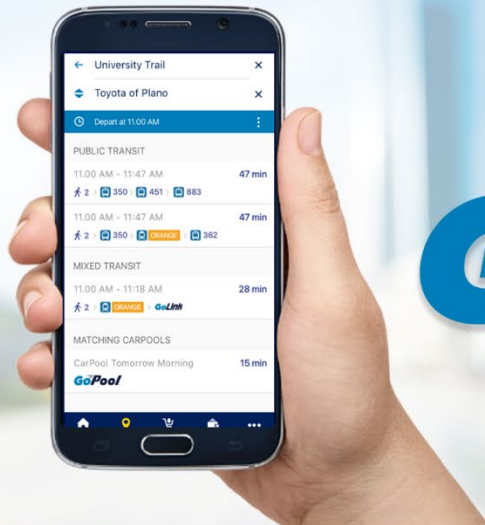




# MOD SANDBOX DEMONSTRATIONS INDEPENDENT EVALUATION

## DART – THE FIRST AND LAST MILE SOLUTION EVALUATION PLAN



U.S. Department of Transportation  
Federal Transit Administration | ITS Joint Program Office

Produced by Booz Allen Hamilton  
U.S. Department of Transportation  
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Systems Joint Program Office

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<b>16. Abstract</b> The Mobility on Demand (MOD) Sandbox Demonstration Program provides a venue through which integrated MOD concepts and solutions – supported through local partnerships – are demonstrated in real-world settings. For each of the 11 MOD Sandbox Demonstration projects, the MOD Sandbox Independent Evaluation includes an analysis of project impacts from performance measures provided by the project partners, as well as an assessment of the business models used.  This report constitutes the Evaluation Plan for the DART First and Last Mile Solution Sandbox project. It includes the following chapters: project overview; evaluation approach and process; evaluation schedule and management; and data collection and analysis plan.			
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# Table of Contents

<b>Chapter 1. Project Overview.....</b>	<b>1</b>
Introduction .....	1
Project Scope .....	1
Key Partners .....	2
Project Timeline .....	2
<b>Chapter 2. Evaluation Approach and Process .....</b>	<b>3</b>
Project Goals .....	3
Evaluation Hypotheses .....	4
Performance Metrics .....	5
Data Types, Elements, and Sources .....	6
Data Types and Elements .....	6
Data Sources .....	7
Data Sources Mapping.....	8
Methods of Evaluation.....	8
Evaluation Logic Model.....	9
Documentation and Reporting.....	14
<b>Chapter 3. Evaluation Schedule and Management.....</b>	<b>15</b>
Evaluation Schedule .....	15
Roles and Responsibilities .....	16
Data Transfer and Storage.....	16
Data Collection Responsibilities .....	17
Risk Management .....	17
Schedule.....	17
Data Quality Assurance .....	18
Data Sufficiency .....	18
Data Anonymity.....	18

**Chapter 4. Data Collection and Analysis Plan .....20**  
Detailed Data Collection and Analysis Plan by Evaluation Hypothesis .....22  
**Appendix A. Selected Draft Survey Questions (Before, After, and Recent Trip Surveys) .34**  
Before Survey .....34  
After Survey .....41  
Recent Trip Survey .....48  
**Addendum. Documentation of Evaluation Plan Variance Following Demonstration  
Deployment .....49**

**List of Tables**

Table 1. Project Goals, Evaluation Hypotheses, Performance Metrics, and Data Types and Sources for the DART Sandbox Project..... 10

Table 2. Data Type and Data Collection Responsibilities for DART Sandbox Evaluation ..... 17

Table 3. Data Type and Risk Mitigation Strategies for DART Sandbox Evaluation ..... 19

Table 4. Data Type, Data Elements, Period of Collection, and Hypothesis Alignment for DART Sandbox Project Evaluation..... 21

**List of Figures**

Figure 1. Map of Data Sources, Data Sets, and Performance Measures ..... 8

Figure 2. MOD Sandbox Evaluation and Demonstration Schedule..... 15

Figure 3. DART Data Collection Framework..... 16





# Chapter 1. Project Overview

This chapter provides a brief introduction to the Dallas Area Rapid Transit (DART) Mobility on Demand (MOD) Sandbox Demonstration project that is the focus of this independent evaluation (IE).

## Introduction

DART is a transit agency in Dallas, Texas, that operates bus, light rail, commuter rail, streetcar, paratransit, and vanpool services in Dallas and its suburbs. While DART has expanded its services significantly to help accommodate the explosive growth in the area, increasing rider penetration and service frequency, most notably through bus service, has been a challenge. Many residents of the Dallas/Fort Worth area have difficulty completing the first mile and last mile (FMLM) of their commutes, even while high-frequency rail or bus service is available for a major portion of their trips. Nearly 28 percent of all residents and 24 percent of all DART service area jobs are more than 1/4 mile from a bus stop or rail station.

DART's MOD Sandbox demonstration aims at implementing FMLM solutions to improve service and connectivity for customers and provide efficiencies and cost effectiveness within DART's operations.

## Project Scope

To solve the FMLM challenge, DART is leveraging its GoPass™ ticketing app to implement a soft integration, also referred to as a smart-app switch, into the apps for transportation network companies (TNCs) (e.g., Uber and Lyft). This will provide seamless access to multiple transportation options, allowing the DART community the ability to travel door to door. This will be accomplished by leveraging the application programming interfaces (APIs) or software development kit (SDK) of key MOD providers including Yellow Taxi (Irving Holdings), Lyft, Uber, and Carpool services, and bike share programs.

This MOD Sandbox project will involve a smart-app switch of the following modes in the GoPass\*\* test application for requesting and paying for rides:

- **GoTaxi** – Taxi-services with wheelchair accessible services
- **GoLink** – Microtransit services and on-demand services
- **GoPool** – Carpool services
- **GoConnect** – DART public on-demand and TNC services
- **GoBike** – Bike sharing.

Total funding provided for this project is \$1,204,000 in U.S. Department of Transportation (USDOT) funds and \$301,000 in local matching funds, for a total budget of \$1,505,000. DART will need to evaluate full app integration, as the cost will exceed the federal funding source provided.

## Key Partners

DART is partnering with the following:

- **Technology Partners:** Unwire, DoubleMap, and PayNearMe; MJM is a potential provider.
- **Carpool Solutions:** SpareLabs.
- **Bike-Sharing Solutions:** Pending agreement with any bike-share company in the project area if the provider(s) meets DART and city ordinance requirements. Potential providers include OFO, Limebike, Mobike, Spin, Vbike, or any bike-sharing company meeting the requirements.
- **Taxi Solutions:** Irving Holdings.
- **Transportation Solutions:** Uber, Lyft. Via is a potential provider pending further review.
- **Settlement Solution:** Vix Technology as the long-term approach. Spare Labs as the interim solution for GoPool platform.

## Project Timeline

The main project milestones are captured in the timeline below. Note that the timeline of the evaluation is provided in a later chapter of this report. The demonstration start and end dates depict the period over which demonstration data collection is expected to occur. This data would be shared with the IE team for evaluation purposes. Chapter 4 provides details on data collection timeframes, responsibilities, and mechanisms.

1. **January 25, 2017** – Agreement execution date with the USDOT.
2. **October 2017** – Lunchtime pilot of GoLink started for User-Acceptance Testing
3. **February 2018** – Field demonstration of the augmented application starts (1-year duration).
  - a. **February 26, 2018** – GoLink will go live with TapRide freestanding app.
  - b. **April 23, 2018** – Freestanding app for GoLink and GoPool will be replaced with GoPass++ as a smart-app switch and integrate with developed payment API.
  - c. **June 2018** – First bike-share services will be integrated or be a smart-app switch in GoPass++.
  - d. **August 2018** – Shared-ride TNC, DART public on-demand, and second bike-share services will be integrated or be a smart-app switch into GoPass++.
4. **February 2019** – Field demonstration of the augmented application ends.
5. **May 2019** – DART team submits the Draft Project Report to the USDOT.

DART will collect data relevant to this MOD Sandbox Demonstration (as outlined in this Evaluation Plan) between February 2018 and February 2019 and will share the data with the IE team for conducting the evaluation. Chapters 2 and 4 of this document provide more details on the data collection planning.

# Chapter 2. Evaluation Approach and Process

For each of the 11 MOD Sandbox projects, the IE team developed an evaluation framework in coordination with each project team. This framework is a project-specific logic model that contains the following entries:

1. **MOD Sandbox Project** – Denotes the specific MOD Sandbox project.
2. **Project Goals** – Denotes each of the project goals for the specific MOD Sandbox project. The project goals capture what each MOD Sandbox project aims to achieve.
3. **Evaluation Hypothesis** – Denotes each of the evaluation hypotheses for the specific MOD Sandbox project. The evaluation hypotheses flow from the project-specific goals.
4. **Performance Metric** – Denotes the performance metrics used to measure impact in line with the evaluation hypotheses for the specific MOD Sandbox project.
5. **Data Types, Elements and Sources** – Denotes each of the data types, elements, and sources used for calculating the performance metrics identified.
6. **Method of Evaluation** – Denotes the quantitative and qualitative evaluation methods used.

This chapter details the evaluation approach and process, as finalized in the evaluation logic model for the DART MOD Sandbox project. This includes listing project goals, evaluation hypotheses, performance metrics, data types, elements and sources, and methods of evaluation.

## Project Goals

The project goals denote what DART aims to achieve through the MOD Sandbox demonstration. These project goals are specific to the pilot users and include the following:

1. Increase transit ridership on DART within the pilot region of implementation.
2. Improve information about alternative modes accessing DART and increase carpool travel to DART. Vanpool services may be included as the pilot progresses.
3. Improve FMLM access to DART transit for people with disabilities. This is contingent on recruiting individuals who are willing to participate in the pilot.
4. Reduce overall automobile travel.
5. Improve transportation/multimodal travel options within the pilot region.
6. Improve FMLM service to DART transit (for all persons).

