Connected Vehicle Pilot Deployment Program Independent Evaluation

Financial & Institutional Assessment—Tampa (THEA)

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Research Report–July 28, 2022
FHWA-JPO-22-939

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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Notice

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-JPO-22-939		

4. Title and Subtitle	5. Report Date
Connected Vehicle Pilot Deployment Program Independent Evaluation: Financial and Institutional Assessment—Tampa (THEA)	July 28, 2022
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Kuhn, B. (TTI) , K. Balke (TTI), and C. Simek (TTI)	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Texas A&M Transportation Institute Texas A&M University System 3135 TAMU College Station, TX 77843-3135	11. Contract or Grant No. DTFH6116D00045

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
US Department of Transportation ITS Joint Program Office 1200 New Jersey Avenue, SE Washington, DC 20590	Research Report
	14. Sponsoring Agency Code

15. Supplementary Notes

Work Performed for Walter During (FHWA) and Neil Spiller (FHWA)

16. Abstract

This report presents the financial and institutional evaluation conducted by the Texas A&M Transportation Institute (TTI) Connected Vehicle Pilot Deployment (CVPD) Evaluation Team of the Tampa CVPD. The purpose of the financial evaluation was to assess the changes in the financial settings, frameworks, models, elements, and associated impacts from the planned and implemented CV deployments and to evaluate the likelihood that the Tampa CVPD site achieved financial sustainability, which included the identification of the key factors that influenced financial sustainability and the key metrics for measuring and evaluating the achievement of financial sustainability, particularly due to changes in the underlying financial and business inputs. The purpose of the institutional evaluation was to assess the organizational changes that stemmed from the Tampa CVPD, including the systematic evaluation of the effects of institutional changes in Tampa to identify potential strategies to minimize institutional risk. Six factors were the target of the institutional evaluation: (a) governance, (b) public partnerships, (c) private partnerships, (d) organizational efficiency, (e) legislation, and (f) industrial organization. The TTI CVPD Evaluation Team also worked to identify to what extent the Tampa CVPD site was able to address identified institutional risks.

17. Keywords	18. Distribution Statement
Connected Vehicle Pilot Deployment, Independent Evaluation, Financial, Institutional, Tampa, Evaluation Plan	

19. Security Classif. (of this report	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	27	

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, Federal Highway Administration (FHWA).
- Neil Spiller, FHWA.
- Kate Hartman, Intelligent Transportation Systems Joint Program Office (ITS JPO).
- Jonathan Walker, ITS JPO.
- Govindarajan Vadakpat, FHWA.
- Douglas Laird, FHWA.
- Tom Kearney, FHWA.
- James Colyar, FHWA.
- James Sturrock, FHWA.
- Volker Fessmann, FHWA.
- Margaret Petrella, Volpe National Transportation Systems Center.
- Wassim Najm, Volpe Center.
- Karl Wunderlich, Noblis.
- Meenakshy Vasudevan, Noblis.
- Sampson Asare, Noblis.
- Kathy Thompson, Noblis.
- Peiwei Wang, Noblis.

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Chapter 1. Introduction

This report provides the results of the financial and institutional evaluations of the Tampa Connected Vehicle Pilot Deployment (CVPD). The overall purpose of the financial evaluation was to assess the changes, if any, in the financial settings, frameworks, models, elements, and associated impacts from the planned and implemented CV deployments and to evaluate the likelihood that the Tampa CVPD achieved financial sustainability, which included the identification of the key factors that influenced financial sustainability and the key metrics for assessing the potential for financial sustainability, particularly due to changes in the underlying financial and business inputs. The purpose of the institutional evaluation was to assess the organizational changes that stemmed from the Tampa CVPD, including the systematic evaluation of the effects of institutional changes in Tampa to identify potential strategies to minimize institutional risk. Six factors were the target of the institutional evaluation:

