MOD

MOBILITY ON DEMAND

MOD SANDBOX DEMONSTRATIONS INDEPENDENT EVALUATION

VTRANS OPEN TRIP PLANNER EVALUATION PLAN

U.S. Department of Transportation

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16. Abstract

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 VTrans OpenTripPlanner Evaluation Plan Sandbox project. It includes the following chapters: project overview; evaluation approach and process; evaluation schedule and management; and data collection & analysis plan.

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Chapter 1. Project Overview

This chapter gives a brief introduction to the Vermont Agency of Transportation Mobility-On-Demand (MOD) Sandbox project that will be evaluated through this independent evaluation.

Introduction

The Vermont Agency of Transportation's (VTrans) goal is to develop a trip planner that provides access to flexible mobility options while also building on a platform that can be adapted, utilized, and scaled elsewhere. This proposed trip planner will include itineraries that utilize both fixed and flexible modes of public transit. The final deliverable of this project is a mobile and desktop-accessible statewide OpenTripPlanner website application.

Project Scope

By further developing the open-source OpenTripPlanner, this platform will leverage pre-existing technology and will be distributed back to others who can use it. After the adaptation of the OpenTripPlanner code to accept GTFS-flex data, the project team will submit that code back to the OpenTripPlanner group for incorporation into the core code. The project team will also submit comments on and suggested revisions to the emerging GTFS-flex specification, in order to provide a scalable model on which flexible public transit services can be defined for public consumption through web applications.

The OpenTripPlanner meets FTA's MOD Sandbox Program goals by conducting research marketing and promoting existing and emerging flexible transit services through open source technologies and open data that that allow for the easy discovery of those services through interfaces already understood by most riders. Goals include:

- Improve transportation efficiency by promoting and creating a platform that allows agile, responsive, accessible and seamless multimodal service inclusive of flexible transit modes.
- Increase transportation effectiveness by ensuring that flexible transit is fully integrated and a vital element of a regional transport network that provides consistent, reliable, and accessible service to every traveler.
- Enhance the customer experience by providing an equitable, accessible, traveler-centric interface and leveraging public transportation's long-standing capability and traditional role in this respect.

Key Partners

The Vermont Agency of Transportation (VTrans) is partnering with Cambridge Systematics and Trillium Solutions, Inc.

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 take place. This data would be shared with the Independent Evaluation (IE) team for evaluation purposes.

1. January 30th, 2017- Cooperative Agreement Execution Date
2. March 2018 – Application Public Launch and Demonstration Start
3. September 2018 – Marketing campaign starts (Video/TV, web, and print ads)
4. March 2019 – Demonstration Completion and Final Report

The VTrans team will collect data relevant to this MOD Sandbox Demonstration (as outlined in this Evaluation Plan) between March 2018 and March 2019, and will share the data with the IE team for conducting the evaluation. More details on the data collection planning are provided in Chapters 2 and 4 of this report.

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 – the 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 is trying 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 the Data Types, Elements, and the Data Sources used for the identified performance metrics.
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 VTrans 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 VTrans is aiming to achieve through the MOD Sandbox demonstration. These project goals include the following:

1. Develop an online trip planner for both "fixed" and "flexible" services
2. Improve the data presentation for transit agencies in Vermont
3. Improve the information for transit riders in the state of Vermont
4. Improve mobility for Vermont transit riders
5. Increase public transit use in Vermont
6. The statewide planner is used by Vermont transit riders
7. Cut call/response time on relevant inquiries pertaining to route info and travel options
8. Obtain lessons learned about project implementation.

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 application will allow users to define an origin and destination within the state and receive fixed route transit itineraries, flag stop, deviated fixed routes, and dial-a-ride options
2. Transit agencies will see the state planner as an improvement
3. Riders will consider the new planner to be an improvement over existing planning tools
4. The new planner will improve rider mobility among planner users
5. Due to improved information, the new planner will increase transit ridership among users in Vermont.
6. Web traffic to the state planner will see on average at least X (to be defined) queries per day that constitute actual users searching the platform.
7. The new planner will lead to a reduced call/response time on relevant inquiries pertaining to route info and travel options
8. Lessons from project implementation can inform future project and system designs and implementation

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 Vermont Independent Evaluation. These performance metrics include the following:

- For a series of pre-defined searches that number 30 or more, the number of transit operators and services reported on the planner that are not presentable on Google Maps with standard GTFS data.
- Transit operator survey responses
- User survey responses to product perception questions
- User survey responses to mobility perception questions
- Number of general public trips arranged using scheduled demand response trips
- Web traffic data (e.g., count of IP addresses in Vermont, distribution at the local level, basic query count data)
- Call/response time on relevant inquiries pertaining to route info and travel options, before and after planner implementation
- Qualitative documentation from stakeholder interviews

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 and elements are used for the performance metrics that are defined for the Vermont Independent Evaluation:

1. Survey Data (Two separate surveys: one for Transit Providers, and one for Users/Riders)
    - Data from User/Rider Survey:
        a. Travel behavior
        b. Perceived user-friendliness of OpenTripPlanner compared to other systems
        c. Demographics
        d. Socio-economic data
    - Data from Transit Provider Survey
        a. Travel behavior
        b. Perceived user-friendliness of OpenTripPlanner compared to other systems
2. Transit Agency Data
    - Call Center's monthly reporting
    - General public trips arranged using scheduled demand response trips
    - Ridership data
    - Web traffic analytics/data from state planner website
3. Stakeholder Interview Data
    - Expert interviews
4. Origin-Destination (OD) Trip Data
    - Trip attributes for pre-defined ODs using the OpenTripPlanner, Google Maps, and other maps using open source transit data (e.g. Bing, Hop Stop)

The following data sources are used to collect the above-mentioned data elements.

VTrans

- Responsible for providing Transit ridership data from the various Vermont transit operators
- Responsible for providing call / response time on relevant inquiries pertaining to route info and travel options
- Responsible for providing web traffic data for state planner website on Vermont trips
- Responsible for conducting surveys and facilitating stakeholder interviews to collect qualitative and quantitative data.