7. Expand service within certain low-density areas not currently served by fixed-route transit due to fiscal constraints, expand public transportation coverage to suburban areas, and improve access to jobs.
8. Replace ineffective, costly fixed-route transit in low-density areas with MOD services (cost effectiveness of shuttle/feeder buses versus MOD service providers for FMLM service).
9. Transition next-day demand-responsive scheduling to same-day scheduling for wheelchair accessible vehicles (WAVs). This is contingent on recruiting individuals who are willing to participate in the pilot.
10. Improve customer satisfaction.
11. Improve user perception of DART brand.
12. Produce lessons learned through stakeholder interviews.
13. Comply with Americans with Disabilities Act (ADA) equivalent level-of-service requirements.

The project goals set the foundation for the evaluation hypotheses.

## Evaluation Hypotheses

The evaluation hypotheses flow from the project-specific goals and denote what should happen if each project goal is met. These evaluation hypotheses include the following:

1. The app increases transit use among the sample as a result of the app improvements, leveraging first- and/or last-mile MOD providers, and lower-cost public transportation.
2. The improvements to the app result in an increase in carpools.
3. Persons with disabilities:
  - a. Find that their ability to access DART transit has improved.
  - b. Experience improved FMLM access as a result of the app.
4. Automobile travel among the pilot group declines. The app causes automobile travel to decline.
5. Users of the app:
  - a. Consider their transportation and multimodal travel options improved because of the app.
  - b. Experience lower travel times than they would have without using the app.
6. App users experience better FMLM (access and egress) mobility to DART transit in the form of reduced travel times for FMLM trips.
7. The geographic scope of locations reachable by DART transit services is increased.
8. The costs of fixed-route transit are higher than the MOD services on a per-rider basis.
9. The average lead time for trips with WAVs that are scheduled for demand-responsive travel declines. This is contingent on recruiting individuals who are willing to participate in the pilot.

10. Customer satisfaction increases as a result of the project.
11. The perception of the DART brand improves as a result of the project.
12. The process of deploying the project will produce lessons learned and recommendations for future research and deployment.
13. FMLM service to passengers with disabilities is equivalent to that provided to passengers without disabilities.

Note that these hypotheses are applicable to the sample population participating in the demonstration of the Sandbox project. The success of each evaluation hypothesis is measured by the performance metrics below.

## Performance Metrics

The performance metrics are used to measure impact in line with the evaluation hypotheses for the DART IE. These performance metrics include the following:

- Ridership change as a result of the app on selected routes that are affected by the app
- Change in mode share of carpools accessing DART transit stations, as a result of the app
- Perception of general FMLM access, mobility, wait times, and travel times
- Measured travel time for access and egress travel to DART transit based on GoLink (microtransit)
- Average distance of travel by mode
- Change in perception of travel options available to pilot participants as a result of the app
- Perceived change in travel time
- Measured travel time of app users
- Measured and perceived travel time for access and egress travel to DART transit
- A measure of area considered accessible via DART with and without the app
- Cost per rider of DART bus routes
- Cost per rider of MOD service providers within the app
- Average schedule lead time from MOD services for WAVs
- Reported customer satisfaction of DART riders
- Reported brand perception of DART
- Qualitative documentation from stakeholder interviews
- Response time, travel time, fare paid by ADA passengers in the Plano area
- Number of WAV trip requests
- Number of trips provided with WAVs

- Average travel distance and average fare of general population and persons with disabilities making similar trips.

The performance metrics will draw from a set of data sources that are specific to the project.

## Data Types, Elements, and Sources

The following data types, elements, and sources are used for the performance metrics defined for the DART IE.

### Data Types and Elements

Five types of data are required to test the hypotheses mentioned in the previous section. These types and the data elements to be collected are listed below.

#### 1. Survey Data (App Users)

##### *Before and After Survey*

- Travel patterns
- Impact that the app and project innovations have had on travel behavior (*in “after” survey only*)
- Transit ridership
- Mode (including carpool) of accessing and egressing DART stations
- Transit mode share within broader travel vehicle ownership, if available
- Perceptions of mobility and accessibility
- Perception of FMLM access, wait times, and travel times
- Demographics
- Disability status
- Home and work location

##### *Recent Trip Survey*

- Trip purpose
- How the trip would have been made had the app not been available

Appendix A provides select sample survey questions for all surveys.

#### 2. App Activity Data

- De-identified user ID
- Trip ID
- Trip start time
- Trip end time
- Mode used
- Distance traveled
- Origin (Census block)
- Destination (Census block)
- Link to DART? (Yes/No)

- j. Disability status of the user

### 3. Transit Agency Data

- a. Bus route data
- b. Mode share of DART access and egress
- c. Social media data (hashtag usage, page visitor interactions), if available
- d. Scheduling data (call-in time, scheduled time, dispatch time, arrival time) for wheelchair accessible vehicles

### 4. Financial and Economic Data

- a. Monthly cost of bus operations per route
- b. MOD total cost to riders
- c. MOD total cost to the agency
- d. Fare paid by WAV users, taxi users, and TNC users, if applicable

### 5. Stakeholder Interview Data

- a. Qualitative documentation from stakeholder interviews.

## Data Sources

The DART team collects the data elements from the following sources and provides them to the IE team.

### 1. DART and Project Partners and Participants

- a. Data from app user surveys
- b. Transit agency data such as on-demand data, bus route data, and social media data
- c. Financial and economic data such as cost of bus operations, MOD cost to the agency
- d. Stakeholder interview data

### 2. GoPass++ App

- a. App activity data resulting from transactional data
- b. Number of active users
- c. Fare on users for each option and selected option

### 3. External Data (Project Partners)

- a. *TNCs*: Number of requests, request time, arrival time, travel time, fare paid, distance traveled
- b. *WAVS*: Number of requests, call-in time, scheduled time, dispatch time, arrival time, travel time, fare paid, distance traveled
- c. *Taxis*: Number of riders, request time, travel time, fare paid, distance traveled
- d. *Carpool*: Number of riders, request time, travel time, fare paid, distance traveled
- e. *Microtransit*: Number of riders, request time, travel time, fare paid, distance traveled.

Chapter 4 provides further details on the data types, elements, and sources by evaluation hypothesis.

## Data Sources Mapping

Figure 1 shows the mapping of data sources, data sets, and performance measures that will be used in the IE of the DART MOD demonstration. As shown, the datasets include both quantitative and qualitative data, and will be submitted to the USDOT ITS Public Data Hub.

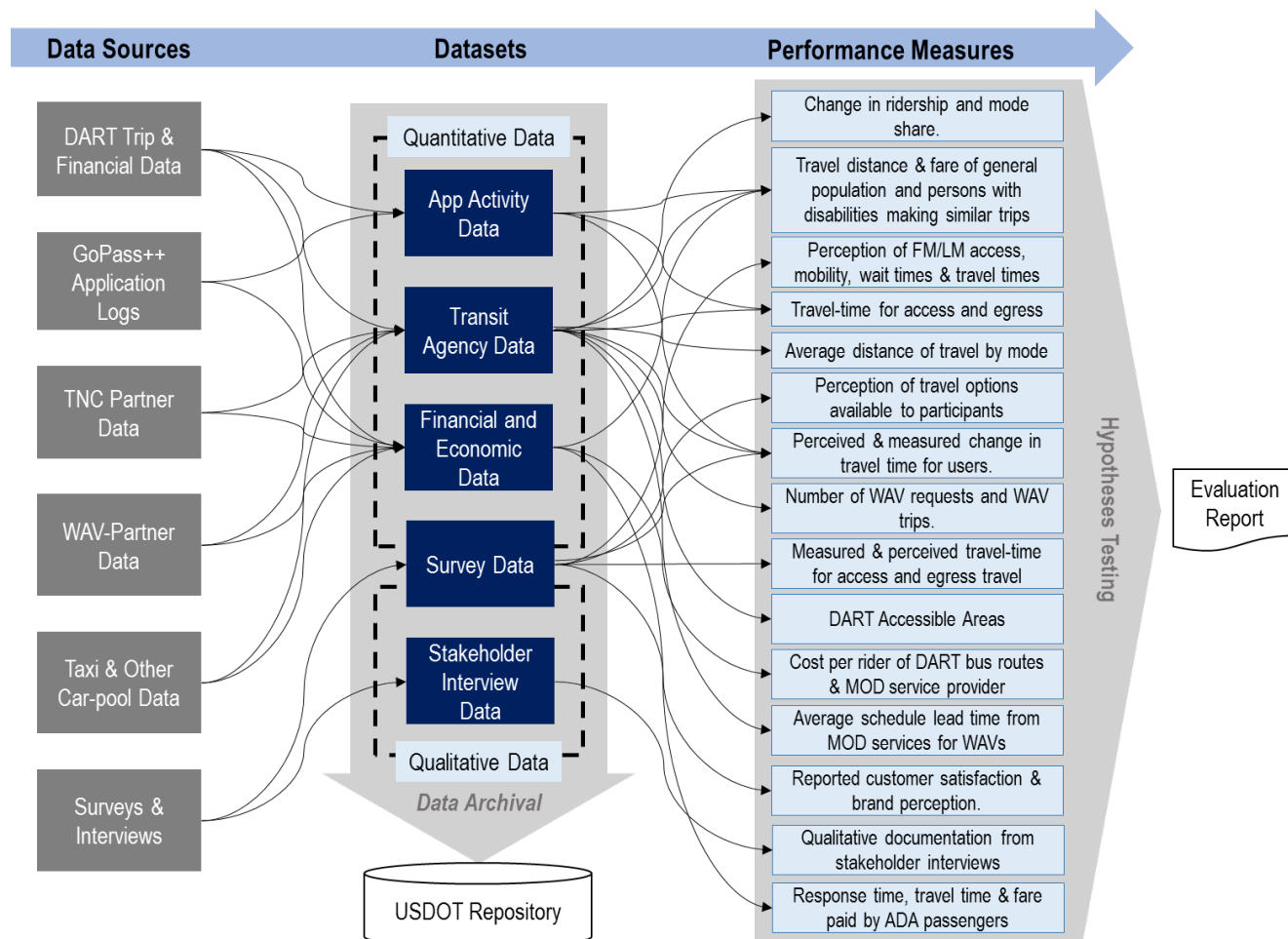


Figure 1. Map of Data Sources, Data Sets, and Performance Measures

## Methods of Evaluation

The quantitative and qualitative evaluation methods used in the DART IE include the following:

- Survey analysis
- Statistical analysis of trends in ridership data
- Statistical analysis of available on-demand share data



- Statistical analysis of travel activity data to evaluate changes in travel patterns contingent on TNC agreement(s)
- Statistical analysis of travel activity data to evaluate changes in travel patterns among disadvantaged populations, assuming that participants are willing to disclose this information
- Travel activity data analysis to measure travel times longitudinally for microtransit users and TNC data in aggregate
- Geospatial analysis of existing services and travel activity data
- Financial analysis of cost data from compared options
- Travel activity data analysis to measure travel times for users making similar trips from these populations.

Chapter 4 provides further details about the analysis methods by evaluation hypothesis.

## Evaluation Logic Model

Table 1 represents an extract from the final DART evaluation logic model. Building on the project goals, the logic model lists evaluation hypotheses, performance metrics, and data types and sources for the DART project.

**Table 1. Project Goals, Evaluation Hypotheses, Performance Metrics, and Data Types and Sources for the DART Sandbox Project**

Number	Project Goals	Evaluation Hypothesis	Performance Metric	Data Types	Data Sources
1	Increase transit ridership on DART within the pilot region of implementation	The app increases transit use among the sample as a result of the app improvements, leveraging first- and/or last-mile MOD providers, and lower-cost public transportation	Ridership change as a result of the app on selected routes that are affected by the app	Survey Data	DART/Pilot participants
2	By improving information about alternative modes accessing DART, increase carpool travel to DART	The improvements to the app result in an increase in carpools	Mode share of carpools accessing DART transit stations, change as a result of the app	Survey Data Transit Data (mode share to DART)	DART/Pilot participants
3.a	Improve FMLM access to DART transit for people with disabilities	Persons with disabilities find that their ability to access DART transit has improved	Perception of general FMLM access, mobility, wait times, and travel times	Survey Data	DART/Pilot participants
3.b	<i>This is contingent on recruiting individuals who are willing to participate in the pilot.</i>	Persons with disabilities experience improved FMLM access as a result of the app	Measured travel time for access and egress travel to DART transit	Survey Data (persons with disabilities) App Activity Data	DART/Pilot participants (persons with disabilities) GoPass++

Number	Project Goals	Evaluation Hypothesis	Performance Metric	Data Types	Data Sources
4	Reduce overall automobile travel based on pilot participant data	Automobile travel among the population declines; the app causes automobile travel to decline	Distance of travel by automobiles	Survey Data Activity Data	DART/Pilot participants GoPass++ TNCs Taxis WAVS
5.a	Improve transportation / multimodal travel options within the pilot region	Users of the app consider their transportation and multimodal travel options improved because of the app	Users' reported perception of options available to them as a result of the app	Survey Data	DART/Pilot participants
5.b		Users experience lower travel times than they would have without using the app	Reported perception of change in travel time  Measured travel time of app users	Survey Data Activity Data	DART/Pilot participants GoPass++ TNCs Taxis WAVS
6	Improve first and last mile service to DART transit (for all persons)	App users experience better FMLM (access and egress) mobility to DART transit in the form of reduced travel times for FMLM trips	Measured and perceived travel time for access and egress travel to DART transit	Survey Data Activity Data	DART/Pilot participants GoPass++ TNCs Taxis WAVS

Number	Project Goals	Evaluation Hypothesis	Performance Metric	Data Types	Data Sources
7	Expand service within certain low-density areas not currently served by fixed-route transit due to fiscal constraints, expand public transportation coverage to suburban areas, improve access to jobs	The geographic scope of locations reachable by DART transit services is increased	A measure of area considered accessible via DART with and without the app	Survey Data	DART/Pilot participants
8	Replace ineffective, costly fixed-route transit in low-density areas with MOD services (cost effectiveness of shuttle / feeder buses versus MOD service providers for FMLM service)	The costs of fixed-route transit are higher than the MOD services on a per-rider basis	Cost per rider of DART bus routes  Cost per rider of MOD service providers within the app	Financial and Economic Data	DART GoPass++
9	Transition next-day demand-responsive scheduling to same-day scheduling for WAVs  <i>This is contingent on recruiting individuals who are willing to participate in the pilot.</i>	The average lead time for trips with WAVs that are scheduled for demand-responsive travel declines	Average schedule lead time from paratransit and MOD services for WAVs	Scheduling Data	Participating demand-responsive services for WAVs

Number	Project Goals	Evaluation Hypothesis	Performance Metric	Data Types	Data Sources
10	Improve customer satisfaction	Customer satisfaction increases as a result of the project	Reported customer satisfaction of DART riders	Survey Data	DART/Pilot participants
11	Improve the brand impact of DART	The perception of the DART brand improves as a result of the project	Reported brand perception of DART	Survey Data Social Media Data	DART/Pilot participants
12	Produce lessons learned through stakeholder interviews	The process of deploying the project will produce lessons learned and recommendations for future research and deployment	N/A	Stakeholder Interview Data	DART, project partners and participants
13	Comply with ADA equivalent level-of-service requirements	FMLM service to passengers with disabilities is equivalent to that provided to passengers without disabilities	Response time, travel time, fare paid by ADA passengers in the Plano area  WAV trip requests  Trips provided with WAVs	Survey Data Activity Data	DART/Pilot participants GoPass++ TNCs Taxis WAVS

## Documentation and Reporting

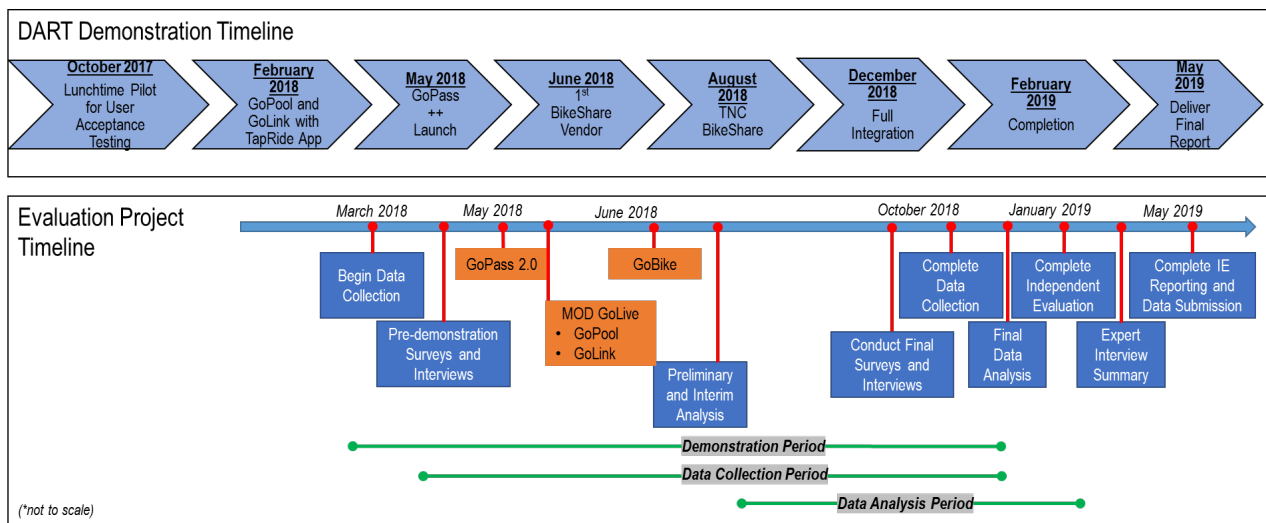
The IE team will develop an evaluation report for this MOD Sandbox demonstration project. The report will include a summary of major project findings, followed by details of the demonstration, evaluation hypotheses, data collected, analysis performed, findings, and results. The results will be presented through a mix of exhibits including tables, graphs, and charts.

# Chapter 3. Evaluation Schedule and Management

This chapter provides details on the evaluation project schedule and management of the evaluation project.

## Evaluation Schedule

Figure 2 shows the IE schedule from the beginning of the quantitative and qualitative data collection that spans throughout the demonstration period and leads to the analysis, whose results are included in the site-specific evaluation report. Note that interim data spot checks and sample analyses will be performed throughout the demonstration period to proactively mitigate data-related risks.



Source: Booz Allen Hamilton, May 2018

**Figure 2. MOD Sandbox Evaluation and Demonstration Schedule**

Data relevant to the program will be collected between February 2018 and February 2019. This data will be shared with the IE team for evaluation purposes. Chapter 4 provides more details on the data types, elements, and collection timeframes.

