some questions that inform the program evaluation; any new questions will be added to the long-term post-deployment interview guide. Questions already in the guide informed Hypotheses 7, 11, 12, and 13. New questions were added to the long-term post-deployment interview guide to address Hypotheses 3, 5, 6, 7, 8, 9, 10, and 14.

These interviews will take place when the deployment at each site is completed.

Interviews will be conducted by telephone. A semistructured interview format will be used for the USDOT stakeholder interviews (as is being used with the sites for the Task C data collection). In semistructured interviewing, a guide is followed, with questions and topics that must be covered. An interviewer has some discretion about the order in which questions are asked, but the questions are standardized, and probes may be provided to ensure that the researcher covers the correct material. This kind of interview collects detailed information, which is needed for the program evaluation, but in a way that is somewhat conversational. The interview guide for the Phase 1 interviews will be developed to include 10–15 questions, resulting in an interview length of about 30 minutes. The interview guide for the Phase 2 interviews will be longer, containing about 30 questions with an interview length of 45–60 minutes.

The interviews conducted subsequent to completion will focus on hypotheses and address data needs relating to program structure, technological maturity, DSRC, open data, security and privacy, credential management, financial and institutional sustainability, performance measurement, outreach, and program vision and goals. These interviews will be in the form of one-on-one interviews conducted via telephone. An interview guide will be developed to include around 25–30 questions, resulting in an interview length of about 30–45 minutes.

The workshop (or focus group) will be held after all of the post-completion interviews have been conducted. The purpose of the workshop is to foster additional dialog concerning the lessons learned and major takeaways from planning and managing the deployments. The common themes identified in the post-deployment interviews will be used to frame the group discussion, which will explore these and other topics in more detail.

Evaluating Financial Impacts

The hypotheses were agreed upon by USDOT on April 23, 2019. For the purpose of evaluating the financial impacts of the program, it is necessary to determine the costs of developing and managing the program. During the initial discussions, there was consideration for comparing the program costs for the CVPD Program with a typical transportation department initiative. TTI received feedback from USDOT on April 23, 2019, indicating that there is no set template for deployment. In a May 22, 2019, conversation, USDOT noted that the benefit-cost analysis may be difficult to assess and may need to be a soft goal. USDOT further suggested that some of this assessment may be captured in the interviews. In a June 19, 2019, conversation, the TTI team suggested proceeding with the following approach:

- Capture program costs and work activities through data provided by USDOT (at least order of magnitude). This includes contractor and USDOT costs, and it covers the time prior to the pre-deployment workshops while the program was being formulated.
- Compile program cost information as a basis to inform future programs.
- Provide program cost information and national deployment perspective to USDOT Task E Workshop participants to inform their opinions.
- Develop impact assessment based on informed workshop project participant opinions.

The USDOT team agreed, and the approach was incorporated into the June 24 version of the Task E Program Evaluation Plan document.

Key data regarding staffing and costs by the USDOT team were not found in the published reports. Further, some aspects of activities were not described in adequate detail. For instance, information on the pre-deployment workshops primarily contained high-level descriptions of the goals and objectives. The

range of workshop participants was not included. Information on participation in the workshops could be used to provide an estimate of private-sector resources leveraged in that activity.

TTI sought data about the USDOT team's work efforts to more fully answer the hypotheses and to assess the impacts of the program, including all USDOT team work activities and costs to develop and administer the program. These include those incurred prior the beginning of the 9/13 start of the pre-deployment activities and through each of the program's phases. TTI submitted this data needs list to USDOT on April 10, 2019.

Achieving the CVPD Program Vision

The last level of analysis involves assessing the extent to which USDOT achieved its overall vision for the CVPD Program. According to the ITS JPO CVPD website (*1*), the overall objectives of the CVPD Program are as follows:

- To spur early CV technology deployment, not just through wirelessly connected vehicles but also through other elements that are major players in this connected environment, such as mobile devices, infrastructure, transportation management centers (TMCs), and other elements. Data can be integrated from these multiple sources to help make key decisions.
- To target improving safety and mobility and environmental impacts and commit to measuring those benefits. Measurement of the impacts and benefits will be gathered from real-world deployments, rather than an isolated testbed or a computer-based simulation testbed. Differentiating and finding these benefits and identifying what can be attributed to these CV applications and technologies is an important component of the activity.
- To resolve issues of various deployments. People often first jump to technical areas and focus on getting applications to work together, but that is only part of the concern. Institutional arrangements must be put in place to ensure installation of the technology as well as to manage and govern the sharing of information. Also, financial arrangements must be made that may integrate the technologies into a financially sustainable model that can be sustained following the initial funding from the initial pilots.