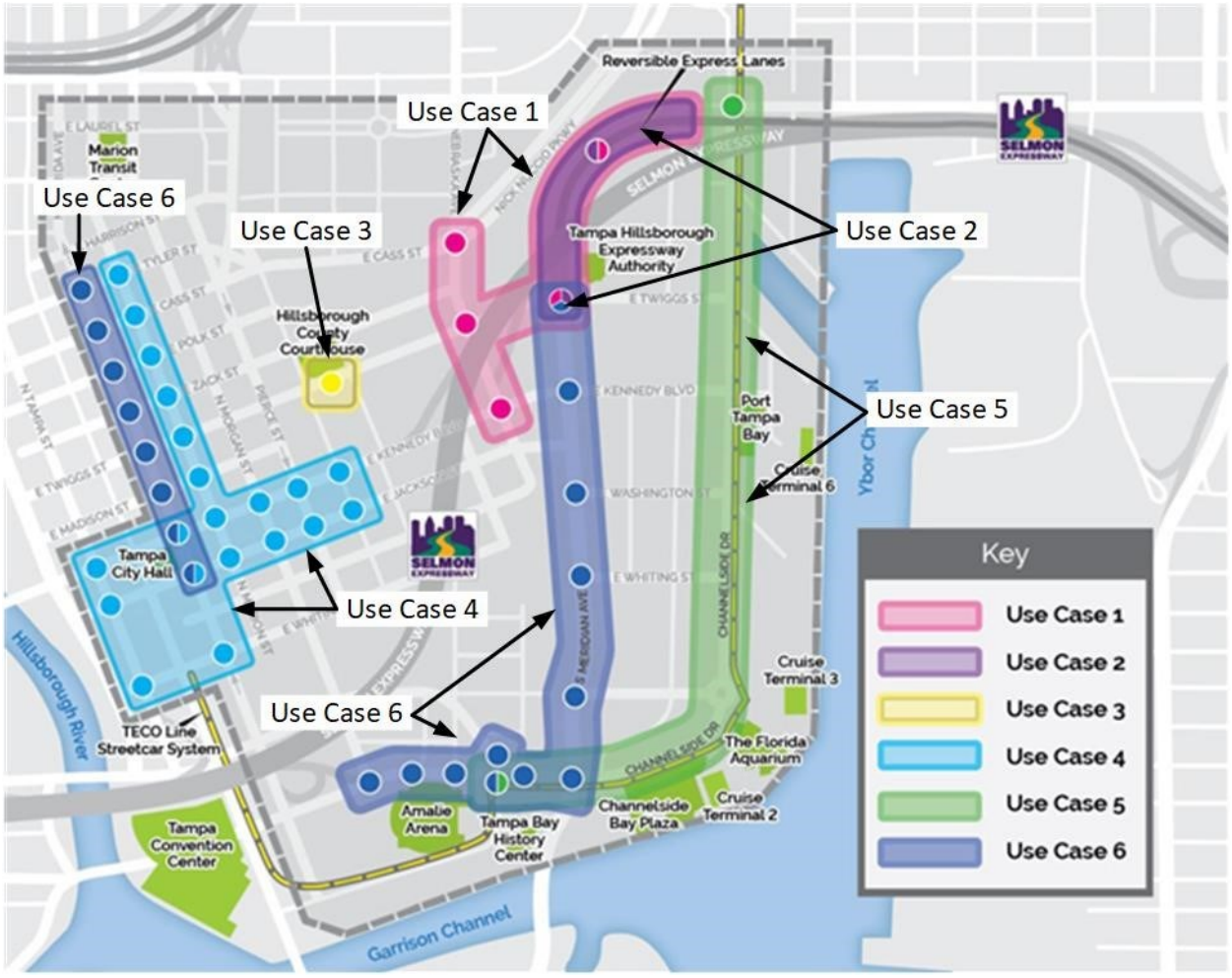
- Governance.
- Public partnerships.
- Private partnerships.
- Organizational efficiency.
- Legislation.
- Industrial organization.

Summary of the Tampa Connected Vehicle Pilot Deployment

The goal of the Tampa CVPD was to transform the experience of automobile travelers, transit riders, and pedestrians 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 equipped buses, streetcars, and privately owned vehicles with connected vehicle (CV) technologies that allowed them to exchange basic safety messages and travel condition information with each other and with the infrastructure; these messages were used by the receiving vehicles to generate alerts/warnings as necessary. The objectives of the Tampa CVPD were 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 deployed CV technologies in the downtown areas.



Source: Tampa Hillsborough Expressway Authority, 2018.

Figure 1. Map. The Tampa CVPD Corridors.

To support these objectives, THEA deployed the following applications as part of its CVPD:[(2)]

- **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 also broadcasts a warning to other equipped vehicles on the REL to be alert for wrong-way vehicles.
- **Pedestrian Collision Warning—**This application warns the driver when a pedestrian is using a crosswalk in the vehicle's projected path.
- **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.

The Tampa CVPD Team was unable to get the Transit Signal Priority and the Intelligent Traffic Signal applications operational during Phase 3. These applications were not included in the post-deployment mobility, environmental, and public agency efficiency assessments. In the Tampa CVPD, THEA deployed CV technologies in 1,020 privately owned vehicles, 10 buses, and 10 streetcars. THEA also planned to install 40 roadside units at strategic locations in the downtown area to support the CV applications.[2]

Organization of Report

The Texas A&M Transportation Institute (TTI) CVPD Evaluation Team organized this report into the following chapters. The titles of each chapter and the major topics contained therein are as followed:

- **Chapter 2. Financial Factors—**This chapter identifies the factors that had the potential to influence the financial outcomes of the pilot deployment and documents the assessment of the financial factors for the Tampa CVPD.
- **Chapter 3. Institutional Factors—**This chapter provides an overview of the information and data provided by the Tampa Pilot Site to conduct the financial evaluation as well as how the TTI CVPD Evaluation Team collected them. This chapter also describes the process that the TTI CVPD Evaluation Team used to perform the financial evaluation and reports the overall results of that analysis.

