GENERAL MEETING OF THE BOARD OF DIRECTORS
OF THE
CENTRAL TEXAS REGIONAL MOBILITY AUTHORITY

RESOLUTION NO. 19-009

APPROVAL TO EXECUTE AN INTERLOCAL AGREEMENT
WITH THE TEXAS A&M TRANSPORTATION INSTITUTE

WHEREAS, the Mobility Authority is committed to implement innovative, multi-modal transportation solutions that reduce congestion and create transportation choices that enhance quality of life and economic vitality; and

WHEREAS, the Mobility Authority has a need for technical and research services, including conducting behavioral studies and other analyses for use in developing initiatives to improve safety, customer service and, ultimately, enhance and the road user experience; and

WHEREAS, the Texas A&M Transportation Institute ("TTI") has the resources and expertise to provide these services to the Mobility Authority; and

WHERAS, the Executive Director and TTI have negotiated an Interlocal Agreement in an amount not to exceed $453,000.00 for TTI to conduct a customer satisfaction and MoPac Express Lane use survey, analyze real world MoPac travel data, assess wrong-way driving characteristics and identify mitigation measures, and provide a research and methodology brief on survey panels; and

WHEREAS, the Executive Director recommends that the Board approve the proposed Interlocal Agreement with TTI, in the form or substantially in the same form as Exhibit A attached hereto; and

NOW THEREFORE, BE IT RESOLVED, that the Board approves an amount not to exceed $453,000.00 for the proposed Interlocal Agreement with the Texas A&M Transportation Institute; and
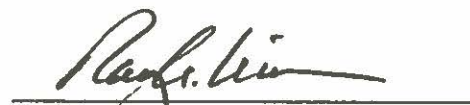
BE IT FURTHER RESOLVED, that the Board authorizes the Executive Director to finalize and execute the proposed Interlocal Agreement with the Texas A&M Transportation Institute in the form or substantially the same form as Exhibit A.

Adopted by the Board of Directors of the Central Texas Regional Mobility Authority on the 27th day of February 2019.

Submitted and reviewed by: Approved:

_____   _____
Geoffrey Petrov, General Counsel   Ray A. Wilkerson
                                                                          Chairman, Board of Directors

Exhibit A

INTERLOCAL COOPERATION CONTRACT

THE STATE OF TEXAS **
THE COUNTY OF BRAZOS **

THIS CONTRACT is entered into by and between a local government and the State agency as shown below Contracting Parties, pursuant to the authority granted and in compliance with the provisions of "The Interlocal Cooperation Act, TEX. GOVT. CODE ANN." § 791.001, et. Seq.

I.   CONTRACTING PARTIES:

Performing Party: Texas A&M Transportation Institute (TTI)
                                 The Texas A&M University System - VID # 37277277275000

Receiving Party: Central Texas Regional Mobility Authority

II.   STATEMENT OF SERVICES TO BE PERFORMED:

Central Texas Regional Mobility Authority Technical Support Services -- See Schedule A

All electronic information transmitted to or housed by the Performing Party is the responsibility of the Performing Party and will be protected in accordance with Texas Administrative Code (TAC) 202 as well as any other applicable state or federal mandate unless additional protection is requested in writing by the sponsor.

III.   BASIS FOR CALCULATING COSTS:

Cost Reimbursable

IV.   CONTRACT AMOUNT:

The total amount of this contract shall not exceed: Four Hundred and Fifty-Three Thousand, $453,000. The maximum amount payable under this contract is contingent upon availability of funds.

V.   PAYMENT FOR SERVICES:

Receiving Party shall pay for services received from appropriation items or accounts of the Receiving Party from which like expenditures would normally be paid, based upon vouchers drawn by the Receiving Party payable to Performing Party.

Payments for services performed shall be billed monthly.

Payments received by the Performing Party shall be credited to its current appropriation items(s) or account(s) from which the expenditures of that character were originally made.

VI.   DISPUTES:

The dispute resolution process provided in Chapter 2260, Texas Government Code, and the related rules adopted by the Texas Attorney General pursuant to Chapter 2260, shall be used by the Performing Party and the Receiving Party to attempt to resolve any claim for breach of contract made by the Receiving Party that cannot be resolved in the ordinary course of business. The Receiving Party shall submit written notice of a claim of breach of contract under this Chapter to the Assistant Agency Director and Chief

Financial Officer of the Performing Party, who shall examine Receiving Party's claim and any counterclaim and negotiate with Receiving Party in an effort to resolve the claim.

VII.   PUBLIC INFORMATION ACT:

The Receiving Party acknowledges that the Performing Party is obligated to strictly comply with the Public Information Act, Chapter 552, Texas Government Code, in responding to any request for public information pertaining to this Agreement, as well as any other disclosure of information required by applicable Texas law.

VIII.   TERM OF CONTRACT:

Payment under this contract beyond the end of the current fiscal biennium is subject to availability of appropriated funds. If funds are not appropriated, this contract shall be terminated immediately with no liability to Receiving Party. This contract begins when fully executed by both parties and terminates on June 30, 2020.