To assess whether USDOT achieved these objectives, TTI will examine how the CVPD Program changed the connected vehicle landscape in the United States. TTI will look at other deployments that are ongoing in the United States to determine what level of contribution the CVPD Program had on those deployments. TTI will also examine the extent to which the CVPD Program contributed to improvements in safety, mobility, and the environment throughout the United States. Finally, TTI will document not only the technological advances derived from the CVPD Program but also how the program helped shape data-sharing, institutional, and financial arrangements in other deployments in the United States.

Chapter 4. Evaluation Data and Data Management

This chapter provides a summary of the sources of data that TTI plans to use to conduct the program structure and process evaluation. Most of the data that TTI needs for this evaluation will come from USDOT. Table 4 lists the data that TTI anticipates needing from USDOT to successfully complete this evaluaiton.

Data Ownership and Privacy

Any data collected by TTI, including the simulation input file and result files, become the property of USDOT once the project is complete. After removing any personally identifiable information from the data, TTI plans to upload any data files generated in the analysis to the Secured Data Commons (SDC). TTI will reference and credit appropriately any data obtained from external sources. TTI has implemented policies and procedures for protecting and controlling personally identifiable information.

Data Analysis and Management Procedures

TTI plans to conduct all data analyses and statistical comparisons within the structure of the SDC. The SDC is a cloud-based, online analytic portal where data collected by each of the CVPD teams are placed for use in the independent evaluation. The purpose of the SDC is to provide a secure platform that will enable USDOT and others to share large data sets, both structured and unstructured, for evaluation and collaboration. TTI will work with USDOT and the SDC development team to ensure that proper resources and analytical tools are available in the SDC. Other than summary charts, figures, and tables contained in published reports, TTI does not plan to disseminate or distribute the data in any form outside of the SDC.

TTI will keep the data gathered from the qualitative interviews, online surveys, and workshops confidential. Survey and interview participants can be identified only by authorized team members of TTI. TTI will prepare summaries of all interviews, surveys, and the workshop. After preparing the summaries, raw survey responses and interview notes will be kept in a secure file cabinet under lock and key until the final report is prepared. Once the final report is approved by USDOT, TTI will destroy any raw notes or materials obtained in the interviews or workshop.

Table 4. Data Needs from USDOT.

#	Hypothesis	Data to Be Provided by USDOT
1	Extensive pre-solicitation outreach would increase the number and enhance the quality of submitted proposals.	• Description of the pre-solicitation outreach activities including the number of sites and participants in the pre-solicitation engagements. Number of pre-solicitation participants can be used as one measure of how the USDOT pre-solicitation effort leveraged external resources. • Number of sites and participants in the awarded pilots. • USDOT team cost for workshops, webinars, and outreach activities during the pre-solicitation period. Cost includes staff time, travel to workshops, and venue costs for conducting in-person exchanges (e.g., hotels, webinar tool costs, handouts). Labor costs include transportation department staff and their consultant team. • Typical number of sites proposed on a similar, traditional project without the extended pre-solicitation phase. • Typical time (should be less than nine months) and effort (cost, labor, and other engagement resources) for pre-solicitation activity for a similar traditional project.
2	Focus on problem-solving would lead to proposals/projects where a definitive impact could be realized, even if only a limited total number of devices, vehicles, and technology might be deployed.	• Description of pre-proposal instances where focus of outreach material and conversation were addressed to problem-solving during the pre-solicitation phase. • Description of proposal and project instances where the USDOT team recognizes that definitive impacts were realized.
3	Expand the set of potential proposers to include agencies otherwise too small or with cumbersome contracting methods to respond to the pace of Phase 1 activity.	• Description of the expected smaller and contract-constrained proposers that could be engaged by a two-phase solicitation structure. • Description of actual smaller and contract-constrained proposers that could be engaged by a two-phase solicitation structure.
4	The two consequential phase gates (one technical, the other operational) would provide USDOT with needed leverage to encourage sites to adhere to schedule, cost, and scope.	• Program schedule showing defining gates. This could be information provided by the USDOT team or verification from USDOT team that the information on the CVPD Program website at https://www.its.dot.gov/pilots/pilots_overview.htm is correct. • Program schedule adherence.