Opensource or External

- GTFS available as open source
- Google Maps and other maps using transit data are available as external data sources

Methods of Evaluation

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

- System testing
- Survey analysis
- Data Analysis
- Web traffic count and trend analysis
- Stakeholder interview summaries

Further details about the analysis methods by Evaluation Hypothesis are provided in Chapter 4.

Evaluation Logic Model

The below table represents an extract from the final VTrans evaluation logic model. Building on the project goals, the logic model lists evaluation hypotheses, performance metrics, and data types and sources for the Vermont project.

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

Project Goals	Evaluation Hypothesis	Performance Metric	Data Types	Data Sources
1. Develop an online trip planner for both "fixed" and "flexible" services	1. The application will allow users to define an origin and destination within the state and receive transit itineraries, flag stop, deviated fixed routes, and dial a ride	For a series of pre-defined searches that number 30 or more, the number of transit operators and services reported on the planner that are not presentable on Google Maps with standard GTFS data.	OD Trip Data	VTrans (OpenTripPlanner) Opensource or External (e.g. Google Maps)
2. Improve the data presentation for transit agencies in Vermont	2. Transit agencies will consider the state planner as an improvement	Transit operator survey responses	Survey Data	VTrans (surveyed Public Transit Providers)
3. Improve the information for transit riders in the state of Vermont	3. Riders will consider the new planner to be an improvement over existing planning tools	User survey responses to product perception questions	Survey Data	VTrans (surveyed Users)
4. Improve mobility for Vermont transit riders	4. The new planner will improve rider mobility among planner users	User survey responses to mobility perception questions	Survey Data	VTrans (surveyed Users)
5. Increase public transit use in Vermont	5. Due to improved information, the new planner will increase transit ridership among users in Vermont.	User survey responses to mobility perception questions Number of general public trips arranged using scheduled demand response trips	Survey Data Transit Ridership Data	VTrans (surveyed users; and ridership from Vermont transit providers)
6. The statewide planner is used by Vermont transit riders	6. Web traffic to the state planner will see on average at least X (to be defined) queries per day that constitute actual users searching the platform.	Web traffic data (e.g., count of IP addresses in Vermont, distribution at the local level, basic query count data)	Web Traffic Data	VTrans (web analytics)

Project Goals	Evaluation Hypothesis	Performance Metric	Data Types	Data Sources
7. Cut call/response time on relevant inquiries pertaining to route info and travel options	7. The new planner will lead to a reduced call/response time on relevant inquiries pertaining to route info and travel options	Call/response time on relevant inquiries pertaining to route info and travel options, before and after planner implementation	Call Center Inquiries Data	VTrans (Call Center)
8. Obtain lessons learned about project implementation	8. Lessons from project implementation can inform future project and system designs and implementation	Qualitative documentation from stakeholder interviews	Stakeholder Interview Data	VTrans (interviewees)

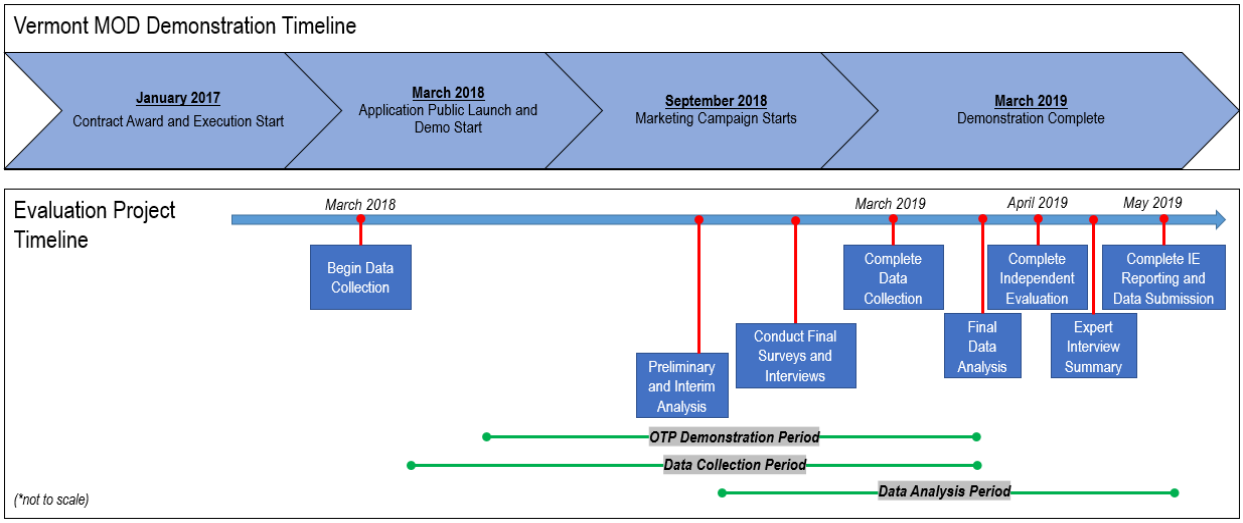
Documentation and Reporting

The IE Team will develop an evaluation report for this MOD Sandbox demonstration project. The report will include a summary of major findings of the project in an Executive Summary section, followed by multiple sections providing details of the demonstration, evaluation hypotheses, data collected, analysis performed, findings, and results. The results will be reported through a mix of exhibits including tables, graphs, and charts.

Chapter 3. Evaluation Schedule and Management

Evaluation Schedule

The figure below (Figure 1) shows the IE schedule from the beginning of 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 during the demonstration period in order to proactively mitigate data-related risks.



Source: Booz Allen Hamilton, May 2018

Figure 1. MOD Sandbox Evaluation Schedule

The demonstration start and end dates depict the period over which demonstration data collection is expected to take place. This data would be shared with the IE team for evaluation purposes.

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

Data Transfer and Storage

Various types of qualitative and quantitative data sources are involved in the evaluation, as specified in Chapter 2. Figure 2 below shows the overall data collection framework, including the steps and parties involved in data design, collection, transfer and storage.