Chapter 2. Financial Factors

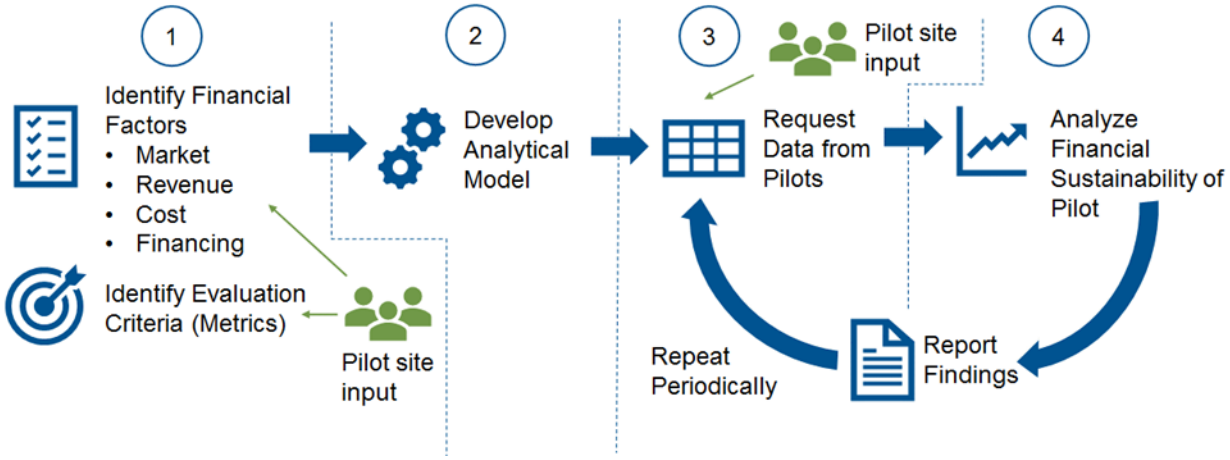
The purpose of the financial evaluation was to assess whether the THEA CVPD achieved financial sustainability based on the planned and implemented deployments. The objectives of this evaluation were to: [3]

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

For the purposes of these objectives, the TTI CVPD Evaluation Team defined financial sustainability as the deployment agency having resources sufficient to operate and maintain the CV applications over a seven-year period without additional CV federal grant y after the pilot deployment program ends at the site.

The primary objective of the THEA CVPD was to demonstrate, quantify, and evaluate the impact of advanced technologies, strategies, and applications on addressing the city's challenges.[1] Specifically, it aimed to improve the safety and mobility of automobile drivers, transit riders, and pedestrians in downtown Tampa through crash prevention and enhanced traffic flow. The applications tested included: (a) vehicle-to-vehicle (V2V) safety applications, (b) vehicle-to-infrastructure (V2I) safety applications, and (c) vehicle-to-pedestrian (V2P) applications. The stated goals of the U.S. Department of Transportation (USDOT) CVPDs were to improve safety, mobility, environmental, and public agency efficiencies. Originally, the TTI CVPD Evaluation Team was tasked with applying quantitative and qualitative evaluation methodologies to before-and-after performance assessments; conducting cost-benefit assessments of the demonstration; assessing user acceptance/citizen satisfaction of the demonstration; documenting lessons learned, challenges, and approaches for mitigating, addressing, and/or overcoming deployment challenges; estimating total impacts, costs, and return-on-investment of the demonstration; and assessing how well the initiative in Florida managed to bring to the table and utilize institutional partners.

The TTI CVPD Evaluation Team originally proposed as part of the financial and institutional evaluation plan to utilize a four-step process to meet the objectives of this task.[3] Figure 2 illustrates the four-step process that the TTI CVPD Evaluation Team intended to use to perform the financial analysis.



Source: Texas A&M Transportation Institute, 2018.

Figure 2. Diagram. Originally Planned Four-Step Process for Achieving Project Objectives.

The original steps in the process were as follows:[3]

- Step 1: Identify the factors that impact financial sustainability and formalize the evaluation metrics that will be used to determine if financial sustainability has been achieved. The pilot sites were asked to provide input for this step.
- Step 2: Develop an analytical model that will take the financial factor inputs and produce output metrics that measure financial sustainability.
- Step 3: Submit a data request to the pilot sites for detailed financial information, based on the factors identified in Step 1.
- Step 4: Analyze the data provided by the pilot sites using the analytical model and report the findings.

However, because of deployment delays and the COVID-19 pandemic, TTI's evaluation transitioned from the intended quantitative analysis to a qualitative analysis supported by financial-related data and qualitative information related to funding and finance as collected by the Tampa deployment team and the evaluation team. Therefore, TTI's qualitative analysis on the financial data that was provided, along with the lessons learned, can be applied in deployments and operations of other CV deployments in the future.

Financial Challenges and Issues

At various stages in the deployment, the TTI CVPD Evaluation Team gathered stakeholder feedback about financial lessons learned.[5] This feedback was provided through interviews with stakeholders and a post-deployment workshop with the Tampa CVPD Team. The purpose of the interviews and workshop was to identify and track changes in stakeholder perceptions as the deployment progressed. Financial issues and challenges were some of the topics examined by the TTI CVPD Evaluation Team. The following summarizes the critical financial issues and challenges experienced by the Tampa CVPD Team throughout the deployment.

THEA indicated that the changes in the regulatory environment (i.e., the withdrawal of the proposed rulemaking by the National Highway Traffic Safety Administration to require the installation of CV technology on vehicles and the reallocation of the dedicated short-range communications [DSRC] spectrum by the Federal Communications Commission (FCC) significantly altered the CV technology marketplace. Prior to the changes in the regulatory environment, THEA was able to maintain collegial and cooperative working relationships with technology vendors (i.e., technology vendors were willing to work with THEA to develop and test their products). After the regulatory environment changed, THEA found it more difficult to engage with technology vendors to invest in product development to support their deployments.

One lesson learned identified by the deployment team was that there will be many unexpected "curveballs" that will arise during deployments, and those unanticipated challenges will lead to budgets being strained. Several stakeholders (specifically the onboard unit [OBU] vendors) did not consider the resources required to meet the extensive needs of a deployment of this magnitude. One stakeholder noted that maintenance and repairs of vehicles that had OBUs installed in them were an unforeseen cost to the deployment. Another stakeholder explained that roadside unit (RSU) providers needed to work with local agencies to bring costs down. An example provided was potential agreements among local agencies and RSU providers where the providers would install RSUs for a more favorable cost but build in service agreements or data ownership considerations. The stakeholder explained that there is a high cost associated with the acquisition, deployment, and management of a CV system (e.g., managing the data that are developed).