#	Hypothesis	Data to Be Provided by USDOT
5	Collaboration among sites would provide more value than creating a competitive "funnel" program with roughly twice as many Phase 1 participants than Phase 2–3 awardees.	• Examples of site cooperation that adds value to the program. In addition to the exchange of data, this added value could be expressed by avoidance of mistakes, purchasing at reduced costs, sharing of local community outreach information, or identification of effective operations procedures.
6	A set of regular structured topical roundtables plus monthly check-ins would ensure sites knew of each other's challenges, resolutions, and progress.	• Listing of post-award roundtable meetings and monthly check-ins including a quantification of the attendees and costs for the meetings.
7	The level of CV readiness was high enough to mount a deployment program. Further, the deployment program would help the industrial base to make these technologies more robust and deployable.	• Examples communicated to USDOT where industry acknowledged that the CVPD Program advanced the marketplace.
8	Requiring sites to use DSRC in some way as a part of the deployment, but not requiring use for all applications, would allow more realistic, practical, and effective deployment concept.	• Listing of communications technologies used at each CV pilot site including DSRC, cellular V2X, and others.
9	The open source/data requirement would not put off serious deployers, would not prove too onerous, and would assist in technology transfer to deployments outside of the CV pilot program.	• Identification of any known serious deployers that would not engage in the pilot deployments despite their interest because of the open data source requirements. • Examples of use of open source data in technology transfer to deployments outside of the CV pilot program. • Number of downloads of CVPD applications on OSADP.
10	An early emphasis on cyber security and privacy would reduce the risk of cyber- or privacy-related issues in the operational phase of the deployments.	• Description of cyber security and privacy issues in the operational phase of CV pilots.
11	Similar to the technical maturity hypothesis, the dependence of the program on external certification and credential management would speed the maturation of these needed capabilities without the program itself having to directly finance/manage their creation.	• Status of USDOT funding for creation of resources and tools associated with certification and credential management during the course of the program.
12	By reiterating the need for long-term financial sustainability of the deployments, the program would reduce the risk of the deployed technologies being removed at the end of the funding period (as in field test) OR the risk of the sites developing a long-term need for federal funding to continue.	• Uses of federal funding to continue operation of the sites and examples of assets being decommissioned after completion of the project.

#	Hypothesis	Data to Be Provided by USDOT
13	A performance measurement capability would reinforce a performance-driven management of the system, allowing impacts to be more easily observed and quantified through an independent evaluation of near-term impacts.	• Examples of sites using performance-management capabilities throughout the deployment and after the completion of the independent evaluation.
14	Getting the word out in a variety of forms, but within a structured and coordinated construct provided by the program, would be the best way to both help other early deployers and shield the sites from numerous repetitive requests for information.	• Estimates of requests for information from sites and an assessment of how many were repetitive.
15	The overall effect of the program's innovative approaches and roadmap of activities resulted in outcomes that were positive to the USDOT team.	• Program vision and program goals of USDOT CVPD Program if they differ from those listed at https://www.its.dot.gov/pilots/pilots_overview.htm.
16	The CV pilot program met the vision laid out at the onset of the program.	• Program vision and program goals of USDOT CVPD Program if they differ from those listed at https://www.its.dot.gov/pilots/pilots_overview.htm.

Chapter 5. Risks and Uncertainties

This chapter discusses key risks and uncertainties that may impact the program structure and process evaluation effort. The chapter also describes mitigation strategies that address some aspects of the identified risks.