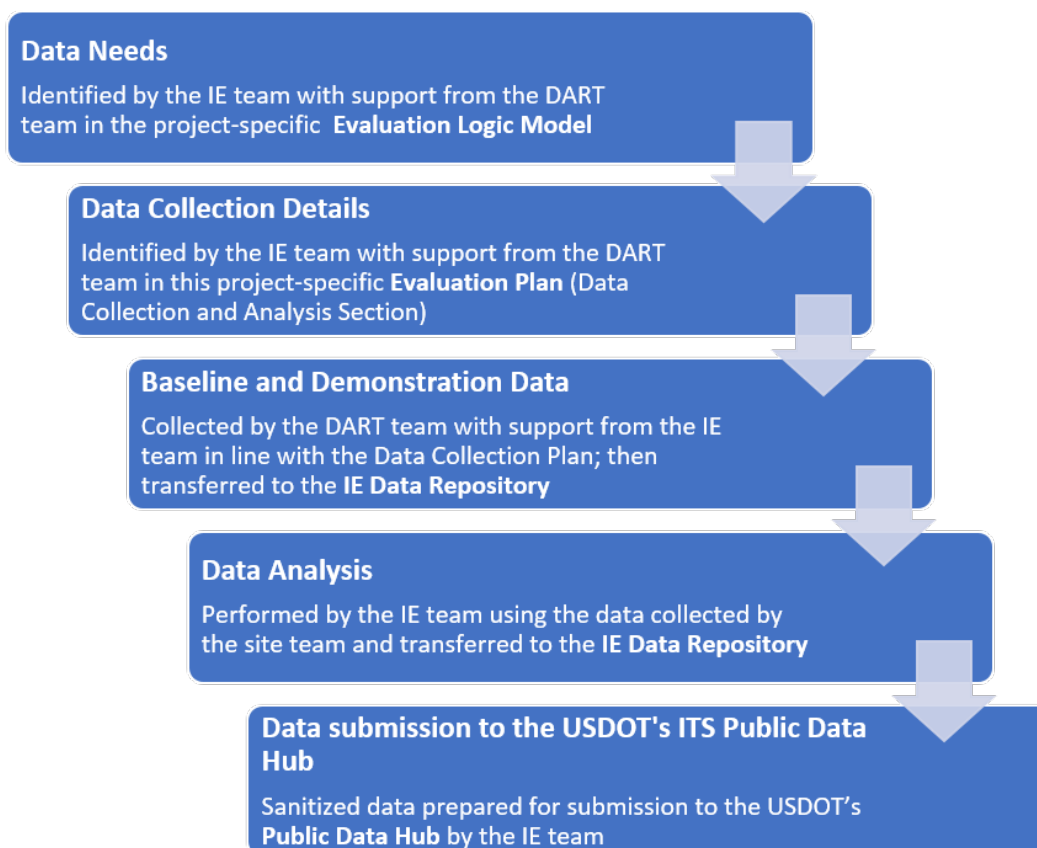
## Roles and Responsibilities

The three main entities involved in the evaluation and their corresponding high-level roles are as follows:

- **The site team** coordinates the collection of the requested evaluation data from the various project partners throughout the demonstration period and transfers the data to the IE team.
- **The IE team** supports the site team in the definition of the requested data elements and performs the analysis using the data provided by the site team.
- **The USDOT team** supervises the work and provides support for topics that encompass more than one site (e.g., coordination with TNCs, who are partnering with several Sandbox sites, for data to assess the ADA equivalent level-of-service requirement).

## Data Transfer and Storage

Various types of qualitative and quantitative data sources are involved in the evaluation, as specified in Chapter 4. Figure 3 shows the overall data collection framework, including the steps and parties involved in data design, collection, transfer, and storage.



**Figure 3. DART Data Collection Framework**



## Data Collection Responsibilities

Table 2 denotes the data collection responsibilities for the various data types required for the evaluation.

**Table 2. Data Type and Data Collection Responsibilities for DART Sandbox Evaluation**

Data Type	Data Collection Responsibilities
Survey Data	<ul style="list-style-type: none"> <li>• Survey questions are developed by the IE team in collaboration with the DART team (<i>draft survey questions provided as an appendix in this document</i>)</li> <li>• A web link to the approved (Before/After) survey is provided by the IE team or the DART team</li> <li>• The survey link is distributed by the DART team to users/participants in the MOD Sandbox project demonstration</li> <li>• [Anonymous] Survey responses are transferred by the DART team to the IE team by e-mail or DropBox (Alternatively, access to the data can be given to the IE team, as appropriate)</li> </ul>
App Activity Data	<ul style="list-style-type: none"> <li>• Collected by the DART team and transferred to the IE team</li> </ul>
Transit Agency Data	<ul style="list-style-type: none"> <li>• Collected by the DART team and transferred to the IE team</li> </ul>
Financial and Economic Data	<ul style="list-style-type: none"> <li>• Collected by the DART team and transferred to the IE team</li> </ul>
Stakeholder Interview Data	<ul style="list-style-type: none"> <li>• Stakeholder interview questions are developed by the IE team in collaboration with the DART team</li> <li>• Stakeholder interviews are administered by the DART team</li> <li>• Stakeholder interview responses are transferred by the DART team to the IE team after the demonstration</li> </ul>

## Risk Management

The IE team will continually monitor risk in an ongoing process throughout the demonstration period and identify the best resources within the team to address each risk. The following are some of the main risks involved in the evaluation.

### Schedule

The IE team will maintain a demonstration tracking schedule to track and contact the DART team for data and documentation. The IE team will maintain an up-to-date integrated schedule that reflects updates from the DART team on a continuous basis. Components of the evaluation reports will be created throughout the demonstration period, as the data and documentation for the project becomes available. The site team should inform the IE team of any changes in schedule that could affect the overall evaluation schedule (e.g., delays in the demonstration schedule).

## Data Quality Assurance

The IE team will perform spot checks on the data as it is collected throughout the demonstration period to proactively manage risks related to data quality. This will allow the following:

- Avoiding insufficient data on performance of MOD demonstration to reliably estimate impacts and/or benefits
- Addressing challenges in empirical data including lack of consistency, biases, and incompleteness
- Identifying and controlling sources of error
- Considering quality and quantity issues in data collection
- Ensuring data privacy and proprietary protections in line with human subjects' protections
- Considering confounding factors.

## Data Sufficiency

Since many of the performance metrics rely on data from surveys, the project runs a risk related to data sufficiency. About 200 participants will be recruited to participate in the demonstration and provide data for the evaluation. The evaluation results will be documented along with the caveats regarding data sufficiency. Participant selection will also include recruitment of travelers with disabilities as well as other variable target demographics. Stratified sampling will be utilized to ensure proper representation of all demographics.

## Data Anonymity

The project relies on collecting specific data from participants regarding their usage of, and behavior regarding, transit options and requires privacy safeguard. The data types, such as survey data and application activity data, will be collected so that no personally identifiable information (PII) is included. Data such as payment/financial data will be cleaned for any PII prior to utilization in this project.

Table 3 includes risk mitigation strategies that will be employed to ensure the availability of the requested data types for the evaluation.

**Table 3. Data Type and Risk Mitigation Strategies for DART Sandbox Evaluation**

Data Type	Risk Mitigation Strategies
Survey Data	The DART team will distribute the survey link to users of the augmented app and ensure that participants in the pilot are willing to take the surveys
App Activity Data	The DART team will ensure that the needed travel activity data is collected from the database and transferred to the IE team
Transit Agency Data	The DART team has access to the requested transit ridership and cost data and can provide these to the IE team
Financial and Economic Data	The DART team will ensure that the data is collected and transferred to the IE team
Stakeholder Interview Data	The DART team will facilitate the connection between the IE team and expert interviewees and help in getting their commitment to participate in the interviews

# Chapter 4. Data Collection and Analysis Plan

This chapter describes the data collection and analysis plan for the DART MOD Sandbox Project evaluation. It summarizes the data that needs to be collected and how that data should be processed and delivered to the IE team. Where possible, the IE team will help the Sandbox project team with data processing to get the requested data format to conduct calculations for the evaluation. Any PII will need to be removed, when present in the data.

The data collection plan follows the evaluation logic model, with each data field discussed in association with a hypothesis and performance metrics. Certain types of data collected address multiple hypotheses. In cases where the data structure is the same for more than one hypothesis, the plan refers to the data structure for a hypothesis already described.

Most demonstration data should be provided from the beginning of the pilot demonstration period. The IE team also requests provision of data about general DART activity dating back to 2015 if possible. This longer time series of activity before and after the pilot demonstration can help discern possible background trends present before and throughout the project. Naturally, any data collected as a result of the pilot demonstration itself can only be produced from the beginning of the data collection period. All hypotheses will be evaluated at the DART level, when data permits. An aggregate analysis will be performed on system-wide impacts as well.

Table 4 summarizes the data types, data elements, collection periods, and hypothesis alignment for the DART Sandbox project evaluation. A more detailed data collection and analysis plan for each evaluation hypothesis follows.