The high cost of cellular service to access the RSUs was another unanticipated cost. What seemed like a small/reasonable amount per RSU was much higher when relying on the cellular network for, say, 100 RSUs.

Perceived Future Financial Challenges

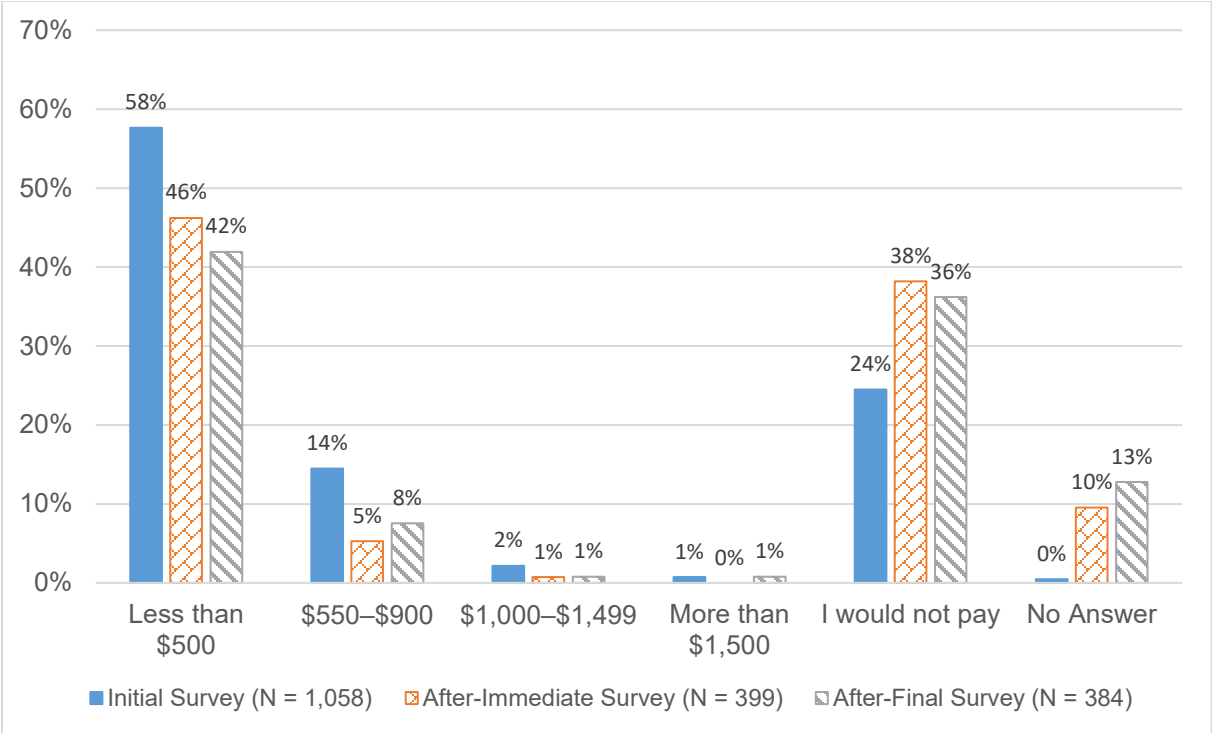
As part of the discussion, the TTI CVPD Evaluation Team asked the Tampa CVPD Team to identify potential future financial issues and challenges that they perceived as impacting their ability to sustain the deployment past the end of the deployment period. The following provides a summary of potential future financial challenges for the deployment team:[5]

- As required by the agreement with the Federal Highway Administration (FHWA), THEA is committed to maintaining and operating the pilot deployment past the one-year post deployment evaluation. THEA has a line item in its work program to maintain the system and to keep things operational. However, THEA believes the value of the deployment lies beyond local operations. THEA expects the deployment to become a research testbed where agencies and vendors can develop and test new applications.
- THEA also plans to pursue grant opportunities to support future expansions of its CV technologies.
- THEA does not plan to financially support further deployment of CV technologies in private vehicles. Because market penetration levels are so low, THEA also does not plan to make CV technology deployment the primary focus of future projects at this time. The agency's ITS budget will help support the ongoing maintenance and operations of its current deployment.
- THEA does not expect to use the deployment as a revenue source but envisions CV technologies becoming another tool in the ITS toolbox.

- THEA indicated that a significant shift in purpose and objective has to occur when an agency transitions from a pilot deployment to an actual operational deployment. An operational deployment must demonstrate real benefits to their customer base. THEA stated that the purpose of the pilot deployment was to transition the applications from development to production—"get the technology working." When agencies move to deployment, their purpose needs to be to show the value of what is being put out in the field. THEA indicated that it would be difficult to continue to fund technologies and systems (especially using toll revenue) if it cannot show a value in terms of improved safety or mobility to its customers.