Risk of Uninformed Opinions about the Program

The CVPD Program has a life of four-plus years. In that time frame, it is possible that federal and local organizational priorities could be modified, that USDOT CV pilot staff and their contractor staff could change, and that funding could be adjusted in USDOT and site-specific agencies. These institutional and staffing uncertainties are a risk for assessing informed opinions about the CVPD Program. Over time, CVPD staffing can be reassigned, memories can fade, and documentation can become unavailable. The result could be that informed opinions are unavailable or so small in number that outcomes are not helpful to future program endeavors.

As a mitigating strategy for the vagaries of time, TTI will conduct interviews in a two-staged manner. This process is described in more detail in Chapter 3 in the section titled Stakeholder Data Collection Plan. The mitigation strategy is that qualitative interviews with USDOT stakeholders conducted in the program evaluation will be implemented at two points in time: (a) prior to the completion of the CV pilot deployments in Wyoming, Tampa, and New York City; and (b) subsequent to the completion of the CV pilot deployments in Wyoming, Tampa, and New York City.

The interviews conducted prior to completion will focus on hypotheses related to solicitation planning. The second interviews after completion of the CV pilots will address the remaining hypotheses.

Risk of Technology Disruption

The CVPD Program is being conducted in a time of extraordinary technology change and marketplace uncertainty. One of the values of the CVPD Program for operational agencies is that local costs are reduced, and the impacts of poor outcomes are muted. Local agencies and their staff perform in an environment where budgets are scarce and the penalties for failure or underperformance can be significant for careers and agencies.

If technology products and services alter the marketplace deployment direction for connected vehicles and alter the associated technology in the ecosystem of automated vehicles, these forces could render old solutions obsolete and bring new, compelling choices to the marketplace. That disruption could impact the opinions of the USDOT team about the CVPD Program.

An example of technology uncertainty and potential change revolves around the use of DSRC for communications. There is no federal mandate for use of DSRC, and vehicle manufacturers have presented differing preferences for communications. For example, Toyota has invested in DSRC vehicles in Japan and announced plans in 2018 to begin deploying DSRC in its USA vehicles beginning in 2021

(*2*). However, on April 26, 2019, in a letter to the FCC, Toyota announced that it would pause its deployment of DSRC (*3*). At the same time, Ford is pursuing a cellular-based approach.

A mitigating strategy is for TTI to take a snapshot of informed opinions before the project is completed and before a technology change impact dramatically alters perceptions of the project. As previously discussed, TTI will conduct interviews in a two-staged manner, as described in more detail in Chapter 3 in the section titled Stakeholder Data Collection Plan. The qualitative interviews will be conducted at two points in time: (a) prior to the completion of the CV pilot deployments in Wyoming, Tampa, and New York City; and (b) subsequent to the completion of the CV pilot deployments in Wyoming, Tampa, and New York City.

The interviews conducted prior to completion will focus on hypotheses related to solicitation planning. The second interviews after completion of the CV pilots will address the remaining hypotheses.

Risk of Sparse Data Describing the USDOT Program Effort

The hypotheses were agreed upon by USDOT on April 23, 2019. TTI sought data about the USDOT team work efforts to more fully answer the hypotheses and to assess the impacts of the program. This requested information is described in Chapter 4. TTI submitted this data needs list to USDOT on April 10, 2019. TTI received feedback from USDOT on April 23, 2019, indicating that there is no set template for deployment. In a May 22, 2019, conversation, USDOT noted that the benefit-cost analysis may be difficult to assess and may need to be a soft goal. USDOT further suggested that some of this assessment may be captured in the interviews. In a June 19, 2019, conversation, the TTI team suggested proceeding with the following approach.

- Capture program costs and work activities through data provided by USDOT (at least order of magnitude). This includes contractor and USDOT costs, and it covers the time prior to the pre-deployment workshops while the program was being formulated.
- Compile program cost information as a basis to inform future programs.
- Provide program cost information and national deployment perspective to USDOT Task E Workshop participants to inform their opinions.
- Develop impact assessment based on informed workshop project participant opinions.

The USDOT team agreed, and the approach was incorporated into the June 24 version of the Task E Program Evaluation Plan document.