IX.   ADMINISTRATIVE CONTACTS:

For Performing Party:
Pricing Proposal or Pre-award:
Mr. Chris Slape
Senior Contract Negotiator II
Sponsored Research Services (SRS)
400 Harvey Mitchell Parkway South, Suite 300
College Station, Texas 77845
Tel. 979-845-6280
Email: cslape@tamu.edu

Administrative Contact after Execution:
Ms. Natilie Johnson
Senior Projects Administrator
Sponsored Research Services (SRS)
400 Harvey Mitchell Parkway South, Suite 300
College Station, Texas 77845
Tel. 979-845-9852
Email: ndjohnson@tamus.edu

For Receiving Party:
Administrative Contact:
Contact Name
Contact Title
Company Name
Address
City, State Zip Code
Tel.
Email:

Invoice Submission Contact:
Contact Name
Contact Title
Company Name
Address
City, State Zip Code
Tel.
Email:

X.   TECHNICAL CONTACTS:

For Performing Party:
Tina Geiselbrecht
Research Scientist
Texas A&M Transportation Institute
505 E. Huntland Dr., Suite 455
Austin, TX 778752
Tel. 512-407-1116
Email: t-geiselbrecht@tti.tamu.edu

For Receiving Party:
Contact Name
Contact Title
Company Name
Address
City, State Zip Code
Tel.
Email:

XI. EQUAL EMPLOYMENT OPPORTUNITY:

The Texas A&M University System serves all persons regardless of race, color, sex, religion, national origin, age, disability, genetic information or veteran status. The Performing Party agrees to comply with Executive Order 11246, entitled "Equal Employment Opportunity," (EEO) as amended by Executive Order 11375 and as supplemented by Department of Labor regulations (41 CFR Part 60).

XII. THE AGREEING PARTIES certify that:

1. The services specified above are necessary and essential for activities that are properly within the statutory functions and programs of the affected agencies of State Government.
2. The proposed arrangements serve the interest of efficient and economical administration of the State Government.
3. The services or resources agreed upon are not required by Article XVI, Section 21 of the Constitution of Texas to be supplied under contract given to the lowest responsible bidder.

XIII. RECORDS AND OWNERSHIP:

1. The Performing Party agrees to maintain all books, documents, papers, accounting records, and other evidence pertaining to costs at its office during the contract period and for four years from the date of final payment under the contract. These materials shall be made available for inspection and copying by the Receiving Party, Texas Department of Transportation, the State Auditor's Office, and by their authorized representatives. If the contract is federally funded, these materials shall also be made available for inspection and copying by the U.S. Department of Transportation and by the Office of the Inspector General.

2. This contract does not convey ownership of or any other rights to any work product, documentation, data or other information of any kind resulting from this contract to the Performing Party. All work product, documentation, data or other information of any kind resulting from this contract shall be the property of Receiving Party, and Receiving Party may use, copy, make, reproduce, or publish them without restriction and to have and permit others to do the same. Subject to any applicable exception to the Texas Public Information Act, Receiving Party agrees to allow the Performing Party to use and publish information resulting from this contract for research, academic, scholarly and other non-commercial educational purposes.

RECEIVING PARTY further certifies that it has the authority to request for the above services by authority granted in <u>TEX. GOVT. CODE ANN." § 791</u>.

PERFORMING PARTY further certifies that it has the authority to perform the services agreed upon above by authority granted in <u>Chapter 85, Texas Education Code</u>.

[Signature Page Follows]

Signature Page to Agreement

The undersigned parties bind themselves to the faithful performance of this contract.

<table>
<tr><td style="text-align:center">PERFORMING PARTY</td><td style="text-align:center">RECEIVING PARTY</td></tr>
</table>

Texas A&M Transportation Institute _____

_____

Authorized Signature   Authorized Signature

_____

Title   Title

_____

Date   Date

SCOPE OF SERVICES

Central Texas Regional Mobility Authority Technical Support Services

This scope of work outlines four major tasks that will be performed by TTI for CTRMA.

1. A survey of central Texas CTRMA toll facility users and non-users to (a) gain a deeper understanding of customer satisfaction and (b) explore factors motivating users and non-users to drive on the newly implemented MoPac Express Lane.
2. Examine travel data collected from the transponder readers located along the MoPac Express Lane (EL) and General Purpose Lanes (GPLs) to gain a better understanding of travel patterns on the lanes. Combine these data with the findings from the survey data (item 1) to get a total picture of EL usage patterns.
3. An assessment of wrong-way driving characteristics and identifying mitigation measures.
4. A research and methodology brief on survey panels.

Task 1. Customer Satisfaction and MoPac Express Lane Use Survey

This mixed method data collection effort will serve two primary goals.

Goal 1: CTRMA is interested in developing a robust customer satisfaction program. An integral component of any customer satisfaction program is assessing and evaluating customer satisfaction. One way to do this is through customer surveying. This task will outline the work that TTI will perform to help CTRMA develop a customer satisfaction baseline, through survey research methods.