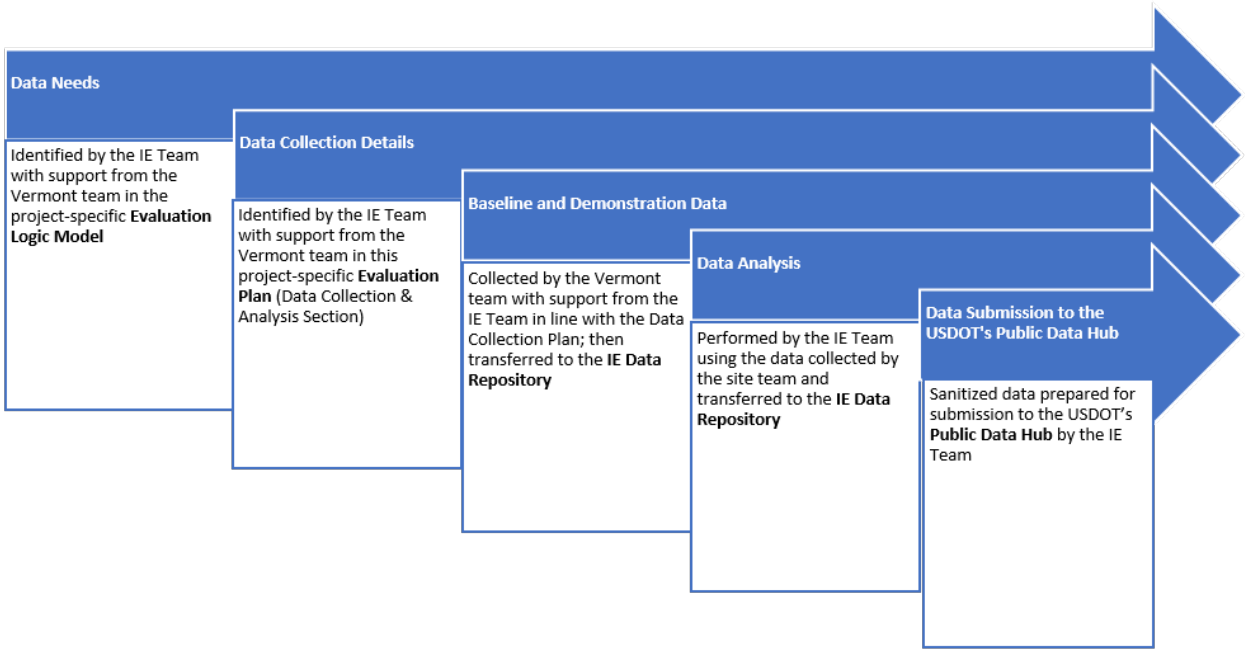


Figure 2. Vermont Data Collection Framework

Data Collection Responsibilities

For the various Data Types required for the evaluation, Table 2 denotes the corresponding data collection responsibilities.

Table 2. Data Type and Data Collection Responsibilities for Vermont Sandbox Evaluation

Data Type	Data Collection Responsibilities
Survey Data	• Survey questions are developed by the IE team in collaboration with the VTrans team (*draft survey questions provided as an appendix in this document*) • Survey responses are transferred by the VTrans team to the IE team
Transit Agency Data	• Collected by the VTrans team and transferred to the IE team
Stakeholder Interview Data	• Interviewees are identified by the IE Team in collaboration with the VTrans Team • The IE Team is connected to the interviewees by the VTrans Team • The IE Team conducts the expert interviews via phone or in person
OD Trip data	• Analyzed by the IE team

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.

Some of the main risks involved in the evaluation are included below.

Schedule: The IE Team will maintain a demonstration tracking schedule to track and contact the demonstration teams for data and documentation. The Team will keep an up-to-date integrated schedule that reflects updates from the site teams on a constant 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 being 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.
- Consideration of quality and quantity issues in data collection.
- Ensuring data privacy and proprietary protections in line with human subjects' protections.
- Consideration of confounding factors.

Table 3 below includes risk mitigation strategies that will be employed in order to ensure the availability of the requested Data Types for the evaluation.

Table 3. Data Type and Risk Mitigation Strategies Vermont Sandbox Evaluation

Data Type	Potential Risks	Risk Mitigation Strategies
Survey Data	• Low survey response rate does not lead to statisitically significant results	• The VTrans team will ensure that transit operators, and users/riders are willing to take the surveys
Transit Data	• Inaccessible or insufficient data does not allow for performance metric computation	• The VTrans team has access to the required ridership, call center, and web analytics data
Stakeholder Interview Data	• Inadequate number of interviews does not lead to a holistic view of pilot outcomes from different perspectives	• The VTrans team will ensure that engaged stakeholders in the pilot are willing to take the interviews
OD Trip data	• Goal of creating opensource software is not met • Inability to compare OpenTripPlanner with leading alternatives does not allow for performance metric computation	• All data pertaining to GTFS and free base maps are opensource • External map data such as Google maps with transit data are available via online access

Chapter 4. Data Collection and Analysis Plan

This chapter describes the plan for data collection for the VTrans MOD Sandbox Project. It summarizes the data that needs to be collected by the project team, and how that data should be processed in delivery to the evaluation team as it relates to the new OpenTripPlanner, following the inclusion of flexible transit services. Where possible, the IE Team will help the Sandbox Project Team with processing the data in order to get the requested data format to conduct calculations necessary for the evaluation. Any Personally Identifiable Information (PII) will need to be removed, when present in the data.

The data collection and analysis plan follows the logic model (see Chapter 2). Each data field discussed is associated with a hypothesis and a performance metric. Certain types of data collected will address multiple hypotheses. In cases where the data structure is the same, the plan refers to the data plan for a hypothesis that is already described.