Key data regarding staffing and costs by the USDOT team were not found in the published reports. Further, some aspects of activities were not described in adequate detail. For instance, information on the pre-deployment workshops primarily contained high-level descriptions of the goals and objectives. The range of workshop participants was not included. Information on participation in the workshops could be used to provide an estimate of private-sector resources leveraged in that activity.

As a mitigating strategy, TTI will continue to ask the USDOT team for data to support the hypotheses. If the data are not provided, the Task E program evaluation will be performed with less quantitative analysis than anticipated and will rely primarily on qualitative data from interviews.

References

1. U.S. Department of Transportation. (n.d.). Intelligent Transportation Systems—Connected Vehicle Pilot Deployment Program. Retrieved April 27, 2019, from https://www.its.dot.gov/pilots/pilots_overview.htm.

2. Toyota and Lexus to Launch Technology to Connect Vehicles and Infrastructure in the U.S. in 2021. (2016, April 16). Retrieved from https://corporatenews.pressroom.toyota.com/releases/toyota and lexus to launch technology connect vehicles infrastructure in u s 2021.htm.

3. Toyota Motor Company North America. (2019, April 26). Federal Communications Systems Filing Toyota Comment 4.26.19 Final. Retrieved from https://ecfsapi.fcc.gov/file/1042648273702/Toyota%20Comment%204.26.19%20FINAL.pdf.

Appendix A. Overview of Connected Vehicle Pilot Deployment Program

This appendix captures the program vision, program goals, program schedule, and program roadmap of USDOT's CVPD Program, as specified on the ITS JPO CVPD Program website as of April 30, 2019 (*1*).

Program Vision

The program seeks to spur innovation among early adopters of CV application concepts using the best available and emerging ITS and communications technologies. The pilot deployments are expected to integrate CV research concepts into practical and effective elements, enhancing existing operational capabilities. The intent of these pilot deployments is to encourage partnerships of multiple stakeholders (e.g., private companies, States, transit agencies, commercial vehicle operators, and freight shippers) to deploy applications utilizing data captured from multiple sources (e.g., vehicles, mobile devices, and infrastructure) across all elements of the surface transportation system (i.e., transit, freeway, arterial, parking facilities, and tollways) to support improved system performance and enhanced performance-based management. The pilot deployments are also expected to support an impact assessment and evaluation effort that will inform a broader cost-benefit assessment of CV concepts and technologies.

Program Goals

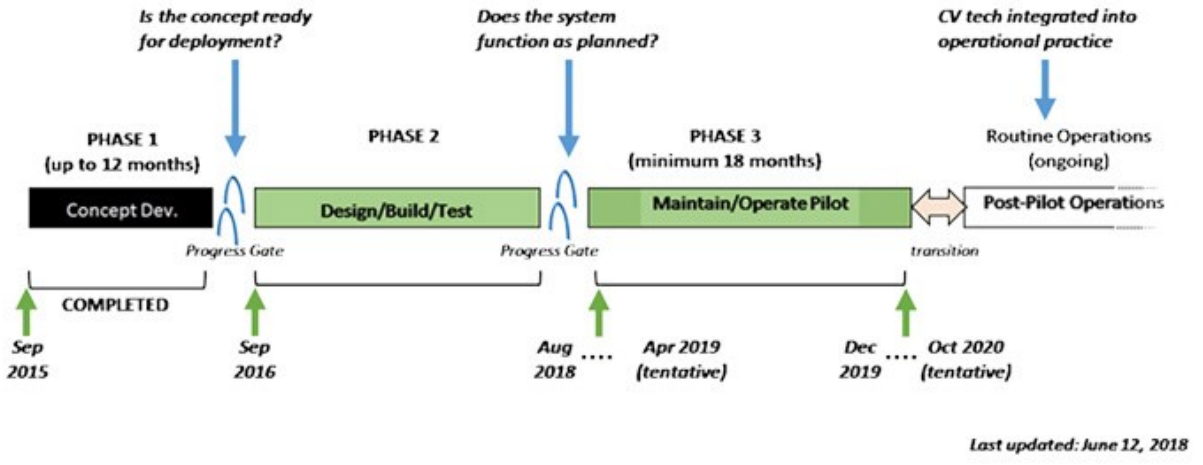
- To spur early CV tech deployment, not just through wirelessly connected vehicles but also through other elements that are major players in this connected environment, such as mobile devices, infrastructure, TMCs, and other elements. Data can be integrated from these multiple sources to help make key decisions.
- To target improving safety and mobility and environmental impacts and commit to measuring those benefits. Measurement of the impacts and benefits will be gathered from real-world deployments, rather than an isolated testbed or a computer-based simulation testbed. Differentiating and finding these benefits and identifying what can be attributed to these CV applications and technologies is an important component of the activity.
- To resolve issues of various deployments. People often first jump to technical areas and focus on getting applications to work together—but that is only part of the concern. Institutional arrangements must be put in place to ensure installation of the technology as well as to manage and govern the sharing of information. Also, financial arrangements must be made that may integrate the technologies into a financially sustainable model that can be sustained following the initial funding from the initial pilots.