Goal 2: In late 2017, the MoPac Express Lane became fully operational. This task outlines the work TTI will perform to help CTRMA better understand the behavior of travelers using the MoPac Express Lane and under what circumstances the lanes are used.

Subtask 1.A. Kick-Off Meeting

This task begins with a meeting with CTRMA to present the proposed scope and timeframe for the project. This will allow researchers and CTRMA to make any minor adjustments needed and be sure everyone has a clear understanding of the goals for this task.

- Deliverable 1.A.1.: Kick-Off Meeting Agenda
- Deliverable 1.A.2.: Kick-Off Meeting Summary Notes

Subtask 1.B. Literature Review

The focus of the review will be to identify current customer satisfaction survey efforts that are being implemented by toll agencies in the United States and beyond. The review will focus on the following topical areas:

- Survey design and content, including what factors and metrics are used to quantify customer satisfaction,
- Sample design,

- Data analysis and presentation,
- Implementation of research results,
- The effect of incentives on customer satisfaction response rates and the potential to bias results
- Maintaining customer satisfaction, including a discussion of the frequency and manner in which future customer satisfaction surveys might be implemented.
- Examination of previously published work focused on continued/longitudinal use of managed lanes over time by individual transponders/toll tags,

The TTI team will use TTI's in-house librarian to access numerous journals and databases, such as the Transportation Research Board's Transportation Research Information Services and Google Scholar. The team will also review relevant work that TTI has conducted for various toll agencies, including CTRMA, North Texas Toll Authority, Harris County Toll Road Authority and State Road and Tollway Authority.

TTI will query CTRMA staff and contractors as well as other toll agency operators to identify and define toll road users, potential users and non-users. This vetting of the sample frame will benefit the effectiveness and efficiency of the survey design and yield a richer dataset for analysis.

The results of this task will identify best practices that may be considered for implementation in this work.

- Deliverable 1.B.1: Technical memorandum documenting literature review findings.

Subtask 1.C. Survey Design

The survey design will be informed by the literature review and best practices. It will consist of two banks of questions: a core set of questions that focus on customer satisfaction, and a battery of questions focused on the MoPac corridor.

The core questions will address topics such as those identified below.

- What is the relationship between customer satisfaction and factors that are important for using a toll facility? How important is each factor that makes up overall customer satisfaction?
- How can the survey be used to help estimate if and to what degree customer satisfaction is correlated with a customer's preference to pay for tolls using a transponder, mobile application or Pay-By Mail (PBM)?
- How can the survey help CTRMA evaluate the benefit that may result from offering digital technology (e.g., technology that allows CTRMA to communicate directly with customers or allows toll payments through mobile applications or within connected vehicles)?

The MoPac corridor questions will address topics such as those identified below.

- How are travelers adjusting to this express lane option?
- Do stated usage patterns of transponder owners match those of PBM travelers?

- Do travelers use any information (apps, roadside signs, etc.) to help make their decision to use or not use the express lane?
- How does roadway configuration impact express lane use?
- Are there traveler characteristics that are common among those that sometimes use the express lane versus those that never choose the express lane?

In addition to capturing data elements that address the literature review findings and those presented above, the survey will capture elements that can be used to segment the survey population. These may include, but are not limited to the following.

- Facility used or used most often,
- Trip purpose,
- Geography (home, work, trip origin, trip destination, etc.),
- User type (Pay By Mail, mobile application, or transponder),
- Account type (auto or manual),
- Customer type (passenger or commercial),
- Demographics (income, race/ethnicity, education, employment, etc.).

TTI also proposes to include a question that gauges interest of survey respondents in participating in a CTRMA Knowledge Panel. This panel could serve as a resource, which CTRMA could query about various toll related issues. This will be an important element in further developing a robust customer satisfaction program.

Once the instrument has been finalized by all project team members, it will be delivered to the data collection contractor for programming, testing and data collection.

The median survey length will be 15-minutes.

It is important to note that the project will need to be reviewed and approved by Texas A&M University Institutional Review Board to ensure human subjects protection protocols and in place and implemented for the project.

- Deliverable 1.C.1.: Draft Instrument
- Deliverable 1.C.2.: Final Instrument

Subtask 1.D. Data Collection Sub-Contractor Selection and Management

Because the project will necessitate mixed method data collection, TTI will work with the Texas A&M Purchasing Department to develop an RFP to select a contractor to perform the recruitment and data collection. This effort will include the following:

- Development of the solicitation notice.
- Review of responses received .
- Selection of a vendor .
- Execution of a contract.
- Management of the contractor.

Subtask 1.E. Sample Design

TTI proposes to complete a total of 2,000 surveys, distributed by facility and user type as suggested in Table 1.