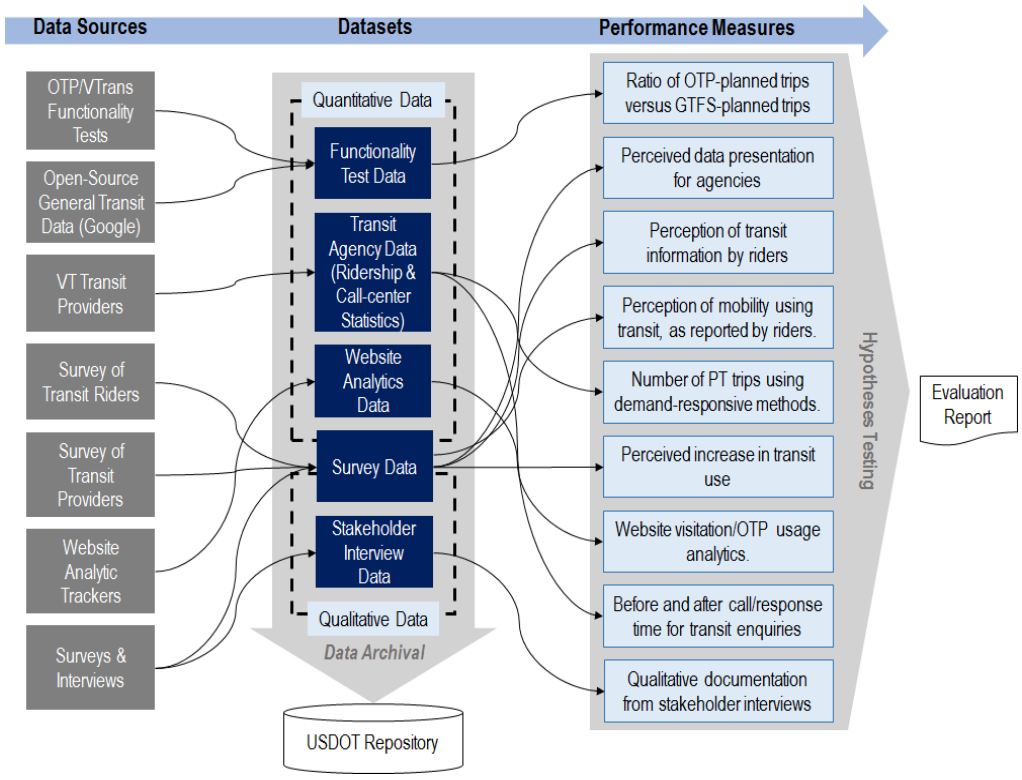


Figure 3. High-level Data Sources, Data Types, and Data Elements Mapping for this Evaluation

Most pilot based data (data provided by project partners) should be provided from the beginning of the pilot demonstration period. The evaluation team also requests that some data about general transit and call center activity in Vermont, such as ridership, call center activity etc., be provided back to 2015 if possible. The request for longer time series of activity is motivated by the need to help discern potential background trends that could have been present before the project and then continue through it. Any data collected as a result of the project itself, can only be produced from the beginning of data collection by systems implemented by the project. The evaluation team does not know the data structures that are available for specific data types.

With this plan, the team presents the data structures that would be preferred if they are available. Other structures may be capable of delivering the same or similar insights and these structures can be discussed with the project team.

Table 4 below summarizes the data types, data elements, collection periods, collection responsibility and mechanisms, and hypothesis alignment for the VTrans Sandbox project evaluation. The table is followed by a more detailed data collection and analysis plan for each evaluation hypothesis.

Table 4. Data Type, Data Elements, Period of Collection, Collection Responsibility and Mechanisms, and Hypothesis Alignment for Vermont Sandbox Project Evaluation

Data Type	Data Elements	Period of Collection	Collection Responsibility and Mechanisms	Hypothesis Alignment
Survey Data -- Two separate surveys, as follows: • Transit operator survey (Public Transit Providers) • User survey (Riders)	Survey Questions addressing: • Travel Behavior • Perceived user-friendliness of OpenTripPlanner compared to other systems • Demographics • Socio-economic data	After the trip planner is ready for testing – this will define when transit agencies/users in Vermont will be able to review the project product and take a survey about their feedback on the trip planner.	• Survey questions are developed by the IE team in collaboration with the VTrans team • Surveys are administered by the VTrans team • Survey responses are transferred by the VTrans team to the IE team after the demonstration	2, 3, 4, 5

Data Type	Data Elements	Period of Collection	Collection Responsibility and Mechanisms	Hypothesis Alignment
Transit Agency Data (ridership, call center, web analytics)	• General public trips arranged using scheduled demand response trips (*daily count of trips that are made using scheduled demand response service*) • Ridership by transit agency by service (*daily ridership by agency by service*) • Call Center's reporting: o <De-Identified ID of Caller> o <Date and Time of Call Start> o <Date and Time of Call End> o <Call Reason> o <Trip Origin of Caller Location (if known, if relevant)> o <Desired Trip Destination of Caller (if known, if relevant)> o <Responding Agency> • Web traffic analytics/data from state planner website	Ridership and Call Center data is requested from 2015 to the end of the demonstration period. The request back to 2015 is meant to evaluate trends that may be longstanding and a continuation through the project's period of performance.	• Collected by the VTrans team and transferred to the IE team	5, 6, 7
Stakeholder Interview Data	• Qualitative documentation from stakeholder interviews	Stakeholder interviews are suggested to occur about three months after the project launch.	● Interviewees are identified by the IE Team in collaboration with the VTrans Team ● The IE Team is connected to the interviewees by the VTrans Team ● The IE Team conducts the expert interviews via phone or in person	8

Data Type	Data Elements	Period of Collection	Collection Responsibility and Mechanisms	Hypothesis Alignment
Origin-Destination (OD) Trip Data	• Using the OpenTripPlanner, and Google Maps respectively, capturing the following attributes for pre-defined test OD pairs: o Total travel time o Total time on public transit o Total time on walking o Total travel distance o Total walking distance o Trip cost by option o Driving distance (done by a separate query of the same OD) o Driving time (done by a separate query of the same OD) o Number of public transit options presented o Number of flexible public transit options presented o User measure of output accuracy on an ordinal scale o Comments on output	After the trip planner is ready for testing	• Analyzed by the IE team	1

Detailed Data Collection and Analysis Plan by Evaluation Hypothesis

Hypothesis 1: The application will allow users to define an origin and destination within the state and receive transit itineraries including such flexible options as flag stops, deviated fixed routes, and dial-a-ride.