Source: USDOT ITS JPO CVPD Program Website

Figure 3. USDOT's Program Goals for the CVPD.

Program Schedule

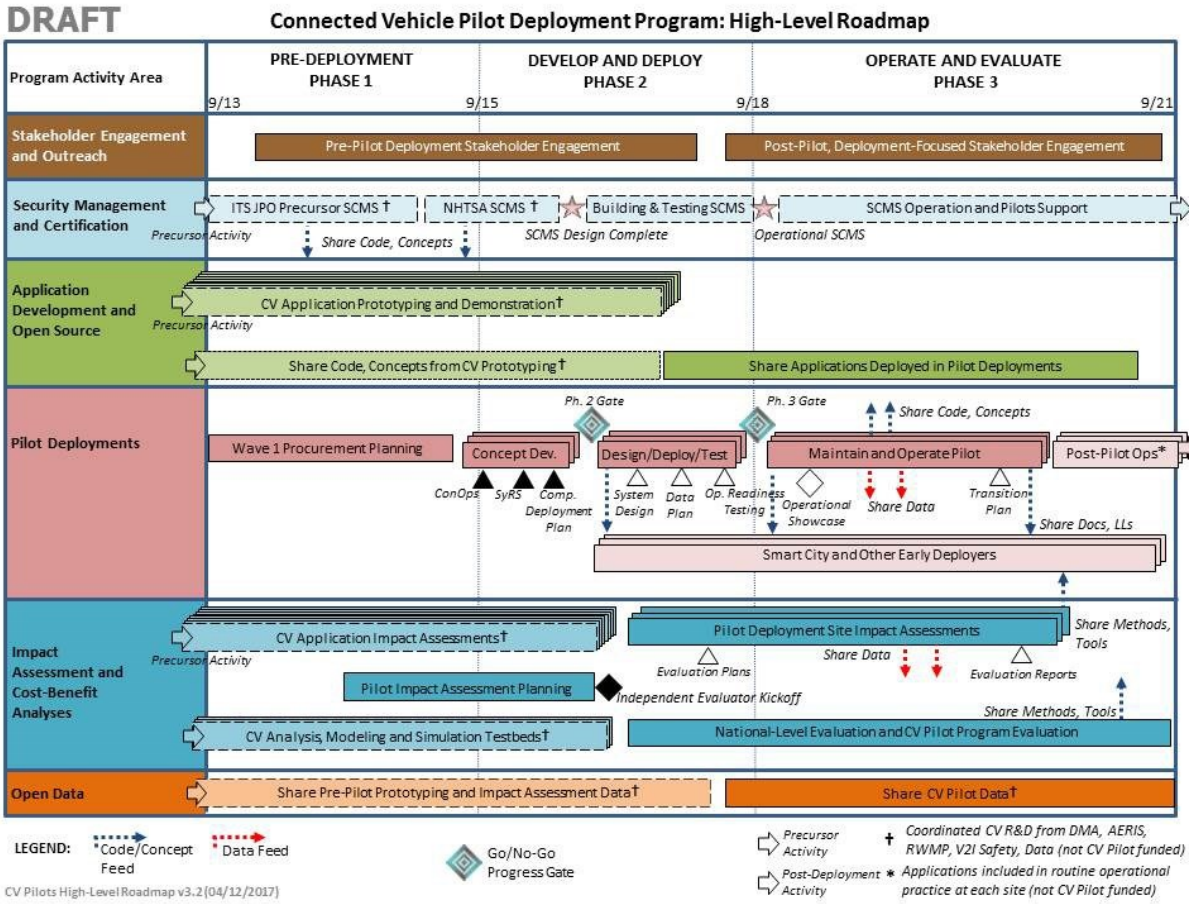
Each pilot deployment site is being developed in three distinct phases. In Phase 1, the sites spent 12 months preparing a comprehensive deployment concept to ensure a rapid and efficient CV capability roll-out. The sites next spent 24–36 months in Phase 2 designing, building, and testing these deployments of integrated wireless in-vehicle, mobile device, and roadside technologies. In Phase 3, the tested CV systems will be operational for a minimum 18-month period, and the systems' impact will be monitored on a set of key performance measures.