Table 1. Web Survey Sample Distribution

Sample Type	Facility Use and Frequency of Use					
	U.S. 183A Toll Road	U.S. 290 Toll Road	SH 71 Toll Lane	MoPac		
				Use ML Frequently	Use ML Periodically	Never Use ML - Use GPL
Customer Satisfaction Core	500	500	500	500		0
MoPac Corridor Supplement	0	0	0	250	250	500

Two thousand surveys will be collected for the customer satisfaction core, 500 from each of the four CTRMA toll facilities. The sample size for the MoPac Corridor Supplement will be 1,000. However, approximately 500 of these surveys will be shared with the customer satisfaction core. That is to say, these 500 will first answer the core questions, then be asked the MoPac Corridor Supplement. The balance of the MoPac Corridor Supplement will be comprised of individuals that never use the managed lanes, but do use the general purpose lanes. At present, these are sample targets, not hard quotas. The literature review will help flesh out the sample design, by hopefully refining what is known about sample universe.

A customer or user will be anyone who has used any of CTRMA's four regional toll facilities in the last month: 183A Toll Road, MoPac Express Lanes, 290 Toll Road, and/or 71 Toll Lane facility.

The geography for this survey, will be a six county area: Williams, Travis, Hays, Bastrop, Caldwell, and Burnet. We assume that most users will be in Travis and Williamson . These two counties not only "house" facilities, they are also the most heavily populated. There will be no geographic targets.

In order to be eligible to participate in the survey, a respondent must be at least 18 years of age, a licensed driver, and speak English well enough to participate in a survey in English

Because CTRMA toll facility customers can pay their tolls in two ways (toll tag or PBM), it is important that the sample plan incorporate this variable into the sample strategy.

The CTRMA PBM contractor has agreed to provide a mailing address database of these customers. This will facilitate a phone match, and subsequent mixed method data collection.

Because TxDOT cannot release tag holder information for non-TxDOT sponsored research, the project team will have to purchase a sample and screen the general population for tag holders and MoPac general purpose lane users. TxDOT has provided estimates of TxTag accounts and tags by county (see Table 2).

Table 2. TxDOT Estimates of Active TxTag Accounts and Tags by County

County	Active Accounts	Active Tags	Occupied Housing Units (OHU) from American Community Service	Percent OHU with Accounts
Bastrop	20,927	37,715	26,015	80.40%
Burnet	7,887	15,117	16,545	47.70%
Caldwell	7,197	12,578	12,894	55.80%
Hays	39,410	70,366	68,045	57.90%
Travis	305,024	512,905	447,561	68.20%
Williamson	179,552	313,805	170,051	105.60%
Total	559,997	962,486	741,111	75.60%

Again, the literature review will help flesh out the sample design, by hopefully refining what is known about sample universe. To the extent possible, TTI will work with the data collection contractor, CTRMA, CTRMA contractors and TxDOT to help ensure that the final sample of completed surveys is representative with regard to facility and payment type, and meets the analytical requirements of the project.

TTI would encourage CTRMA to consider offering a toll credit or discount to recruits as an incentive to participate. This method worked well in the recent CTRMA Touch Point Survey.

- Deliverable 1.E.1.: Sample Plan
- Deliverable 1.E.2.: Incentive Management Plan

Subtask 1.F. Data Collection

TTI will work with the selected data collection contractor to develop a data collection plan that will guide the field protocol. The plan will include, but not be limited to, the following:

- Sample management strategies.
- Interviewer selection and training strategies.
- Data management strategies, including QA/QC.
- Dialing protocols, including schedule of active dialing hours and day of week.
- Silent monitoring protocols.

TTI envisions that data collection will last approximately six weeks. Throughout the process, TTI will provide CTRMA with weekly updates on progress toward goals, issues encountered and suggested resolutions.

Because the sample frame for tag holders is not well defined, TTI suggests a rolling launch of the survey that will allow for a pilot testing period for the project. This would include the collection of approximately 300 surveys, then briefly halting data collection for a period of 24-48 hours, during which the data is reviewed. The focus of the review would be to validate assumptions about sample distributions by facility, user type, and payment type for both BPM customers and tag holders. In the event that the data review suggest that the assumptions made during the

design phase were inaccurate, this early identification would allow TTI to establish a plan for finishing the project out in a manner that is mutually agreeable to all project team members.

- Deliverable 1.F.1.: Data Collection Plan
- Deliverable 1.F.2.: Pilot Technical Memorandum

Subtask 1.G. Data Processing.

At the end of the field period, TTI and the data collection contractor will subject the data to a series of manual and automated data checks to ensure the data is error-free. The focus of this process is to identify errors such as missing data or out of range data. The project team has a strict set of quality control mechanisms to assure the data is acceptable and there are no errors. After all records from the survey have been processed and corrections made, the analysis will begin. The proposed project budget does not include weighting of the survey sample.

- Deliverable 1.G.1.: Cleaned survey dataset
- Deliverable 1.G.2.: Data dictionary

Subtask 1.H. Analysis and Reporting.

Prior to beginning the analysis, TTI will develop a report outline that summarizes how TTI intends to present the summarized survey data. Upon mutual agreement on the outline from all members of the project team, TTI will begin with data preparation, such as creating different forms of data variables. Once the analytical dataset is finalized, the team will utilize a comprehensive descriptive analysis to characterize the survey data profile and develop a detailed understanding regarding customer satisfaction and use of the MoPac corridor.