> **Performance Metric:** For a series of pre-defined searches that number thirty or more, the number of transit operators and services reported on the planner that are not presentable on Google Maps with standard GTFS data.

Data Types:

- **Modified OpenTripPlanner for State-wide planning**

  This is the functional product of the project. It consists of the modified trip planner that can handle GTFS-flex data and present appropriate options that augment the user's ability to review and select flexible travel options over and above what can be delivered by Google Maps and other comparable mapping services.

- **Google Maps and/or other comparable maps using open-source transit data (Bing, Apple Maps, etc.).**

  The primary benchmark for testing will be Google Maps, which is arguably the private sector standard bearer for mapping and trip planning. This platform will be used as the benchmark for comparison. Other mapping platforms may also be used for comparison by the IE team. But Google Maps is the dominant platform used by the public and will thus the primary platform of comparison.

- **Pre-defined test origin and destination (OD) pairs**

  The IE team will create at least thirty (can be more) origin-destination pairs that represent trips that would benefit from GTFS-flex information. These will be used for system testing. The OD pairs will also include other relevant attributes needed for the search, such as departure time, and potentially other constraints that should be tested for the purposes of comparison with the standard platform(s).

Data Collection Period:

- The data collection period will be dependent on when the trip planner is ready for testing. The project team will inform the evaluation team when the system testing can occur based on its internal timeline. The evaluation team can prepare OD inputs beforehand. The evaluation team would prefer to have three months to conduct the test, since it will likely require script writing/testing, and human inspection of individual outputs.

Analysis Procedure:

The pre-defined test OD pairs will be run into the OpenTripPlanner and the Google Maps platform. The output will be recorded from each. The evaluation team will record a number of attributes from the output, which may include but not be limited to:

1) Total travel time
2) Total time on public transit
3) Total time walking
4) Total travel distance
5) Total walking distance
6) Trip cost by option

7) Driving distance (done by a separate query of the same OD)
8) Driving time (done by a separate query of the same OD)
9) Number of public transit options presented
10) Number of flexible public transit options presented
11) User measure of output accuracy on an ordinal scale
12) Comments on output

The testing procedure may utilize a combination of automated and human activities. The quantitative outputs (e.g., distances, time, etc) may be collectible using scripts that simulate queries and record the output parameters, while output accuracy is a more subjective human determination of the quality of the output. The human tester will review the output from the planner to make sure it makes sense, and that it is accurately reflecting the intended trip between the origin and destination. The tester will document and comment on how the responses vary, with a particular eye on the inclusion of flexible transit services. The VTrans trip planner should generally include a flexible option in a manner that makes each trip shorter, cheaper, or one that entails less overall transfers.

Hypothesis 2: Transit agencies will consider the new state planner as an improvement.

Performance Metric: Transit Operator Survey Responses

Data Types:

- **Transit operator survey**

  Survey responses from staff at all eight transit operators throughout the state,[1] including those that specifically manage flexible transit services. Survey questions should gauge their opinion on the functionality of the trip planner, and if they think flexible transit services are adequately returned by queries. There will be specific questions about the performance of the OpenTripPlanner in comparison with other options, including Google Maps, Apple Maps, and Bing, which all include fixed transit options (to varying degrees).

Data Collection Period:

- The data collection period will be dependent on when the trip planner is ready for testing. This will define when transit agencies in Vermont will be able to review the project product and take a survey about their feedback on the trip planner.

[1] Addison County Transit Resources, Advance Transit, Green Mountain Community Network, Green Mountain Transit, Marble Valley Regional Transit District, Rural Community Transportation, Southeastern Vermont Transit, and Stagecoach Transit Services.

Analysis Procedure:

A survey will be drafted by the evaluation team with input from the VTrans project team. The survey will be administered online using the Qualtrics Platform. The survey will be administered to a select staff within each transit agency, including members of planning, operations, and executive staff. The evaluation team would like to survey at least three staff members from each agency, including at least one vehicle driver. The prospective respondents will receive an email informing them about the upcoming survey, and introduce them to the OpenTripPlanner. Prospective respondents will be asked to review the planner and use it to plan a few trips. They will then receive a follow up email about a week later asking them to take a survey about the trip planner, with the survey link.

The survey questions will evaluate the anonymous and aggregate response of agency staff to the trip planner, and summarize the responses. The questions will probe the opinions of staff by general classification, and evaluate opinions on functionality, information quality, general appearance, usefulness over existing platforms, and qualitative feedback. Anonymous responses will be reported.

Hypothesis 3: Riders will consider the new planner to be an improvement over existing planning tools.

Performance Metric: User survey responses to product perception questions.

Data Types:

- **User Survey**

  The User survey is a survey of travelers that would use the planner in the State of Vermont. The population would be defined by the project team, and the evaluation team would seek support from the VTrans project team in conducting outreach to the population for the implementation of the online survey. The survey will ask respondents about their impression of the trip planner as compared to other trip planning options and their overall travel needs.

Data Collection Period:

- The data collection period will be dependent on when the trip planner is ready for testing. This will define when users can use the trip planner for review and response to the survey. Once the trip planner is ready for user review, the evaluation team would prefer two months to launch the survey with the users.

Analysis Procedure:

A survey will be drafted by the evaluation team with input from the project team. The survey will be administered online using the Qualtrics Platform. The survey will be administered to a selected user group that the project team will help define. The user group would ideally be contactable by email, but also other methods of contact must be defined to reach special populations. These methods may include mail and phone contact of specially defined populations.

The prospective respondents will receive an email (or other supporting correspondence) informing them about the upcoming survey, and introduce them to the OpenTripPlanner.