Source: USDOT ITS JPO CVPD Program Website

Figure 4. CVPD Program Schedule.

Program Roadmap



Source: USDOT ITS JPO CVPD Program Website

Figure 5. CVPD Program Roadmap.

Appendix B. Initial Review of CVPD Program Literature and Reports

The USDOT Connected Vehicle Pilot Deployment Program is an extensive activity that is generating substantial documentation as it progresses. To ensure that Task E Program Evaluation work has access to relevant Program material and that duplicative data capture and assessment actions are avoided, the TTI Team reviewed key Program documents. Appendix B highlights the Team's observations.

CV Pilots Featured in Wyoming Traffic Management Center Open House
(https://www.its.dot.gov/pilots/cv_wyoming_traffic.htm)

The Wyoming Department of Transportation (WYDOT) held an open house at its Traffic Management Center and Highway Patrol dispatch complex for interested industry and government leaders on February 19, 2018. The open house showcased the work being done at the complex, including the WYDOT-led CV pilot program.

In the middle of the active State budget session, about a dozen Wyoming State legislators made the trip to the open house, along with representatives of the Wyoming Trucking Association and other industry groups.

Wyoming DOT (WYDOT) Connected Vehicle Pilot Showcases Safety Technology
(https://www.its.dot.gov/pilots/wydot_safety_tech.htm)

WYDOT conducted an Operational Capability Showcase (or Showcase) on October 30, 2018, at the WYDOT Office Auditorium in Cheyenne. The Showcase was an opportunity for WYDOT to share with the media and other invited attendees the intent of the CV pilot and its value to travelers on I-80 in southern Wyoming.

The Showcase was attended by the media, members of the Wyoming Trucking Association, WYDOT pilot partners, and USDOT. Representatives from several partners made remarks echoing that the pilot offers game-changing technology and will increase safety and efficiency of the transportation system. John Dooley, former WYDOT commissioner and president of Dooley Oil Inc., stated that all of his drivers are committed to training and taking the opportunity to participate in the pilot. Jack Bedessem, president of Trihydro, said it was a "no brainer to participate in the project." Tom DeHoff, WYDOT District 1 district engineer, representing all districts, stressed support for the pilot, particularly using technology to increase safety of the field personnel and traveling public. Col. Kebin Haller of the Wyoming Highway Patrol also echoed support to participate in the pilot, stressing that timely information from CV technology will benefit the traveling public.

Connected Vehicle Pilot Deployment Program Phase 2 Deployment Outreach Plan, Version 3—WYDOT (https://rosap.ntl.bts.gov/view/dot/36239)

This document is great for outreach information. Not much on specific numbers.