- Deliverable 1.H.1.: Final report highlighting all of the research, the results of the project, survey results, and suggestions
- Deliverable 1.H.2.: PowerPoint presentation for presentation to interested stakeholders.

Estimated Task 1 Budget: $ $286,000 (includes $ 220,000 for data collection subcontractor)

Task 2. Analysis of Real World MoPac Travel Data

This task seeks to understand the behavior of travelers using the MoPac express lane by analyzing real world data. Understanding this behavior will greatly enhance understanding of how travelers perceive the benefits of express lanes and increase the ability to predict future demand for express lanes. Like Katy Freeway in Houston, MoPac has transponder readers on both the general purpose lanes (GPLs) and express lane (EL). This allows for the tracking of trips on the roadway and the ability to observe travel patterns and lane choices over time. This type of data and analysis has provided amazing insights into travel behavior on the Katy Freeway. The analysis will examine:

- How travelers are adjusting to the new MoPac EL and better understand how the ramp-up period impacts travel. For example, does an increase in EL use stem more from new EL travelers, current EL travelers who make additional EL trips, or maybe new travelers to MoPac.

- Do usage patterns on MoPac resemble those of Katy Freeway?
- How are travelers valuing their travel time savings on MoPac?
- How do travelers adjust to the dynamic toll rate? Is it possible to measure a toll price elasticity?
- How does overall congestion impact use of the lanes, particularly peak versus off-peak travel?

When combined with the survey data from Task 1, research would also examine:

- Are there reasons why the PBM travelers do not get a transponder? Particularly frequent travelers of MoPac.
- Are there traveler characteristics that are common among those that sometimes use the EL versus those that never choose the EL?
- Do stated usage patterns of transponder owners match those of PBM travelers?

Note that this research task focuses exclusively on MoPac since that facility has the parallel general purpose lanes with transponder readers. General purpose lane use by transponder owners is critical for answering many of the research questions above. Therefore, the task does not include other toll roads in the Austin area and only includes people who pay using a transponder.

A significant portion of this task will be converting the massive number of transponder reads along MoPac into trips. This involves identifying when reads of the same transponder represent a continuous trip and when they are separate trips. It also involves cleaning the data. Once individual trips are developed the dataset can then be used to answer the questions above.

Deliverables:
- Deliverable 2.1. A dataset of trips on MoPac by transponder equipped vehicles.
- Deliverable 2.2. A final report highlighting the analysis done to answer the questions listed above.

Estimated Task 2 Budget: $ 116,000

Task 3. Assessing Wrong-Way Driving Characteristics and Identifying Mitigation Measures

This task seeks to understand the wrong-way driving problem on CTRMA roadways in order to identify locations where mitigation measures, such as detection technologies, should be installed. In this task, TTI researchers will conduct the following activities to understand the wrong-way driving problem on CTRMA roadways:

- Obtain and analyze historical wrong-way driving crashes and 911 call data.
- Perform land use data collection and analysis.
- Perform field inspections/observations,
- Review interchange/exit ramp designs (existing and/or under construction).

TTI researchers will also consider other ITS technologies (such as tolling sensors, cameras, loop detectors, etc.) that exist or are planned for the roadways. Based on these data, TTI researchers will identify and recommend potential mitigation measures that can be used to deter wrong-way movements. Potential mitigation measures could include active warning and detection systems, detection only, and/or connected vehicle wrong-way driving applications. This process will first

be applied to 183 South to help CTRMA identify locations where mitigation measures should be installed on 183 South. Future analysis may include additional CTRMA roadways.

- Deliverable 3.1.: Technical memorandum documenting the results of the research and suggestions for implementing the research.
- Deliverable 3.2.: PowerPoint presentation for interested stakeholders.

Estimated Task 3 Budget: $ 41,000

Task 4. Research and Methodology Brief on Survey Panels

In July 2015, TTI published research for the Transportation Policy Research Center that documented the practices and uses of online communities in both the public and private sector. Online communities and their cousins, survey panels, serve to offer agencies insights and opinions about any number of topics from a representative sample. The panels and communities are cultivated so that a representative sample is ready "on-call" at any time to offer opinions and answer questions. This provides a mechanism to quickly gather data and/or test policies, theories, or practices. The online communities and survey panels operate in a virtual space. Depending on how the community or panel is organized, users can interact with one another and the sponsoring agency. It is an effective mechanism to quickly gather feedback.

Since the report initial report was published in 2015, advances in technology have made this engagement mechanism even more promising. This task would update the research to document new technology that is available to initiate and maintain this type of feedback mechanism. The research will focus on, but not be limited to, the use these panels by government or public sector agencies. The findings will be documented in a succinct research brief and an accompanying frequently asked questions (FAQ) document. The team will make this information available to directors at CTRMA. After the directors have had an opportunity to review the research, a member of the research team and the CTRMA Innovation officer will meet individually with directors to determine how this feedback mechanism can be structured to meet their objectives.