Willingness to Pay

THEA asked users how much they would be willing to pay to retrofit their vehicle with CV technologies.[5] Participants in the initial survey (before actually having experienced the installed OBUs) were generally more willing to pay to retrofit their vehicles with the CV technologies than participants in the later surveys (see Figure 3). Fifty-eight percent of the initial survey respondents would be willing to pay less than $500 compared to 46 percent of respondents in the after-immediate survey and 42 percent of those in the after-final survey. Very few respondents in any of the survey iterations would be willing to pay more than $500. A quarter (24 percent) of respondents in the initial survey would not be willing to pay anything to retrofit the vehicle with the CV technologies. Even larger percentages in the subsequent surveys expressed zero willingness to pay: 38 percent in the after-immediate survey, and 36 percent in the after-final survey. The percentage of people willing to pay is still larger than the percentage of people not willing to pay.

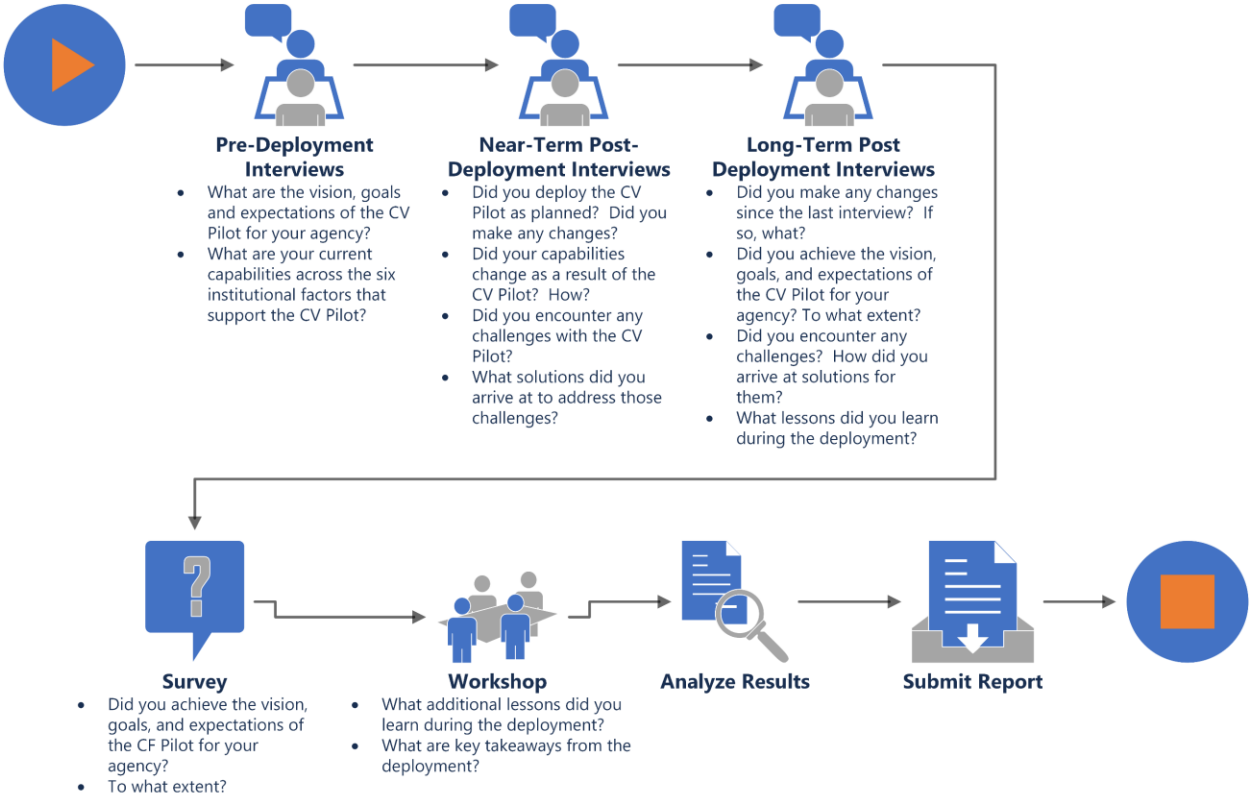


Source: Texas A&M Transportation Institute, 2022.

Figure 3. Bar chart. Willingness to Pay.

Chapter 3. Institutional Factors

As illustrated in Figure 4, the TTI CVPD Evaluation Team broke down the institutional evaluation into a series of activities throughout the deployment period in an effort to extract critical information related to the institutional impact the deployments had in the region.[3] The overall intent was to establish a baseline or starting point for agencies prior to deployment, to identify the vision anticipated by the agencies after deployment, to assess to what extent the agencies achieved that vision, to learn how their capabilities and readiness changed because of the deployments, and to document the lessons learned throughout the entire deployment.



Source: Texas A&M Transportation Institute, 2022.

Figure 4. Diagram. Institutional Evaluation Framework.

The first phase in the framework was to collect a broad baseline understanding of the vision, goals, and expectations that the agency had for the CVPD. These elements of the project helped establish the metrics against which the agency could measure overall success and progress related to the CV deployment. Related to these elements, the TTI CVPD Evaluation Team worked with the agencies to identify their capabilities across the six institutional factors of governance, public partnerships, private partnerships, organizational efficiency, legislation, and industrial organization.

The second framework phase was intended to assess the near-term deployment to determine if the agencies deployed the CV technologies as planned and whether any changes were necessary throughout the initial deployment process. This phase also examined how agency capabilities might have changed because of the deployment and documented any challenges that arose and how the agency identified and implemented solutions to those challenges.

The third framework phase took an in depth look at the deployments to determine if the agencies met the overall vision, goals, and expectations of the CVPDs. This phase documented any changes executed since the previous phase and described any challenges agencies encountered and how they were addressed. Finally, the phase worked to summarize any lessons learned during the deployment that could benefit other agencies considering CV technology deployments.