Audience Group	Outreach Goal
Federal/State/Local Government	Establish understanding, awareness, and support (preferably public support) of the pilot.
Stakeholders	Establish understanding, awareness, and support. Achieve partnerships that will allow stakeholders to share positive information about the pilot to their members/customers.
Trucking Industry	Successfully communicate with key players in the trucking industry and gain their support of the pilot and commitment to recruit drivers to participate.
Media	Ensure that all identified and relevant media outlets are contacted and informed of the pilot and invited to the press events. Secure positive press about the pilot.
General Public	Achieve public support for the pilot and mitigate negative public sentiment.
Other CV Pilots	Provide information, training, and best practices/lessons learned.
Vendors	Establish support and garner participation in the pilot.

Demonstration of Connected Vehicle Technology in Tampa to State Transportation Officials (https://www.its.dot.gov/pilots/cv_tech_tampa.htm)

On Thursday, April 12, 2019, representatives of 18 transportation agencies from across the United States were treated to a Tampa State Transportation demonstration of CV technology by the Tampa Hillsborough Expressway Authority (THEA) in Tampa, Florida.

The visiting officials represented state departments of transportation of California, Tampa State Transportation Florida, Georgia, Illinois, Kansas, Michigan, Minnesota, Missouri, Nevada, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Utah, and Wisconsin; the Regional Transportation Commission of Southern Nevada; and FHWA. The officials were in Tampa for a meeting of the TMC Pooled Fund Study, a group that conducts TMC-related research, operational tests, technology transfer, and training. Information about this group can be found at https://tmcpfs.ops.fhwa.dot.gov/.

Tampa Connected Vehicle Pilot Success in Recruiting Participants (https://www.its.dot.gov/pilots/tampa_participants.htm)

On August 15, 2019, THEA distributed a news release with the header “Tampa Hillsborough Expressway Authority Seeks Volunteers to Test Connected Vehicle Technology.” This attracted coverage from several local TV stations as well as the *Tampa Bay Times*. The number of signups increased dramatically in the first few days after the project received that boost in media coverage.

Every driver must complete the online eligibility questionnaire and schedule an installation appointment. As of late October 2017, more than 1,200 people have completed the online eligibility questionnaire, and 800 of them have scheduled appointments.

Partnerships with Taxis and Delivery Trucks in New York City to Improve Safety and Mobility (https://www.its.dot.gov/pilots/nyc_partnerships_safety.htm)

The project began in 2015 when NYCDOT approached the TLC, MTA, UPS, and others to propose a large-scale deployment of connected vehicles. The meeting included technical, operations, and legal personnel to address a wide range of issues, including device installation, maintenance requirements, operating hours, operator selection, geographic coverage areas, stakeholder responsibilities, system operation, driver interface, and data collection activities.

Connected Vehicle Pilot Deployment Program Driving Towards Deployment: Lessons Learned from the Design/Build/Test Phase (https://rosap.ntl.bts.gov/view/dot/37681)

One such conference was the Institute of Transportation Engineers Annual Meeting that occurred August 19–23, 2018, in Minneapolis, Minnesota. Representatives from each of the sites presented as part of a workshop on Building Smarter Communities through Better Transportation.

Connected Vehicle Pilot Deployment Program Independent Evaluation: Stakeholder Acceptance Plan (https://rosap.ntl.bts.gov/view/dot/36414). The Independent Evaluator will be conducting a workshop of foster a cross-stakeholder dialog concerning the lessons learned and major takeaways. Information for financial and institutional assessments. The workshop will be conducted 9-12 months after activation of the pilots. The table below shows the targeted stakeholders for each deployment

Timeline (Expected Date)	Target Group (Number of Entities)—Number of Persons
New York City	• Deployment Managers (1)—3 • Deployment Team Members (5)—12 • Operating Agencies (6)—15 • Total = 30
Tampa	• Deployment Managers (1)—3 • Deployment Team Members (4)—10 • Operating Agencies (2)—6 • Total = 19
Wyoming	• Deployment Managers (1)—3 • Deployment Team Members (11)—16 • Operating Agencies (3)—9 • Total = 28

Connected Vehicle Pilots Phase 2 Interoperability Test—Test Report (https://rosap.ntl.bts.gov/view/dot/39009)

Appendix B. Individuals that Participated in the Interoperability Test

Archived ITS Presentations (https://www.its.dot.gov/resources/archived_presentations.htm#cvpilots)

Lots of information but nothing on participants.

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