**Table 4. Data Type, Data Elements, Period of Collection, and Hypothesis Alignment for DART Sandbox Project Evaluation**

Data Type	Data Elements	Period of Data Collection	Hypothesis Alignment
<p>Survey Data (Appendix A provides select sample questions for all surveys)</p>	<p>Before survey questions addressing:</p> <ul style="list-style-type: none"> <li>• Travel patterns</li> <li>• Impact that the app and project innovations have had on travel behavior (<i>in after survey only</i>)</li> <li>• Transit ridership</li> <li>• Mode (including carpool) of accessing and egressing DART stations</li> <li>• Transit mode share within broader travel vehicle ownership, if available</li> <li>• Perceptions of mobility and accessibility</li> <li>• Perception of FMLM access</li> <li>• Wait times</li> <li>• Travel times</li> <li>• Demographics</li> <li>• Disability status</li> <li>• Home and work location</li> </ul> <p>After survey questions addressing:</p> <ul style="list-style-type: none"> <li>• Trip Purpose</li> <li>• How the trip would have been made had the app not been available</li> </ul> <p>Recent trip survey covering:</p> <ul style="list-style-type: none"> <li>• Trip purpose</li> <li>• How the trip would have been made had the app not been available</li> </ul>	<p>Before the launch of the app improvements (<i>Before survey</i>), and at the end of the project demonstration period (<i>After survey</i>)</p>	<p>1, 2, 3a, 3b, 4, 5a, 5b, 6, 7, 10, 11, 13</p>

Data Type	Data Elements	Period of Data Collection	Hypothesis Alignment
App Activity Data	<ul style="list-style-type: none"> <li>De-identified User ID</li> <li>Trip ID</li> <li>Trip start time</li> <li>Trip end time</li> <li>Mode used</li> <li>Distance traveled</li> <li>Origin (Census block)</li> <li>Destination (Census block)</li> <li>Link to DART? (Yes/No)</li> <li>Disability status of the use</li> </ul>	Throughout the project demonstration period	3b, 4, 5b, 6, 13
Transit Agency Data	<ul style="list-style-type: none"> <li>Bus route data</li> <li>Mode-share of DART access and egress</li> <li>Social media data (hashtag usage, page visitor interactions), if available</li> <li>Scheduling data (call-in time, scheduled time, dispatch time, arrival time) for wheelchair accessible vehicles</li> </ul>	Data is requested for the history of app use in the Dallas region from 2016 through the period of MOD project performance. <i>(The app has been in use as early as October 23, 2015. Data beginning in 2016 would permit before and after analysis of activity as related to measuring DART FMLM access travel time)</i>	2, 9, 11
Financial and Economic Data	<ul style="list-style-type: none"> <li>Monthly cost of bus operations per route</li> <li>MOD total cost to riders</li> <li>MOD total cost to the agency</li> <li>Fare paid by WAV users, taxi users, and TNC users, if applicable</li> </ul>	Data is requested from 2015 through the end of the MOD project demonstration period. <i>(This longer time frame will allow the evaluation team to inspect trends, upward or downward, that may have existed prior to the project implementation.)</i>	8
Stakeholder Interview Data	<ul style="list-style-type: none"> <li>Qualitative documentation from stakeholder interviews</li> </ul>	Stakeholder interviews are suggested to occur toward the end of the project demonstration period.	12

## Detailed Data Collection and Analysis Plan by Evaluation Hypothesis

**Hypothesis 1:** The app increases transit use among the sample as a result of the app improvements, leveraging first- and/or last-mile MOD providers and lower-cost public transportation.

**Performance Metric:** Reported change in transit use by users of the app

**Data Type:** Survey of app users

The survey will be implemented in a before-and-after design:

- The “before” survey will ask the selected 200 users questions about their travel behavior. It will establish baseline information, connect responses with a de-identified ID, and explore the data elements below.
- The “after” survey will ask similar questions, but will also contain questions that evaluate any measured change in behavior that is recorded by the app.

Both surveys will cover the following elements:

- Travel patterns
- Impact that the app and project innovations have had on travel behavior (“after” survey only)
- Transit ridership
- Mode (including carpool) of accessing and egressing DART stations
- Transit mode share within broader travel vehicle ownership
- Perceptions of mobility and accessibility
- Perception of FMLM access, wait times, and travel times
- Demographics
- Disability status
- Home and work location.

Furthermore, a *recent trip survey* could benefit the evaluation if DART can coordinate the survey dissemination. Recent trip surveys ask up to three questions pertaining to the most recent trip taken by the user. Respondents receive an email, to respond to at their discretion. Respondents do not receive emails after every trip, only after a few (3 to 5 trips) and never twice within 72 hours. The recent trip survey would ask about:

- Trip purpose
- How the trip would have been made had the app not been available

Appendix A provides select sample questions for all surveys.

**Data Collection Period:**

- The before survey will be implemented once DART has established the test group and the survey has been made operational. The survey will be implemented online in collaboration with DART, using emails and other contact media to disseminate the survey link.
- The after survey will be implemented on a timetable determined during discussions between DART and the IE team. The evaluation team would prefer to implement the survey at least three months before the end of the project evaluation period to provide time for data analysis and synthesis.

### Analysis Procedure:

To explore this hypothesis, the IE team will evaluate survey questions about respondents' travel behavior during the before survey and during the after survey. The measurements of activity within both surveys will be compared on a paired basis. The after survey will also explore whether the app has caused changes in their transit ridership, and if so, in what direction and magnitude. These causal and attributional questions will assess whether those who have had direct interaction with the app and other project components feel that it has impacted their transit ridership.

**Hypothesis 2:** The improvements to the app result in an increase in the mode share of carpool travel to DART transit

**Performance Metric:** Mode share of carpools accessing DART transit stations changes as a result of the app

### Data Types:

- *Survey of app users*

The survey of app users will be the same as described in Hypothesis 1.

- *Data on modes accessing DART*

DART may have general population surveys on mode share of people accessing the DART rail and bus routes that can be used as benchmark data for the behavior of riders before the implementation of the project.

### Data Collection Period:

- The data collection period for the survey is as described in Hypothesis 1.
- The data collection period on modes accessing DART is defined by the available rider surveys conducted by DART from 2016 to the present. These comprise any surveys DART has conducted with its general population within the targeted area that may be useful in providing profiles of mode share for accessing DART.

### Analysis Procedure:

The analysis for this hypothesis will rely on survey data from app users and comparisons of results from mode-share questions asked to riders by DART before and during the project. The primary instrument will be the survey of app users. The survey will ask questions evaluating how travel behavior has changed as a result of the app, and questions will specifically focus on how modes used to access DART have changed. The distribution of responses to causal questions of mode shift will be analyzed along with benchmark mode-share data collected from any available previous and contemporary surveys that DART might have to indicate trends in mode shift.



**Hypothesis 3a:** Persons with disabilities find that their ability to access DART transit has improved

**Performance Metric:** Perception of general FMLM access, mobility, wait times, and travel times

**Data Type:** Survey of app users within the population of people with disabilities

The survey will be implemented as described in Hypothesis 1, but the population of analysis will be constrained to those indicating a disability status within the population.

**Data Collection Period:**

The data collection period for the survey is as described in Hypothesis 1.

**Analysis Procedure:**

The survey will contain questions about app user perceptions of FMLM access, mobility, wait times, and travel times. The questions will ask whether respondents believe the app itself contributed to their perceptions of improvement on the metrics above.

Because DART is only planning to have 200 people in the beta group for evaluation, the sample of persons with disabilities may be limited. It is not known how many people within the sample will have a disability. Even if it is 10 percent of the sample, this will only be 20 people. The evaluation team plans to draw insights from persons with disabilities to the extent possible. However, if the sample does not contain enough respondents from that group, then the hypothesis may not be addressable.

**Hypothesis 3b:** Persons with disabilities experience improved FMLM access as a result of the app

**Performance Metric:** Measured travel-time for access and egress travel to DART transit

**Data Types:**

- *Travel activity data of app users*

This is activity data derived from the app itself. The app may have capacity to collect data on movements of individuals that can be *de-identified* or aggregated in ways that address questions regarding the experience of travel. The IE team would seek activity data that can be used to measure FMLM travel times over time. The data can be as disaggregated as GPS points of movement, or summarized information on travel. At the disaggregated level, the data might be generally constructed as follows:

- De-identified user ID
- Date and time stamp
- Latitude at time stamp
- Longitude at time stamp
- Accelerometer measurements (m/s<sup>2</sup>) [for mode determination]
- Attributes on app activity (e.g., Trip planner, “Where’s My Train?”)
- Disability status of the user (needed for Hypothesis 13).

Although the app is known to access a person's location during use, the IE team does not know what data the app is capable of collecting over time, so these data points specify the types of raw data points that can be processed to extract insights necessary to address this hypothesis. But other structures, if available, might achieve the same objective. Ultimately, the IE team is interested in using the data to measure the changes in FMLM access as a result of the project. Aggregation of the data above to the trip level can also serve this purpose if done using a mutually agreed-upon systematic approach to render the information into trip records with descriptive statistics. Summary data that can be used for the same analysis might have the following structure:

- De-identified User ID
  - Trip ID
  - Trip start time
  - Trip end time
  - Mode used
  - Distance traveled
  - Origin (Census block)
  - Destination (Census block)
  - Link to DART? (Yes/No)
  - Disability status of the user (needed for Hypothesis 13).
- *Survey of app users within the population of people with disabilities*  
The survey will be implemented as described in Hypothesis 1.

#### **Data Collection Period:**

- The data collection period for the survey is as described in Hypothesis 1.
- The data collection period for the activity data is requested for the history of app use in the Dallas region, from 2016 through the period of project demonstration. The app has been in use since as early as October 23, 2015. Data beginning in 2016 would permit before and after analysis of activity as related to measuring DART FMLM access travel time.

#### **Analysis Procedure:**

The analysis evaluating this hypothesis will calculate the travel speeds observed in the activity data over the course of the project implementation. The analysis will evaluate the observed average travel times, determine whether travel times exhibit a downward trend during the evaluation period, and include a comparison with any activity measurements of travel time prior to project implementation. For example, measurements from the GoPass™ app prior to project implementation could provide some baseline measurement of travel. The most preferred pathway for analysis would be to conduct a longitudinal comparison of travel-time measurements from app activity data of users before and after the implementation of the project modifications. The feasibility of this analysis will be contingent on app activity data.

The survey would also support evaluating this hypothesis. The survey would provide two key inputs. The survey would contain questions assessing whether respondents felt the modifications to the GoPass++

app improved their FMLM access, and asking respondents to measure the travel time for access and egress travel to DART transit before and after improvements to the app.