The fourth and fifth framework phases further examined the extent to which the deployments achieved the regional vision, goals, and expectations along with more detailed lessons learned and key takeaways. All the results from each phase were analyzed to establish the overall evaluation of institutional issues associated with the CV deployments.

The TTI CVPD Evaluation Team proposed a seven-step process for meeting the objectives of the various phases of this task. The steps in the process were as follows: [3]

- Step 1. Develop a comprehensive checklist of potential institutional factors. The first step was to identify specific institutional issues that affected an agency's ability to successfully deploy CV technologies and projects and to formalize the evaluation criteria or metrics that were to be used to determine if institutional factors played a role in the successful CV deployment.
- Step 2. Map institutional factors to metrics. This step mapped the specific institutional factors to the deployment objectives and metrics in use by the individual CV deployment sites. This mapping exercise helped establish the framework for analysis of institutional issues.
- Step 3. Develop analytical tools to assess institutional risks and opportunities in comparison to the baseline. These tools and related questions were structured around four assessment activities that were conducted as part of the overall CVPD evaluation: pre-deployment interviews (February-March 2019), post-deployment interviews for both near-term (November-December 2019) and long-term deployment (July 2020) timeframes, surveys, and a workshop. These activities are described in detail in the Task B Stakeholder Survey and Interview Guides.
- Step 4. Determine as-is business processes at the deployment site. In this step, the TTI CVPD Evaluation Team examined the site's as-is institutional and business-related processes and practices related to the planning, design, operations, and maintenance of the CV technologies. The as-is processes related to those that existed at the end of Phase I of the CVPD.
- Step 5. Determine the implementation case for the deployment site. The implementation case represents those institutional and business processes that were put in place to support the deployment.
- Step 6. Determine future business processes. These future business processes represent recommended and desired changes to the implementation case for the specific deployment. This step included describing and documenting what institutional and business policies worked well, what did not work well in the deployment, and what would be done differently if given the opportunity.

- Step 7. Prepare the institutional evaluation report. This step involved documenting the findings from the institutional evaluation, including the documentation of the lessons learned, best practices, and case studies to illustrate results.

Starting in 2016, the THEA CVPD Team deployed 46 RSUs and installed OBUs in 1,000 vehicles, 10 buses, and 10 streetcars.(4) During the period between February 4, 2019, and January 31, 2020, THEA operated the system in the silent mode, meaning that while the applications functioned as normal, they did not issue alerts to drivers. Beginning February 3, 2020, THEA began transitioning vehicles in the active mode (i.e., the vehicles issue alerts to drivers). However, on March 20, 2020, THEA placed the REL in the outbound operating mode 24 hours a day in response to Florida's COVID-19 response mandate. While THEA continued to collect performance data on the operations of the CVPD, limited interaction between vehicles prevented THEA from collecting meaningful performance data. The post-deployment data collection officially ended May 31, 2021. The Tampa CVPD Team conducted an analysis using the limited data available. (4)

Institutional Arrangements

The complexity of the Tampa CVPD required partnerships of multiple stakeholders in the deployment of CV devices in vehicles and along the roadside as well as applications that rely on data from multiple sources and across multiple elements of the transportation system. The Tampa CVPD called for participation by multiple jurisdictions that covered the intended geographical area in Tampa. As depicted in Figure 5, the THEA Board of Directors, the Hillsborough Area Regional Transit (HART), and the City of Tampa mayor's office joined as policy makers for the effort, providing guidance and support to the THEA Deployment Team.(6) THEA was the primary stakeholder and project champion for the deployment. THEA had complete authority over the project and selected other key stakeholders with complementary expertise to assist with the deployment. For the original deployment, THEA limited the involvement of other public agencies.