Prospective respondents will be asked to review the planner and use it to plan a few trips. They will then receive a follow up email about a week later asking them to take a survey about the trip planner, with the survey link.

The survey questions will evaluate the anonymous and aggregate response of users to the trip planner, and summarize the responses. The questions will probe the opinions of respondents on functionality, information quality, general appearance, usefulness over existing platforms, and qualitative feedback. The respondents will also be asked about their travel patterns, and how the trip planner might (or has) impacted their travel behavior and mobility. The respondents will also be asked about vehicle ownership, demographics, and travel needs. Responses to questions will be reported in aggregate, or in the case of written comments, in anonymous form.

Hypothesis 4: The new planner will improve rider mobility among planner users.

Performance Metric: User survey responses to mobility perception questions.

Data Types:

- The User survey is as described in Hypothesis 3.

Data Collection Period:

- The data collection is as described in Hypothesis 3.

Analysis Procedure:

The survey will include questions that probe the impact that the trip planner has had on their mobility. The questions will be designed to explore how the trip planner has improved their mobility. If the the respondent has not used the planner, it will explore how the planner might improve their mobility. The question text will adjust based on this context.

For example, respondents may be asked if, since using the new planner their trips have been (A) shorter, (B) cheaper, and/or (C) involve fewer transfers. They may be queried on if the new trip planner has allowed them to use public transit to reach destinations they otherwise could not, including places of employment, medical care, retail, schools, and social functions. The survey will also aim to probe any impacts of the trip planner on car usage, public transit usage, walking, bicycling, and accessibility. The analysis of survey data will report in aggregate the responses of individuals to questions that probe impacts on travel behavior.

Hypothesis 5: Due to improved information, the new planner will increase transit ridership among users in Vermont.

Performance Metrics:

- User survey responses to mobility perception questions
- Number of general public trips arranged using scheduled demand-response trips.

Data Types:

- **User survey**

  The user survey is as described in Hypothesis 3.

- **General public trips arranged using scheduled demand response trips.**

  This is the daily count of trips that are made using schedule demand response service. If origin/destination/time attributes are available on a trip-by-trip basis, such information may be useful for evaluating more detailed patterns in the data, but the counts per day are the primary data point that will be evaluated.

- **Ridership by transit agency by service**

  This is the daily count of unlinked trips by agency by service. The evaluation team will accept data that is disaggregated by route if this is available. However, the current plan is to evaluate trends in overall ridership by day by agency.

Data Collection Period:

- The data collection period of the user survey is as defined in Hypothesis 3. The data items 2) and 3), which consist of ridership data, are requested from 2015 to the end of the evaluation period. The request back to the 2015 is meant to evaluate trends that may be longstanding and a continuation through the period of project performance.

Analysis Procedure:

This hypothesis will be evaluated using two separate data sources, the survey and the ridership data. The responses user survey will evaluate whether users report that the trip planner has enabled a change in their travel ridership and whether their ridership has increased as a result. The ridership data will be evaluated to determine if there is any positive departure to the existing trend of ridership activity that coincides with the launch of the trip planner. Because it is not certain if the impact of the planner will be large enough to produce detectable impacts on ridership, the survey responses may be the primary means of analysis for this hypothesis. Nonetheless, ridership will be evaluated to understand the ridership environment of Vermont agencies at the time of the project.

Hypothesis 6: Web traffic to the state planner will see on average at least X (to be defined) queries per day that constitute actual users searching the platform.

Performance Metric: Web traffic data (e.g., count of IP addresses in Vermont, distribution at the local level, basic query count data).

Data Types:

- **Web traffic analytics/data from state planner website**

  OpenTripPlanner Web Traffic data analytics: This data will consist of Web traffic data (count of IP addresses in Vermont, distribution at the local level, basic query count data).

Data Collection Period:

- The data is requested from the beginning of the OpenTripPlanner launch period to the end of the evaluation period.

Analysis Procedure:

The analysis procedure will consist of a trend analysis that captures the web traffic counts from the launch of the OpenTripPlanner through the end of the evaluation period, with a special attention to the distribution of IP addresses in Vermont to pinpoint the distribution of actual users of the planner.

Hypothesis 7: The new planner will lead to a reduced call/response time on relevant inquiries pertaining to route info and travel options

Performance Metric: Call/response time on relevant inquiries pertaining to route info and travel options, before and after planner implementation.

Data Types:

- **Call Center's monthly reporting**

This data will consist of records of call activity that define the response time from the call center(s) of the relevant transit agencies. The data structure is unknown to the evaluation team, but call-level raw data is requested. The data structure could appear as follows:

<De-Identified ID of Caller>
<Date and Time of Call Start>
<Date and Time of Call End>
<Call Reason>
<Trip Origin of Caller Location (if known, if relevant)>
<Desired Trip Destination of Caller (if known, if relevant)>
<Responding Agency>

This exact data structure may not exist. The structure request is one that primarily can determine the length of the call by time and by de-identified ID. Other information on travel requested may be useful to support the analysis and would be used by the evaluation team if it is available.

Data Collection Period:

- The data collection period of the call center data is requested from beginning of 2015 to the end of the evaluation period.

Analysis Procedure:

The analysis procedure will calculate the start and end times of call center calls using the raw data. The average call time will be plotted over time and evaluated during distinct periods defined before and after launch of the trip planner to determine whether statistically significant changes in call length occurred. The test applied will be the t-test

on the average call length over appropriate periods for call center time averaging. Other methods of trend analysis may also be applied.

Hypothesis 8: Lessons from project implementation can inform future project and system designs and implementation.

Performance Metric: Qualitative documentation from stakeholder interviews

Data Types:

- **Expert interviews of key project team members**

  This data is qualitative in nature. The Project Team will identify members that can be available to interview with the Evaluation 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 of the stakeholder interviews should occur about three months after the project launch. Because the project is more technical in nature, the evaluation team wishes to gain the fresh experiences of project members on the challenges and opportunities presented with implementation. At the same time, the evaluation team wishes to allow some post-launch experience to be included in the evaluation. The three-month post launch time frame is suggested as suitable for this combined purpose.