- Deliverable 4.1.: Research brief that documents that updates methodologies for initiating and maintaining online communities and/or survey panels.
- Deliverable 4.2.: A technical memorandum that documents the needs of CTRMA directors in the use and operation of an online community and/or survey panel.

Estimated Task 4 Budget: $ 10,000

(Draft) CTRMA Research Plan

CTRMA's mission as laid out in the 2018-2019 Strategic Plan is "to implement innovative, multi-modal transportation solutions that reduce congestion and create transportation choices that enhance quality of life and economic vitality." The Strategic Plan also lays out several goals and associated strategies for meeting this mission which include commitments to:
- Deliver Multi-Faceted Mobility Solutions
- Invest in Efforts that Extend Beyond Roadways
- Employ a Collaborative Approach to Implementing Mobility Solutions
- Explore and Invest in Transformative Technology and Adopt Industry Best Practice

While many programmatic efforts are planned and underway for meeting these goals and carrying out these strategies, research fulfills a critical role in informing some of these efforts, providing measures for benchmarking and tracking metrics, and in monitoring and contributing to Industry practice. Furthermore, with technology and innovation being at the core of the agency's mission it is critical to monitor emerging and innovative technologies which are advancing at a rapid pace in our industry. For example, more than ten states now have significant CV pilot programs, allow AV testing on public roads, and/or are in the planning stages for AV/CV programs, projects, and deployments. In assessing this and other technology and multi-modal solutions, there are a variety of open questions and issues that need research, planning, and resolution at CTRMA and regionally to enable successful deployment of emerging technology, including CV/AV.

The purpose of this roadmap is to facilitate CTRMA's active assessment of transportation and mobility technology and innovation trends and their related issues and inform decision-making regarding the opportunities that are fit and proper for the agency, given strategic priorities.

This roadmap is comprised of four sections.
- First, in the section below, the Innovation team is compiling a catalog of technology trends and research directions that are current impacting or being introduced into transportation systems, nationwide. The catalog will be narrowed to critical trends for focus by CTRMA; these are trends that align with our strategic priorities and problems/need use cases.
- Next, research projects are outlined in Section 2. This include CTRMA-funded internal research and projects in which CTRMA is a co-sponsor or contributor to a local or industry research or innovation project.
- Finally, Section 3 (Currently in development) contains detailed research summaries for the planned, CTRMA-funded research projects identified in Section 2.

Section 1: Technology Trends and the Opportunities for CTRMA

The following table is a compilation of broad transportation technology trends resulting from an industry literature and conference review and meetings/discussions with private industry and regional agency stakeholders.

Trend	Description	Tangential Trends	Opportunities
1. Big Data, including IoT—form the basis for other technology trends.	Connectivity and IoT enabling the sharing of data	Big data analytics, dashboards Blockchain Data sharing across agencies, companies and the public Connectivity; 5G and DRSC	• Improved system reliability due to better data on real time travel conditions.

				• Improved dynamic system management due to data availability and integration
2.	Advanced Vehicle Technologies	Connected Vehicles, Autonomous Vehicles, Electric Vehicles, Alternative Fuel Vehicles	These are related to the other trends, primarily V2I and V2X, 5G, DRSC and connected corridor activities.	• Safety improved due to reduction in driver error • EV/AFV will reduce GHG emissions
3.	Shared and On-Demand Mobility Options, technology enabled	New mobility options that possess the potential to reduce congestion and/or lessen the impact of driving alone; often powered by technology or mobile applications. Mobile applications for wayfinding, communicating with drivers on roadway conditions and incidents, and facilitating the use and payment of mobility options, including tolls; eventual V2V and V2X	Transit, park and ride, transportation demand management (including carpool, telework, flex schedule) and everything shared mobility and mobility-on-demand. Mobile apps including WAZE, Google Maps, Metropia, Mobility as a Service and Mobility-on-Demand, Passport, Bankpass, etc.	• Increased mobility & travel options (than driving alone) due to shared mobility choices • Improved system reliability due to better data on real time travel conditions. • Improved dynamic system management
4.	Connected and Integrated Transportation Systems	Smart infrastructure, mobile payment methods, interoperability of payment across systems, real-time traveler information, integrated corridor management	Interoperable, mobile based payment methods, dynamic management systems, traveler information, smart pavements and bridges, Wrong Way Driving	• Safety improved due to reduction in driver error • Improved system reliability due to better data on real time travel conditions. • Improved management of transportation system assets • Improved dynamic system management
5.	Technology Developments affecting freight and logistics	drones and robots to transport / deliver goods, efficient vehicle routing and efficiency such as platooning of trucks)	Connected Corridors, V2X Communications,	• Creation of new jobs in growing advanced technology industries

Research Needs Statements

The following set of "use cases" present research needs in the form of "We want to" statements. Each is followed by a set questions that research and / or technology (or a combination of) would answer.