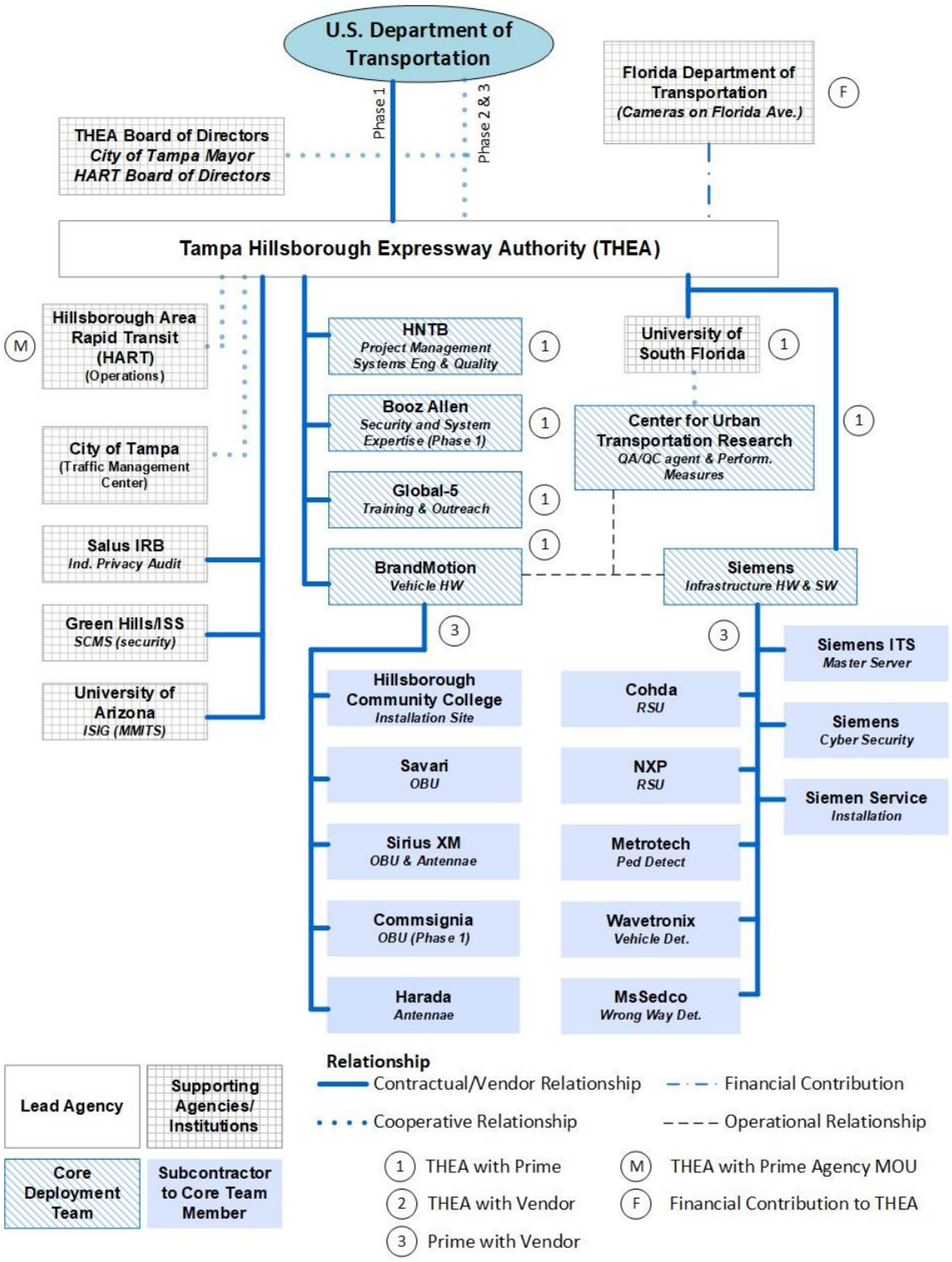
As the responsible party for all phases of the CVPD, including technical, policy, and funding, THEA formed the organization to include the following:(6)

- **THEA**, besides leading this effort and performing other tasks, owns and operates the expressway that was part of the evaluation. Traffic management center (TMC) operations are a combined and shared effort between THEA and the City of Tampa. THEA owns and maintains the TMC, while the City of Tampa staffs the TMC.
- **HART**, a partner of this program, owns, maintains, and operates its transit operations center and operates an express route along and through the downtown city streets. It also manages the TECO Streetcar line.
- **The City of Tampa** owns several of the streets and operates a parking garage that was to be the forum for the anticipated applications. The City of Tampa was to install and maintain a significant amount of new equipment along pilot deployment area roadways. The city also operates the TMC that is responsible for the operation of all traffic control devices at intersections and areas that were impacted by the CVPD.

THEA also engaged several private contractors to assist it in installing CV technologies in the field and in vehicles; developing, integrating, and calibrating applications for use in the deployment; and providing data to support. Those private contractors included:

- **HNTB**, as the general engineering consultant, worked alongside THEA staff to support and participate in systems engineering as well as management and governance of the program as needed.
- **Booz Allen Hamilton** served as the lead in the areas of Security Management Operating Concept and performance measurement and evaluation of programs and technologies, including deployment plans. Their work effort did not extend into Phases 2 and 3..
- **Global-5 Communications** led the participant and staff training as well as stakeholder outreach. During Phase 3, it provided help desk support.
- **Center for Urban Transportation Research** at the University of Southern Florida served as a resource for performance measurement and quality control.
- **Salus Institutional Review Board** provided oversight responsibility for all aspects of the human subjects research, including assuring the privacy of participants.
- **Brandmotion** was fully responsible for the vehicular-based technologies and led the development and integration of all onboard applications and devices. OBU vendors Savari, SiriusXM, and Commsignia (Phase 1) worked under the direction of Brandmotion, the entity fully responsible for all vendors working on vehicular technologies. Other vendors, such as Harada, provided to Brandmotion the needed components (e.g., antennas).
- **Hillsborough Community College (HCC)** provided support to Brandmotion by providing installation services of in-vehicle technologies. During Phase 3, HCC assisted with the vehicular-based technologies maintenance program along with Harada.
- **Siemens** had complete authority for the development and deployment of the required infrastructure including roadside sensor and communication technologies as well as backend software. Siemens then involved key divisions of its organization as well as vendors that specialized in the different roadside sensor technologies required by the pilot. The Florida Department of Transportation provided video traffic detection devices to enable the operation of improved traffic signals, Cohda and NXP provided RSUs, Metrotech and Quanergy provided pedestrian detectors, Wavetronix and McSedco provided movement detectors, and the Tampa Traffic System provided installation support.

In Phase 1, THEA anticipated participation by BMW, General Motors, and Honda, but that help did not materialize.(6)



Source: Texas A&M Transportation Institute, 2022.

Figure 5. Diagram. Institutional Participation, Tampa CVPD.

Summary of Institutional Challenges

The THEA team faced and overcame many challenges throughout the effort. The changes that were articulated by the team members and the means to resolve them are articulated in Table 1.

Table 1. Summary of Institutional Changes, Tampa CVPD.