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.

Table 5. Suggested Interviewee Name, Role/Affiliation, and Contact Info

Interviewee	Role/Affiliation	Contact Info
Ross MacDonald	Project Manager, MOD	ross.macdonald@vermont.gov
Amanda Kolifrath	Call Center Representative	akolifrath@veic.org
Peter Johnke	VT Center for Independent Living	peter@vcil.org
Nicole Clements	Creative Workforce Solutions	nclements@vabir.org
Deb Sachs	Go Vermont Consultant, Outreach and Business Services	dsachs@ecostrategiesllc.com

Appendix A. Selected Draft Survey Questions

Transit Operator Survey

This section presents selected draft survey questions for Vermont Transit Operators in review of the OpenTripPlanner. These survey questions are a first draft and subject to revision, additions, and deletions. These questions provide examples of the types of questions that may be asked, subject matter to be covered, and serve as a starting point for final design. Wording may be adjusted to handle specific nuance or circumstances that are germane to the project. Additional questions may be added. The timing and the structure of the survey implementation may also change content, based on input from project partners.

Branching and skip logic will be used, reducing the amount of irrelevant questions or options presented to respondents. The questions below are specifically designed within a retrospective context. Respondents are surveyed once, after the project has been launched, to review the trip planner and offer their perceptions of it. The survey may require modification to present context specific questions within Vermont.

Draft Survey

Introductory Text:

About a week ago, you were sent an email introducing you to the newly revised OpenTripPlanner built as a part of MOD Sandbox Project sponsored by VTrans and the Federal Transit Administration. You were asked to review the OpenTripPlanner and make some trip plans with it. This survey is about your experience reviewing and using the OpenTripPlanner. If you did not get a chance to review the OpenTripPlanner planner yet, feel free to do so now. Review and use of it should take about 5 to 10 minutes. Then please proceed to take this survey.

1. Please indicate your organization

   <Drop down list of organizations>

2. Please indicate your position within that organization

   <Drop down list of positions>

3. In 2 to 5 sentences, please describe what your role is in the agency.

First, we would like to get your travel patterns.

4. What is your general impression of the OpenTripPlanner?

    - o Excellent
    - o Very Good
    - o Good
    - o Fair
    - o Poor

5. How would you say OpenTripPlanner compares to GoogleMaps overall for trip planning?

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

6. How would you say OpenTripPlanner compares to GoogleMaps for appearance?

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

7. How would you say OpenTripPlanner compares to GoogleMaps overall for the format and display of information?

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

8. How would you say OpenTripPlanner compares to GoogleMaps overall for the quality of travel options presented?

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

9. Have you used OpenTripPlanner for planning flex-transit trips?

- o Yes
- o No

10. Relative to Google Maps, how useful to think OpenTripPlanner is for planning transit trips in Vermont

    - o Much more useful
    - o More useful
    - o About as useful
    - o Less useful
    - o Much less useful

11. How important do you consider flex-transit services to be within your agency?

    - o Very important
    - o Important
    - o Somewhat important
    - o Not too important
    - o Not important at all

12. Do you think that OpenTripPlanner is an improvement for flex transit planning?

    - o Yes, a significant improvement
    - o Yes, a modest improvement
    - o Yes, a slight improvement
    - o No, not an improvement

13. Do you think that OpenTripPlanner is an improvement for travel planning in Vermont overall?

    - o Yes, a significant improvement
    - o Yes, a modest improvement
    - o Yes, a slight improvement
    - o No, not an improvement

14. Have you noticed any operational improvements within your transit agency as a result of the OpenTripPlanner? This could be any type of improvement that you have noticed (e.g., vehicle occupancy increased at non-commute times).

    - o Yes, significant improvements
    - o Yes, modest improvements
    - o Yes, slight improvements
    - o No improvements

15. If you answered yes to the above question, please explain these improvements below and, if possible, why you attribute them to the OpenTripPlanner. If there are multiple improvements that you've noticed, please describe each one.

16. In your personal opinion, due to the OpenTripPlanner, ridership probably has…

    - o Greatly increased
    - o Modestly increased
    - o Slightly increased
    - o Not changed
    - o Slightly decreased
    - o Modestly decreased
    - o Greatly decreased

17. In your personal opinion, due to the OpenTripPlanner, the information on your agency's customer needs probably has…

    Note: This question refers to any understanding of customer behavior, patterns, and/or demand (e.g., data from the OpenTripPlanner will allow your agency to better plan vehicle arrival times).

    - o Greatly increased
    - o Modestly increased
    - o Slightly increased
    - o Not changed
    - o Slightly decreased
    - o Modestly decreased
    - o Greatly decreased

18. In your personal opinion, due to the OpenTripPlanner, the operational efficiency of your agency probably has…

    - o Greatly increased
    - o Modestly increased
    - o Slightly increased
    - o Not changed
    - o Slightly decreased
    - o Modestly decreased
    - o Greatly decreased

19. In your personal opinion, due to the OpenTripPlanner, customer satisfaction with your agency has…

    - o Greatly increased
    - o Modestly increased
    - o Slightly increased
    - o Not changed
    - o Slightly decreased
    - o Modestly decreased
    - o Greatly decreased

20. If you had any comments to improve OpenTripPlanner, please feel free to provide them here. Please offer any open ended comments that are polite, constructive, and helpful to the development team. Your comments will be read by evaluators and system developers. Please do not include any information that identifies you personally.

_____
_____
_____

User Survey

This section presents selected draft survey questions for Transit users in Vermont in review of the OpenTripPlanner. As with the Transit Operator Survey, these survey questions are a first draft and subject to revision, additions, and deletions. These questions provide examples of the types of questions that may be asked, subject matter to be covered, and serve as a starting point for final design. Wording may be adjusted to handle specific nuance or circumstances that are germane to the project. Additional questions may be added. The timing and the structure of the survey implementation may also change content, based on input from project partners. Branching and skip logic will be used, reducing the amount of irrelevant questions or options presented to respondents. The questions below are specifically designed within a retrospective context. Respondents are surveyed once, after the project has been launched, to review the trip planner and offer their perceptions of it. The survey may require modification to present context specific questions within Vermont.