1. Wrong Way Driving Tech. We want to prevent wrong way driving on our facilities
   a. What is the appropriate and state-of-the art technology for detecting WWD and communicating WWD to drivers and emergency teams?
   b. To what extent (timing, level of effort and investment) do we need to install technology before it will be standard in CAV, making our investment obsolete?
   c. Can we do a better job at designing facility/road projects to prevent WWD?

2. Customer Data and Insights. We want to provide data-driven traffic incident and travel information to drivers and users of our facilities by using programs that are robust in the capabilities and more capable of engaging with our customers/community and delivery alerts. This means we need to have a platform to store data and interface / venues to "push" out customer communications. The concept is to be able to send all types of alerts directly from the same user interface.
   a. Should CTRMA invest in the development of an App or push data that any existing App can use to push information to drivers?
   b. What are the venues / tools for to push information to drivers, beyond Apps, and which emerge as the best practice? (DMS, Website, Text Subscriptions, partnerships with

> TV/Radio stations). There cannot be only one—as different tools can be used for specific reasons, capabilities (text messaging vs push notification to mobile applications to emails or voice calls or digital signs)
>
> c. Who are the providers of communication tools? (Everbridge—the system Florida consolidated on for emergency managers;)
> d. What is the best format to host data (e.g., Data Hub) that is pushed to private/public sector?
> e. What are the best practices of emergency communications? Are there lessons learned we can apply to planned and unplanned incident communications? (e.g., Florida is an early adopter of the new concept of incident zones—geofenced areas customer can sign up for notifications on incident / events)

3. Road Use and Pricing. We want to protect our interests associated with future policies affecting the tolling industry including road user charges, interoperability and privatization of toll payments
   a. What are the future policies that could affect our tolling interests (RUC, VMT, Automated tolling, Payment with mobile app/CV or smart car)?
   b. What practices are currently being piloted or studied?
   c. Are there completely new models that would result in our not having to deal with customers at all—credit card or bank model?

4. Customer Insights. We want to understand our customer's travel behaviors and satisfaction levels to better inform our planning and marketing efforts.
   a. Do we have ready-access to origin and destination and driving behavior data (e.g., information on propensity and frequency to use our facilities versus non-tolled roadways, quantify market potential for new facilities and mobility services, assess attitudes and opinions about our facilities and on a range of mobility and transportation topics, etc.)?
   b. What studies have been previously completed and is there planned survey or other related studies?
   c. How can travel behavior data be used to better understand how our roads are used, be used to better manage our traffic flows, and plan for new facilities?
   d. Can customer satisfaction research be crafted to inform continual improvement?

5. Big Data. We want to make use of our own facility data to better quantify, measure and communicate congestion levels and the contributions of our facilities in mitigating congestion.
   a. What data is available?
   b. Are there regional sources of data from other agencies that could supplement our internal data sources?
   c. Are there systems in place to facilitate the transfer of data between agencies? Are data sharing agreements needed? Standards for data format to facilitate data sharing?
   d. What are the sources of external, third party data we could purchase?
   e. What are the advantages and limitations of third-party data?

6. Customer Insights on Digital Technologies. We want to address the declining participation in the electronic tag usage, anticipate customer needs in a connected vehicle future, and assess how digital technology could meet the needs of our customers.
   a. What is the level of digital technology "readiness" among our customers?

b. Which technology should we develop and manage or purchase from private companies to meet the current and future levels of readiness?
c. Are our facilities "future ready" for connected vehicles and other emerging technology?
d. What are the issues involved and the best practice for digital mobile payment of tolls?

Section 2: Research Roadmap

CRTMA Sponsored Research

Project Title / Technology Trend	High Level Description of Outcomes	Research Lead	Cost	Schedule	Status
1.1 Emissions and Fuel Consumption Analysis: MoPac Express Lane	Estimation of the air emissions and fuel consumption benefits of the EL versus GP lanes; estimation of mode-shift from passenger vehicles to transit buses that use the EL	CAPCOG	$10,000	6 mos Dec 2018-June 2019	In progress Dec 2018 - April 2019
1.2 Analysis of Real World MoPac Travel Data	Improve ability to predict EL use for future facility planning; insights on the influencing factors behind decisions to use EL	TTI	$116,000	12 mos	ILI with TTI currently under review; anticipate approval in Feb 2019
1.3 Customer Satisfaction, MoPac travel behavior and digital readiness Survey	Regional survey to develop a baseline measure of satisfaction of CTRMA facilities, assess behavior and use of MoPac Express Lane and digital readiness.	TTI	$286,000	9 mos	ILI with TTI currently under review; anticipate approval in Feb 2019
1.4 Research and Methodology Brief on Web-based Survey Panels	Obtain regular and frequent insights from a pool of customers and interested stakeholders on CTRMA topics of interest	TTI	$10,000 (Additional funding once	4 mos	ILI with TTI currently under review; anticipate approval in Feb 2019
1.5 Assessing Wrong-Way Driving Characteristics and Identifying Mitigation Measures	Understand wrong-way driving on 183S in order to identify where mitigation measures (detection technologies) should be installed	TTI	$41,000	6 mos	ILI with TTI currently under review; anticipate approval in Feb 2019
1.6 Focus Groups with RMA Users/Non-Users (Follow on to Mike's focus group)	Insights on awareness levels of how EL "work" and elicit opinions and ideas for improving communications (use of DMS, mobile applications)	CTRMA (Mia Zmud)	$25,000 (ongoing monthly if additional funding available 75K)	1 month February 2019	Getting estimate from local focus group facility to recruit and host 3-4 groups.
1.7 Review of Data Sources for Origin and Destination analyses	Understanding of the external data sources that provide information to support OD analysis and other.	WSP (Jessica K)		4 mos October 2018-January 2019	In progress.
1.8 Emissions and Fuel Consumption Analysis: SH 45;	Estimation of the air emissions and fuel consumption benefits of new facilities, estimation of mode-shift from passenger vehicles to transit buses that use the EL	CAPCOG	$40,000	12-18 mos 2020 budget	These projects will be funded in 2020
1.10 Regional Summit on Innovative Technology	Interagency workshop and collaboration on innovative technology	CTRMA	$5000	July2019	TxDOT in agreement
1.11 Flex Incentive Pilot (Modeled after SRTA)	Pilot a program to incentivize drivers to flex their commutes outside of peak traffic.	CTRMA	2020 Budget	TBD	Planning.