Challenge	Process in Place	Method Used	Takeaway for future efforts
Vendor not motivated to support effort	Contractual obligation	Worked with vendor to complete obligation and then replaced them	Explicit contract deliverables Treat vendors like partners and make relationship win-win Be creative in finding ways to motivate partners
Vendor incapable of meeting required needs	Contractual obligation	Found alternative and capable vendor	Articulate all support needs in the contractual agreement Consider the limitation, but be diligent in finding resources that can meet the needs Program management should have support of the organization to make necessary changes in a timely manner
Technical information that was proved to be unreliable (SCMS)	None	A development team was hired to come up with the needed solution	To the extent possible, study the needs and ask experts Be flexible and have contingency plans (i.e., schedule, funding, vendors) Minimize external exposure until all technologies are deployed and tested

One of the most significant challenges in the Tampa CVPD was educating all stakeholders on the benefits of the CV Pilot. [5] A lot of stakeholders had pre-conceived notions regarding safety and security issues. Once they were educated, they were much better advocates for the pilot. THEA also experienced significant challenges involving public perception including educating the public on the differences

between automated vehicles and CV, informing them that the pilot was just CV, and providing sufficient information to the public to put them more at ease regarding the security of their personal information.

Another issue of concern to many of the stakeholders was the schedule. (5) Many of the stakeholders felt that the schedule was extremely aggressive given the level of maturity of the applications and delays in getting promised systems (e.g., SCMS) in a timely fashion. When unanticipated events occurred (e.g., having to educate stakeholders, delays with adjacent projects that affected the CV pilot, installation of fiber downtown, etc.), they exacerbated an already limited schedule. Furthermore, some stakeholders felt that the phased nature of the schedule would result in the technology adopted in the pilot being outdated in later phases.

There was consensus that institutional issues were sufficiently addressed. (5) Most stakeholders agreed that, at the end of the day, consensus existed among the various stakeholders, even if stakeholders needed occasional reminders of the overall goals of the deployment. One interviewee stated, “Everyone’s main goals were the same, [but] priorities were a little different. It did not result in any delays but definitely some heated conversations. We always found some sort of common ground.”

Perceived Future Institutional Challenges

Although no formal agreements between the public stakeholders were enacted to ensure continued operation and expansion of the system, all stakeholders were committed to building upon what had already been accomplished through the deployment.(5) Each stakeholder had their own objectives and priorities associated with the deployment—many of which were likely shared by more than one agency. In the end, the implementation naturally coalesced around these shared objectives. To be successful, the deployment agencies had to create a “win-win” situation by understanding what was important to all stakeholders, working hard to identify and examine problems and issues from different perspectives, and building shared solutions for the end project.

Liability concerns remain an issue that public stakeholders need to address as the agencies transition into operations and maintenance. (5) Concerns also exist over the type of record keeping and performance data that are needed to support a potential defense against a liability clam. This concern also raised the issue about data ownership, particularly for operations beyond the evaluation period.

A potential issue identified by the stakeholders was the topic of “spectrum sharing.” (5) There is a perception that as CV technology advances issues will emerge with who controls the communication channels/bandwidth. One interviewee indicated that the public sector is concerned that they will have to cede control of public bandwidth to the private sector. Furthermore, the private sector’s pursuit of DSRC technology will make it less accessible to others as the cost goes up. This individual also believed that there should be a combination of 5G and DCRC communication in the future, though there is concern that the private sector will be too focused on tech that is compatible with only 5G. The public sector is concerned that this could result in public agencies being “captive to the tech,” with the private sector having unreasonable control over who has access and at what cost.

Interoperability across jurisdictional boundaries was also deemed to be a challenge that future deployments will need to face.(5) At least one Tampa CVPD stakeholder mentioned that for CV technology to achieve widespread deployment, road operators in different states will need to agree (i.e., standardized) not only on the technology to be deployed but also how the applications function (particularly the V2I applications) under different operational conditions. A nationwide decision is needed on what baseline CV technology should be deployed so that everyone has the same understanding of

how to implement it and can purchase that technology at a reasonable price. Another stakeholder indicated that they were concerned with technology being proprietary since it is advanced by the private sector. The different goals of the players (both public and private) involved in the development of this technology can create compatibility issues between not only equipment but also applications and driver expectations.

Lack of market penetration is another issue that likely will be a challenge for sustaining and expanding the system. (5) There were simply not enough equipped vehicles to give THEA the information it needed to influence operation. Several stakeholders are looking at how existing technology (e.g., ITS, video cameras, microwave, analytics) can be used to support connectivity until enough vehicles are equipped.

Continued funding and the development of technologies continue to be perceived by the stakeholders as the biggest challenge to sustaining the deployment. (5) The stakeholders believed that the program cannot remain stagnant with what has already been developed but needs to continue to build upon what has already been started. One interviewee cited the preservation of DSRC options as being very important. The recent FCC ruling taking away some of the bandwidth in the DSRC spectrum had caused agencies to pivot to new strategies for continuing their work on I2V and V2I applications.

All the stakeholders agreed that policy changes must come from the national level and not the local level. National policy can enable the true benefits of CV. (5) There needs to be a critical mass of OBU deployments for agencies to justify the costs associated with deploying the infrastructure. It will also be necessary to establish standard operating procedures for maintenance and servicing of RSUs at the local level to ensure system function reliability. It was an issue during the pilot in that there were a lot of maintenance issues to be addressed, and the team did not have a ready response to them.

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