As detailed in Hypothesis 3a, because DART is only planning to have 200 people in the beta group for evaluation, there may be a very limited sample of persons with disabilities. It is not known how many people within the sample will have a disability. The evaluation team plans to draw insights from persons with disabilities to the extent possible. However, if the sample does not contain enough respondents from that group, then the hypothesis may not be addressable.

**Hypothesis 4:** Automobile travel among the pilot group declines

**Performance Metric:** Distance of travel by automobiles (including carpools)

**Data Types:**

- *Survey of app users*  
The survey will be implemented as described in Hypothesis 1.
- *Travel activity data of app users*  
This data will be the same as structured for Hypothesis 3b.

**Data Collection Period:**

- The data collection period for the survey is as described in Hypothesis 1.
- The data collection period for the activity data is as described in Hypothesis 3b.

**Analysis Procedure:**

The IE team will evaluate whether the travel activity data can be used to identify automobile travel. This will require the activity data to render modes of travel and distance. Effectively, the activity data must be rendered and summarized into modes by trip. The IE team can then evaluate whether there is a change in the average number of carpool trips or the carpool distance traveled following the implementation of the GoPass++ improvements. The activity data can provide a direct measure of travel activity, but cannot reveal cause or purpose.

The survey data will support the activity data analysis, with questions evaluating whether respondents increased their carpool travel as a result of the GoPass++ improvements. The changes in travel behavior as derived from the survey and the activity data will be used to estimate changes in energy consumption from personal transportation among the beta group respondents. The evaluation will consider the use of personal vehicles across different modes to service the marginal trip. This will include personal driving as well as other trips using a personal vehicle that would not have been made otherwise.

**Hypothesis 5a:** Users of the app consider their transportation and multimodal travel options improved because of the app

**Performance Metric:** User-reported perception of options available to them as a result of the app

**Data Type:** Survey of app users

The survey will be implemented as described in Hypothesis 1.

**Data Collection Period:**

The data collection period of the survey is as described in Hypothesis 1.

**Analysis Procedure:**

The survey will ask questions about whether respondents feel that their transportation and multimodal travel options have improved because of the app. The questions will probably be structured on a Likert scale, but other structures are possible. The questions will require or imply attribution to the app within the response. The distribution of responses to these questions will be used to assess this hypothesis.

**Hypothesis 5b:** Users experience lower travel times than they would have without using the app.

**Performance Metrics:**

- Reported perception of change in travel time
- Measured travel time of app users

**Data Types:**

- *Survey of app users*  
The survey will be implemented as described in Hypothesis 1.
- *Travel activity data of app users*  
This data will be the same as structured for Hypothesis 3b.

**Data Collection Period:**

- The data collection period for the survey is as described in Hypothesis 1.
- The data collection period for the activity data is as described in Hypothesis 3b.

**Analysis Procedure:**

The analysis would use the activity data from both the app and the survey to evaluate whether users experience improved travel times. The analysis would compute travel times for trips of users over time. It would evaluate whether travel times decline over time. This will be assessed by constructing comparable trips that users take within the longitudinal data set and evaluating whether the average travel time changed over time across users. It may be assessed by evaluating whether average velocity changed over time across users. The analysis will be supported by the survey, which will explore perceptions of change in travel time. If necessary and relevant, the analysis may use estimations of how certain trips would have been made in the absence of the app using applications such as Google Maps to evaluate plausible travel times using other modes.

**Hypothesis 6:** App users experience better FMLM (access and egress) mobility to DART transit in the form of reduced travel times for FMLM trips

**Performance Metric:** Measured and perceived travel time for access and egress travel to DART transit

**Data Types:**

- *Survey of app users*  
The survey will be implemented as described in Hypothesis 1.
- *Travel activity data of app users*  
This data will be the same as structured for Hypothesis 3b.

**Data Collection Period:**

- The data collection period for the survey is as described in Hypothesis 1.
- The data collection period for the activity data is as described in Hypothesis 3b.

**Analysis Procedure:**

The analysis will use the activity data to evaluate travel times for trips that connect to DART transit. The evaluation of travel times will be longitudinal over time and across users. It will assess whether average travel times for trips accessing and egressing DART declined over the course of the project. The before survey will also be used to produce responses defining "before" measurements of travel time. The after survey will evaluate whether perception and measurement of FMLM travel times have changed.

**Hypothesis 7:** The geographic scope of locations reachable by DART transit services is increased.

**Performance Metric:** A measure of area considered accessible via DART with and without the app

**Data Type:** Survey of app users

The survey will be implemented as described in Hypothesis 1.

**Data Collection Period:**

The data collection period for the survey data is as described in Hypothesis 1.

**Analysis Procedure:**

The survey will ask questions about accessibility and diversity of locations traveled. The before survey will ask whether there are locations that the user would like to access but cannot, due to lack of access or unreasonable travel times. The after survey will probe whether the user has been able to access a more diverse set of locations.

**Hypothesis 8:** The costs of fixed-route transit are higher than the MOD services on a per-rider basis.

**Performance Metrics:**

- Cost per rider of DART bus routes
- Cost per rider of MOD service providers within the app

**Data Types:**

- *Cost data of bus operations*  
This is cost information on bus operations including fuel, labor, and any other operating costs. Capital costs are also to be considered.
- *Bus route ridership data*  
Ridership data on key bus routes within the region of the project
- *MOD total cost data on a per rider basis*  
MOD cost data to the rider
- *MOD operations cost to the agency*  
Any data that describes the cost of MOD operations to the agency
- *MOD ridership subsidized by the agency*  
MOD trips taken by users of the app, as secured through the app

**Data Collection Period:**

The data collection period for this data is requested from the beginning of 2016 to the end of the MOD Sandbox project evaluation period.

**Analysis Procedure:**

The analysis of cost data will evaluate the cost to DART per rider for bus routes within regions targeted by the project. These costs will be compared to costs experienced by users and by the agencies for similar trips using MOD services.

**Hypothesis 9:** The average lead time for trips with WAVs that are scheduled for demand-responsive travel declines.

**Performance Metric:** Average schedule lead time from ADA paratransit and MOD services for WAVs

**Data Type:** Scheduling data from all participating demand-responsive services for WAVs

This is the time a ride is scheduled and the time the ride begins.

**Data Collection Period:**

Since this is a before and after analysis, the data collection period is requested from the beginning of 2016 to the end of the project evaluation period. The data is requested for operators that engaged in paratransit operations before and after the project implementation.

**Analysis Procedure:**

The analysis will evaluate whether lead time (wait time) is significantly lower for trips scheduled for demand responsive travel through the app. The comparison will be made within MOD and across modes.

**Hypothesis 10:** Customer satisfaction increases as a result of the project.

**Performance Metric:** Reported customer satisfaction of DART riders

**Data Type:** Survey of DART riders

The survey will be as described in Hypothesis 1.

**Data Collection Period:**

The data collection period for the survey is as described in Hypothesis 1.

**Analysis Procedure:**

Questions will be included in the survey that evaluate the change in customer satisfaction as a result of the project. Customer satisfaction may increase or decline. The distribution of responses will be used to evaluate the hypothesis, and the net change in customer satisfaction (on an ordinal scale) will be assessed.

**Hypothesis 11:** The perception of the DART brand improves as a result of the project

**Performance Metric:** Reported brand perception of DART

**Data Types:**

- *Survey of DART riders*  
The survey will be as described in Hypothesis 1.
- *Social media hits on DART's social media pages*  
The number of social media hits over time will be provided by DART. The data is requested in aggregations of hits per day.

**Data Collection Period:**

- The data collection period for the survey is as described in Hypothesis 1.
- The data on social media hits is requested from the beginning of 2016 to the end of the MOD Sandbox project evaluation period.

**Analysis Procedure:**

The analysis will evaluate whether respondents report an improvement in their perception of the DART brand as a result of the project. Questions will focus on brand perception in the survey. Social media hits will also be plotted over time to evaluate whether they exhibited any positive change in trend.

**Hypothesis 12:** The process of deploying the project will produce lessons learned and recommendations for future research and deployment

**Performance Metric:** Response from interviews and qualitative documentation from stakeholder interviews

**Data Type:** Stakeholder interviews

This data is qualitative in nature. The project team will identify members that can be available to interview with the IE team. The project team should specify a minimum of three people with enough knowledge on the project to talk candidly about its successes and challenges. The evaluation team will interview these candidates to understand the lessons learned from project implementation.

**Data Collection Period:**

The data collection for stakeholder interviews should occur at least 6 months after the launch of the demonstration, but it may be conducted later, if it is within a maximum of 2 months after the end of the demonstration period.

**Analysis Procedure:**

An expert interview protocol will be developed. The interviews will be conducted and synthesized from notes and recordings into a summary describing key insights from experts directly involved in the project.

**Hypothesis 13:** FMLM service to passengers with disabilities is equivalent to that provided to passengers without disabilities.

**Performance Metrics:**

- Average travel time of general population and persons with disabilities making similar trips
- Average wait time (or planning time) of general population and persons with disabilities making similar trips
- Average travel distance and average fare of general population and persons with disabilities making similar trips

**Data Types:**

- *Survey of DART riders*  
The survey will be as described in Hypothesis 1.



- *Travel activity data of app users*

This is the same data as described for Hypothesis 3b, except that it focuses on persons with a disability.

**Data Collection Period:**

- The data collection period for the survey is as described in Hypothesis 1.
- The data collection period for the activity data is as described in Hypothesis 3b.

**Analysis Procedure:**

The analysis will evaluate travel times for persons with disabilities and persons without disabilities who make trips between similar origin and destination pairs. Average travel times for the two populations will be calculated and statistically compared using the t-test. The analysis will also explore wait and planning times if it is available in the activity data. The surveys will also contain questions that explore travel and wait times that can be used to determine the degree to which equivalency of service is attained.