Project Title / Technology Trend	High Level Description of Outcomes	Research Lead	Cost	Schedule	Status
1.12 Knowledge Panel Research and Customer Satisfaction	Implement findings from 1.4 and conduct annual customer satisfaction study	TTI	2020 Budget	Ongoing	These projects will be funded in 2020

CRTMA Cooperative Research (co-funded or in-kind resource)

Project Title	High Level Description of Outcomes	Research Lead	Cost	Schedule	Status
2.1 Society of Automotive Engineers V2X Message Set for Tolling	Set of standards tolling agencies can adopt when ready for V2V/V2I communications	TBD/SAE Cooperative with 4-5 other tolling agencies	TBD Est. cost share 30K-40K	TDB	SAE Committee chair (Susanne Murtha) is seeking confirmation from other tolling agencies (MDxway, BATA, SRTA)
2.2 Blockchain Pilot involving tolling (industry expert and attend a half-day blockchain use-case work shop 4/29 with the TAMU Trans Tech Conference	Accelerate research and test bed pilots for machine (vehicle or mobile phone) to machine (tolling company) payments using stable tokens-based.	TTI-Ginger Goodin	No cost-this is an in-kind industry expert	6 mos Est. Jan-June	Project is pending final approval on behalf of TAMU system.
2.3 Autonomous Vehicle Acceptance in Central Texas	Awareness and acceptance levels of AV	TTI-COA	TBD Est cost share 30K-40K		COA is checking with CTRMA, Cap Metro and CAPCOG to co-fund
2.4 SeatsX Evaluation (on-line market place for seats on vehicles for carsharing/carpooling-driver/rider matching)	Assessment of SeatsX and prospects for developing a Texas market for vehicle seats.	NCTCOG & CTR-UT Texas Innovation Alliance	No cost-evaluation assessment	6 mos Est Jan-June	TBD
2.5 FHWA Cooperative Automation Research Mobility Applications (CARMAHUB) to support CV deployments (Join Austin Team)	Coordinated effort to support CV deployments region-wide using the same "middleware" (FHWA CARMAHUB)	City of Austin and FHWA	No cost	TBD	Jason Jon Michael to followup with Jeff Dailey; Austin team kick off in early 2019 (COA, CTRMA, TxDOT ITS Division, TxDOT Austin District)

Other Research Efforts (to further needs assessment and decision-making for funded to cooperatively funded research)

- 3.1 Topics Under Investigation
    - 3.1.1 MOKAN Connected Corridor
    - 3.1.2 Mobile App for driver communication and possibly toll payment
- 3.2 Research and Technology Briefs - deep dive white papers to explore emerging transportation technology, systems, processes, or best practices and recommend whether each is a good fit for CTRMA. These will be used to inform decision-making and will serve as content for thought leadership outreach and engagement. (Researched and compiled by GECs, internal staff).:
    - 3.2.1 Big Data—What is the potential for Big Data to transform our industry (Mia is coordinating this)
    - 3.2.2 Smart City Innovations in Procurement—How are other agencies and "Smart Cities" pursuing innovation-related procurements and what are the lessons from Smart City and Connected Vehicle initiatives?

3.3 Facilitate Regional Technology Summits and Workshops – CTRMA will coordinate regional events (summit and/or workshops) to serve as a conduit for assuring regional coordination of mobility technology and innovation activities among city/county/regional transportation agencies, organizations and other key stakeholders.

3.4 Pooled-Fund Research among tolling industry (IBTTA) – what are the options for pursuing a pooled-fund research with other tolling agencies. This paper will recommend an approach for IBTTA Foundation or other organization to structure out a pooled fund research program.

Section 3: Detailed Research Summaries (In development)