With the 200-person beta group, this hypothesis may not be robustly evaluated. If the beta group does not have a significant number of users that are classified as people with disabilities within the sample population, then instances of comparable wait time and travel time will be difficult to occur. This analysis requires persons with and without disabilities making a similar trip request from similar locations and at a similar time. Such overlapping circumstances could be rare under these circumstances. The IE team will evaluate the potential to address this hypothesis as we proceed with data collection.

# Appendix A. Selected Draft Survey Questions (Before, After, and Recent Trip Surveys)

## Before Survey

This section presents draft survey questions for the Before Survey of app users. These survey questions are subject to revision, and not all questions are presented. This section provides examples of the proposed structure of selected key questions. The survey questions may be revised/augmented with input from the DART project team.

### *Sample Questions*

Including yourself, how many people live in your current household?

- 1
- 2
- 3
- 4
- 5
- More than 5

What best describes your relation to the other people in your current household? (Please check all that apply)

- Parent/Guardian(s)
- Relatives (e.g., siblings)
- Housemates/Roommates
- Partner/Significant Other
- Children (who are under your guardianship)

Please list the year, make, and model of your household's CURRENT vehicle(s) (e.g., 2012 Honda Civic), including those that are owned or leased:

Current Vehicle	Year	Make	Model
Vehicle 1			
Vehicle 2			
Vehicle 3			
Vehicle 4			
Vehicle 5			

In the last year, approximately how many miles have you driven on these vehicles? (Not cumulative odometer reading. If the vehicle was owned for less than a year, please approximate your annual miles, based on how much you have driven it thus far.)

Please indicate how frequently you CURRENTLY use the following modes:

Mode	Not available to me or not in my area	Never in the last year	Less than once a month	Once a month	Every other week	1 to 3 days per week	4 to 6 days per week	Once a day	2 to 4 times a day	More than 4 times a day
Drive alone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drive/ride with others (non-commute)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Carpool (for commuting)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
DART Bus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
DART Light Rail	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bicycle	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Uber/Lyft	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taxi	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

For the trip purposes you selected, please indicate how frequently you currently make those trips?

Trip Purpose	More than 4 times a day	2 to 4 times a day	7 to 13 times a week	4 to 6 times per week	1 to 3 times per week	2 times a month	Once a month	Less than once a month
Go to or from a restaurant/bar								
Social/ recreational inside the Dallas-Fort Worth region								
Social/ recreational outside the Dallas-Fort Worth region								
Commute to or from work								
Commute to or from school								
Go to or from public transit								
Go to or from work-related meetings during the day								
Go to or from grocery shopping								
Go to or from other shopping (non-groceries)								
Run non-shopping errands								
Go to or from healthcare services								
Go to or from gym								
Move bulky items								

Currently, how many days a week do you typically work and/or go to school?

- I do not work/ I do not go to school
- 1
- 2
- 3
- 4
- 5
- 6
- 7

Please indicate how many days a week you commute to work or school by the transportation mode(s) below:

	More than 4 times a day	2 to 4 times a day	7 to 13 times a week	4 to 6 times per week	1 to 3 times per week	2 times a month	Once a month	Less than once a month
Drive alone								
Drive/Ride with family/friend (non-commute)								
Carpool (for commuting)								
Public Bus								
DART Light Rail								
Walk (to a destination)								
Uber/ Lyft or other ride-hail service								
UberPOOL/Lyft Line or other shared-ride service								
Taxi								
Bicycle								
Citi Bike								
Motorcycle or scooter								

**Sample Demographic Questions**

What is your gender?

- Male
- Female
- Prefer not to answer

In what year were you born?

What is the highest level of education you have completed?

- Less than high school
- Currently in high school
- High school/GED
- Currently in 2-year college
- 2-year college degree
- Currently in 4-year college
- 4-year college degree
- Currently in post-graduate college
- Post-graduate degree (MA, MS, PhD, MD, JD, etc.)
- Prefer not to answer

What is your race or ethnicity? (Please check all that apply.)

- African American
- American Indian or Alaskan Native
- Asian
- Caucasian/White
- Hispanic or Latino
- Middle-Eastern
- Native Hawaiian or Pacific Islander
- South Asian (e.g., Indian, Pakistani)
- Southeast Asian
- Prefer not to answer

What kind of housing do you currently live in?

- Detached single-family home
- Building with more than 100 units
- Building with between 10 and 100 units
- Building/house with fewer than 10 units
- Mobile home/RV/Trailer

Approximately what was your gross (pre-tax) income in 2015?

- Less than \$10,000
- \$10,000 to \$14,999
- \$15,000 to \$24,999
- \$25,000 to \$34,999
- \$35,000 to \$49,999
- \$50,000 to \$74,999
- \$75,000 to \$99,999
- \$100,000 to \$149,999
- \$150,000 to \$199,999
- \$200,000 or more
- Prefer not to answer

Approximately what was your gross (pre-tax) household income in 2015? (Your household includes the people who live with you with whom you share income.)

- Less than \$10,000
- \$10,000 to \$14,999
- \$15,000 to \$24,999
- \$25,000 to \$34,999
- \$35,000 to \$49,999
- \$50,000 to \$74,999
- \$75,000 to \$99,999
- \$100,000 to \$149,999
- \$150,000 to \$199,999
- \$200,000 or more
- Prefer not to answer

Please indicate two streets that cross near your HOME location as well as the city (please include NW, NE, SW, SE, if applicable).

City

Street #1

Street #2

Please indicate two streets that cross near your WORK location as well as the city (please include NW, NE, SW, SE, if applicable).

City

Street #1

Street #2



## After Survey

This section presents draft survey questions for the After Survey of app users. These survey questions are subject to revision, and not all questions are presented. This section provides examples of the proposed structure of selected key questions. The survey questions may be revised/augmented with input from the DART project team.

### Sample Questions

Including yourself, how many people live in your current household?

- 1
- 2
- 3
- 4
- 5
- More than 5

What best describes your relation to the other people in your current household? (Please check all that apply)

- Parent/Guardian(s)
- Relatives (e.g., siblings)
- Housemates/Roommates
- Partner/Significant Other
- Children (who are under your guardianship)

Please list the year, make, and model of your household's CURRENT vehicle(s) (e.g., 2012 Honda Civic), those that are owned or leased:

Current Vehicle	Year	Make	Model
Vehicle 1			
Vehicle 2			
Vehicle 3			
Vehicle 4			
Vehicle 5			

In the last year, approximately how many miles have you driven on these vehicles? (Not cumulative odometer reading. If the vehicle was owned for less than a year, please approximate your annual miles, based on how much you have driven it thus far.)

Please indicate how frequently you CURRENTLY use the following modes:

Mode	Not available to me or not in my area	Never in the last year	Less than once a month	Once a month	Every other week	1 to 3 days per week	4 to 6 days per week	Once a day	2 to 4 times a day	More than 4 times a day
Drive alone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drive/ride with others (non-commute)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Carpool (for commuting)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
DART Bus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
DART Light Rail	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bicycle	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Uber/Lyft	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taxi	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Have the improvements to the GoPass app caused an increase or a decrease in your use of these modes? Please indicate which modes have changed, and which modes have been unaffected by the GoPass app

Mode	Yes, my use of this mode HAS CHANGED due to improvements to the GoPass app	No, the improvements to the GoPass app have NOT CHANGED my use of this mode
Drive alone	<input type="radio"/>	<input type="radio"/>
Drive/ride with others (non-commute)	<input type="radio"/>	<input type="radio"/>
Carpool (for commuting)	<input type="radio"/>	<input type="radio"/>
DART Bus	<input type="radio"/>	<input type="radio"/>
DART Light Rail	<input type="radio"/>	<input type="radio"/>
Bicycle	<input type="radio"/>	<input type="radio"/>
Walk	<input type="radio"/>	<input type="radio"/>
Uber/Lyft	<input type="radio"/>	<input type="radio"/>
Taxi	<input type="radio"/>	<input type="radio"/>

Overall, how much more or less often have you used these modes of transportation because of the availability of the improvements to the GoPass app?

Overall, because of the improvements to the GoPass app, I travel by...

Mode	Much more often	More often	About the same	Less often	Much less often
Drive alone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drive/ride with others (non-commute)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Carpool (for commuting)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
DART Bus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
DART Light Rail	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bicycle	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Mode	Much more often	More often	About the same	Less often	Much less often
Walk (to a destination)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Uber/Lyft	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taxi	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Because of the GoPass app, my **first mile** access to DART is:

- Much better
- Better
- About the same
- Worse
- Much worse
- I did not use DART before using the GoPass app, and I do not use it now
- My first mile access to DART has improved or worsened, but not because of the GoPass app

Because of the GoPass app, my **last mile** travel from DART is:

- Much better
- Better
- About the same
- Worse
- Much worse
- I did not use DART before using the GoPass app, and I do not use it now
- My last mile travel from DART has improved or worsened, but not because of the GoPass app

Because of the GoPass app, my **overall mobility** (the general speed of my travel) is:

- Much better
- Better
- About the same
- Worse
- Much worse
- I did not use DART before using the GoPass app, and I do not use it now
- My mobility has changed, but not because of the GoPass app

Because of the GoPass app, my **wait times using DART transit** are:

- Much shorter
- Shorter
- About the same
- Longer
- Much longer
- I did not use DART before using the GoPass app, and I do not use it now
- My DART wait times have changed, but not because of the GoPass app

Because of the GoPass app, my **travel times with DART transit** are:

- Much better
- Better
- About the same
- Worse
- Much worse
- I did not use DART before using the GoPass app, and I do not use it now
- My DART travel times have changed, but not because of the GoPass app

Because of the GoPass app, my **access to suburban locations** is:

- Much better
- Better
- About the same
- Worse
- Much worse
- I did not use DART before using the GoPass app, and I do not use it now
- My access to suburban locations has changed, but not because of the GoPass app

Because of the GoPass app, my access to locations within Plano is:

- Much better
- Better
- About the same
- Worse
- Much worse
- I did not use DART before using the GoPass app, and I do not use it now
- My access to suburban locations has changed, but not because of the GoPass app

With the GoPass app, I can access more mobility providers than I could before.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree
- Don't know

The GoPass app has a simple and effective payment process for purchasing DART tickets.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree
- Don't know

Relative to other methods of ticket buying, the GoPass app simplifies the payment process for purchasing DART tickets.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree
- Don't know

Because of the GoPass app, my ability to access different options for travel is:

- Much better
- Better
- About the same
- Worse
- Much worse

The GoPass app has helped me reduce the time I spend traveling.

- Strongly agree
- Agree

- Neither agree nor disagree
- Disagree
- Strongly disagree
- Don't know

The GoPass app has improved my ability to access DART transit systems.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree
- Don't know

In the last year, my satisfaction with DART has become:

- Much better
- Better
- About the same
- Worse
- Much worse

## Recent Trip Survey

The implementation of a recent trip survey may benefit the evaluation. This simple survey includes two or three questions about the recent trip. It asks about mode shift and trip purpose. The recent trip survey is valuable because it captures high-resolution mode shift, ideally tied to a specific trip. It is more technically challenging to implement, because it requires quick follow up after a recent trip (usually via email), and the survey operator must try to avoid over-surveying people if they take a lot of trips. The questions asked would appear roughly as follows.

### **Draft Questions**

If the GoPass app had not been available, how would you have made this trip?

- I would not have made the trip
- I would have driven all the way
- Public bus
- DART light rail
- Got a ride from friend or family
- Regular Uber or Lyft
- Regular taxi
- Bicycle
- Walk
- Other, please specify:

What was the purpose of this trip?

- Go to or from a restaurant/bar
- Social/recreational
- Commute to or from work
- Commute to or from school
- Go to or from public transit
- Go to or from work-related meetings during the day
- Go to or from grocery shopping
- Go to or from other shopping (non-groceries)
- Run non-shopping errands
- Go to or from healthcare services
- Go to or from gym
- Move bulky items
- Transport pets
- Other, please specify:



# Addendum. Documentation of Evaluation Plan Variance Following Demonstration Deployment

The evaluation plans for the MOD Sandbox Demonstration projects were developed in the planning phase of the project, prior to the execution of the demonstration. As part of this process, data structures and data availability were anticipated. As project implementation proceeded, certain elements of the project and data availability changed.

This addendum presents differences between the planned and executed analyses for the independent evaluation of the Dallas Area Rapid Transit (DART) First and Last Mile Solution project. Due to changes to pilot operations, data availability issues, and other unforeseen circumstances, some of the hypotheses proposed as part of the original scope of work were modified or their analyses were adjusted to better encompass these changes. In this addendum, changes that were made to each hypothesis (if any) and the key reasons why study methods may have differed from what was planned are identified and discussed. Many hypotheses and their proposed analytical approaches did not change significantly or at all. In these cases, it is noted that there were no differences between the proposed and executed analyses.

**Hypothesis 1:** The app increases transit use among the sample as a result of the app improvements, leveraging FMLM MOD providers and lower-cost public transportation.

**Proposed analysis:** The analysis outlined in the evaluation plan proposed a “before” and “after” survey design which would match unique respondents’ answers to questions across these two surveys regarding their travel behavior to determine whether the app caused changes in their transit ridership.

**Executed analysis:** Two separate on-board surveys of GoLink users were launched (the first focusing on GoLink shuttle users, the second asking additional questions about the UberPool option of GoPass). The surveys were ultimately not designed using a “before” and “after” approach, and the on-board deployments did not allow for respondent tracking across surveys. Therefore, the executed analysis instead used responses from the first survey and determined that a notable portion of users taking first-mile last-mile (FMLM) trips with DART would have made their trip without DART or not at all, if the GoLink shuttle had not been available.

**Hypothesis 2:** The improvements to the app result in an increase in the mode share of carpool travel to DART transit.

**Proposed analysis:** The analysis outlined in the evaluation plan proposed to use “before” and “during” pilot survey data to analyze potential carpool mode share impacts due to the pilot.

**Executed analysis:** DART had initially planned to have a more extensive integration of carpooling (which was called GoPool) with GoLink; however, this ultimately was not successful due to a lack of available drivers as well as other challenges. Survey results indicated that just 5% of GoLink users were replacing trips they had previously made carpooling or vanpooling. Absent greater integration of carpooling, the hypothesis was not supported.

**Hypothesis 3a:** Persons with disabilities find that their ability to access DART transit has improved.

There were no differences between the proposed and executed analyses for Hypothesis 3a. Survey questions gauged perceptions of DART’s accessibility among respondents with disabilities.

**Hypothesis 3b:** Persons with disabilities experience improved FMLM access as a result of the app.

There were no differences between the proposed and executed analyses for Hypothesis 3b. Survey questions gauged perceptions of FMLM access among respondents with disabilities due to the implementation of GoLink.

**Hypothesis 4:** Automobile travel among the pilot group declines.

**Proposed analysis:** The analysis outlined in the evaluation plan proposed using both survey and travel activity data of app users to measure automobile use.

**Executed analysis:** Since the GoPass app did not collect individual users’ travel activity beyond their use of the GoLink shuttle, the executed analysis instead used survey data alone to evaluate changes in automobile travel. The results suggest that about 42% of respondents were taking GoLink instead of using a personal automobile in some form (personal car or taxi/TNC).

**Hypothesis 5a:** Users of the app consider their transportation and multimodal travel options improved because of the app.

There were no differences between the proposed and executed analyses for Hypothesis 5a. Survey questions gauged respondents’ opinions about GoLink’s impact on their transportation and multimodal travel options.

**Hypothesis 5b:** Users experience lower travel times than they would have without using the app.

**Proposed analysis:** The analysis outlined in the evaluation plan proposed computing travel times for trips (including trips made by modes other than the GoLink shuttle) made by individual users over time through activity data collected by the GoPass app. The planned analysis proposed using this longitudinal travel activity data to evaluate whether travel times declined over time among those using the app.

**Executed analysis:** Since the GoPass app did not collect individual users' travel activity beyond their use of the GoLink shuttle, the executed analysis instead assessed average monthly travel times with both the GoLink and UberPool options and user ratings (survey responses) of their in-vehicle travel times. Additionally, average monthly trip times for DART GoLink trips were compared to the travel time of driving and public transit trips between the same and origin and destination pairs. The results found that the GoLink shuttle was faster, on average, than existing public transit options but slower than driving.

**Hypothesis 6:** App users experience better FMLM (access and egress) mobility to DART transit in the form of reduced travel times for FMLM trips.

**Proposed analysis:** The analysis outlined in the evaluation plan proposed using travel activity data of app users and survey data to evaluate longitudinal travel times across users and assess whether travel times for FMLM trips declined over the course of the project.

**Executed analysis:** Since the GoPass app did not collect individual users' travel activity beyond their use of the GoLink shuttle, travel times for all trips (including non-GoLink trips) that connect to or from DART transit were not captured. Thus, the evaluation assessed whether app users experienced improved access and egress mobility to DART transit through analysis of survey data and GoLink shuttle travel activity data, with the results generally supporting Hypothesis 6.

**Hypothesis 7:** The geographic scope of locations reachable by DART transit services is increased.

There were no differences between the proposed and executed analyses for Hypothesis 7. The geographic coverage of DART was measured and survey questions gauged respondents' opinions about their ability to reach a more diverse set of locations.

**Hypothesis 8:** The costs of fixed-route transit are higher than the MOD services on a per-rider basis.

**Proposed analysis:** The analysis outlined in the evaluation plan proposed evaluating cost to DART per rider for bus routes within regions targeted by the project and comparing with the cost per rider of GoLink.

**Executed analysis:** Since cost to DART per rider data for all bus routes within regions targeted by the project were not provided, subsidy per rider comparisons were made between the GoLink shuttles and a

low ridership fixed-route bus service in the West Legacy region that GoLink replaced, as well as comparisons to DART's system-wide subsidy per rider.

**Hypothesis 9:** The average lead time for trips with wheelchair accessible vehicles (WAVs) that are scheduled for demand-responsive travel declines.

There were no differences between the proposed and executed analyses for Hypothesis 9. Activity data from GoLink permitted for the evaluation of changes in lead time (wait time) across the course of the project, which was compared with lead times for non-GoLink paratransit service.

**Hypothesis 10:** Customer satisfaction increases as a result of the project.

There were no differences between the proposed and executed analyses for Hypothesis 10. Survey questions gauged respondents' satisfaction with DART services.

**Hypothesis 11:** The perception of the DART brand improves as a result of the project.

There were no differences between the proposed and executed analyses for Hypothesis 11. Survey questions gauged respondents' perceptions of the DART brand.

**Hypothesis 12:** The process of deploying the project will produce lessons learned and recommendations for future research and deployment.

There were no differences between the proposed and executed analyses for Hypothesis 12. Stakeholder interviews were conducted to better understand challenges, barriers, best practices, and lessons learned from the implementation of the project.

**Hypothesis 13:** FMLM service to passengers with disabilities is equivalent to that provided to passengers without disabilities.

Rather than strictly defining "equivalence" of service between those who require the use of a Wheelchair Accessible Vehicle (WAV) and those who do not, an analysis of the wait and travel times experienced by those using WAVs, compared to those traveling in standard vehicles was presented.

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