Draft Survey

Introductory Text:

About a week ago, you were sent an email introducing you to the newly revised OpenTripPlanner built as a part of MOD Sandbox Project sponsored by VTrans and the Federal Transit Administration. You were asked to review the OpenTripPlanner and make some trip plans with it. This survey is about your experience reviewing and using the OpenTripPlanner. If you did not get a chance to review the OpenTripPlanner planner yet, feel free to do so now. Review and use of it should take about 5 to 10 minutes. Then please proceed to take this survey.

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

    - o 1
    - o 2
    - o 3
    - o 4
    - o 5
    - o 6
    - o More than 6

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

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

3. Please list the year, make, and model of your household's CURRENT vehicles, those that are owned or leased (e.g., 2014 Ford Fusion):

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

4. 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.)

    <Vehicle piped from above> <Miles driven drop down>

    <Vehicle piped from above> <Miles driven drop down>

    <Vehicle piped from above> <Miles driven drop down>

5. Which of the following modes of transportation have you used **within Vermont in the last two years**? (Please check all that apply.)

    - o Drive alone
    - o Drive/Ride with family/friend (non-commute)
    - o Walk (to a destination)

- o Fixed route public bus
- o Deviated-fixed public bus
- o Hail-and-ride bus
- o Dial-a-ride
- o Amtrak
- o Green Mountain Railroad
- o Uber / Lyft or other ride-hail service
- o UberPOOL / Lyft Line or other shared-ride service
- o Taxi
- o Bicycle
- o Motorcycle or scooter
- o Carpool (for commuting)
- o Vanpool
- o Employer Shuttle (for commuting)
- o Car Rental within Vermont
- o Other, please specify:_____

Note: The following question is used to narrow down the modes used by the respondent. Only modes selected are presented in the following questions about changes in mode use. For all questions that carry forward, respondents are only asked questions about modes that they have used. Subsequent questions narrow this down further.

6. Please indicate about how frequently you CURRENTLY use the following modes.

	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**
<Mode that was selected in Q3>										
<Mode that was selected in Q3>										
<Mode that was selected in Q3>										
<…>										

21. How essential are flexible transit services (e.g., services that are on-demand or use non-fixed pickup/dropoff locations) to meeting your personal transportation needs?

    - o Very important
    - o Important
    - o Somewhat important
    - o Not too important
    - o Not important at all

22. When you travel by public transit, which trip planning platforms have you used in the last year? (please check all that apply)

    - o Google Maps
    - o Waze
    - o Bing Maps
    - o Apple Maps
    - o OpenTripPlanner
    - o Other, please specify:_____

23. When you travel by public transit, which trip planning platform do you find to be the most useful? (please select the best response)

    - o Google Maps
    - o Waze
    - o Bing Maps
    - o Apple Maps
    - o OpenTripPlanner
    - o Other, please specify:_____

24. Have you used the latest version of the OpenTripPlanner?

    - o Yes
    - o No

25. How many times have you used OpenTripPlanner?

    - o 1 time
    - o 2 to 3 times
    - o 3 to 5 times
    - o 6 to 10 times
    - o 11 to 20 times
    - o More than 20 times

26. What is your general impression of the OpenTripPlanner?

- o Excellent
- o Very Good
- o Good
- o Fair
- o Poor

27. How would you say OpenTripPlanner compares to GoogleMaps overall for trip planning?

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

28. How would you say OpenTripPlanner compares to GoogleMaps for appearance?

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

29. How would you say OpenTripPlanner compares to GoogleMaps overall for the format and display of information?

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

30. How would you say OpenTripPlanner compares to GoogleMaps overall for the quality of travel options presented?

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

31. Have you used OpenTripPlanner for planning flex-transit trips?

- o Yes
- o No

32. Relative to Google Maps, how useful to think OpenTripPlanner is for planning transit trips in Vermont

    - o Much more useful
    - o More useful
    - o About as useful
    - o Less useful
    - o Much less useful

33. Do you think that OpenTripPlanner is an improvement for flex transit planning relative to other options available?

    - o Yes, a significant improvement
    - o Yes, a modest improvement
    - o Yes, a slight improvement
    - o No, not an improvement

34. Do you think that OpenTripPlanner is an improvement for travel planning in Vermont overall?

    - o Yes, a significant improvement
    - o Yes, a modest improvement
    - o Yes, a slight improvement
    - o No, not an improvement

35. Has OpenTripPlanner influenced how you have traveled to date?

    - o Yes, significantly
    - o Yes, modestly
    - o Yes, slightly
    - o No, not at all

36. Do you think OpenTripPlanner could influence how you have travel in Vermont?

    - o Yes, it could significantly
    - o Yes, it could modestly
    - o Yes, it could slightly
    - o No, I do not think it really could

37. As a result of the information in OpenTripPlanner I have…

    - o Much greater mobility
    - o Somewhat greater mobility
    - o My mobility has not changed
    - o Somewhat less mobility
    - o Much less mobility

38. As a result of the information in OpenTripPlanner I use public transit…

- o Much more
- o Somewhat more
- o About the same
- o Somewhat less
- o Much less

39. About how much more do you think you use public transit as a result of the information provided in the OpenTripPlanner?

    - o A negligible amount
    - o Once more every few months
    - o Once a month more
    - o Once every two weeks more
    - o Once a week more
    - o Once a day more
    - o More than once a day more

40. What is your gender?

    - o Male
    - o Female
    - o Prefer not to answer

41. In what year were you born?

    Drop-down <years>

42. Do you use a wheelchair?

    - o Yes
    - o No

43. Do you have other disabilities that require specialized accommodations for transportation?

    - o Yes
    - o No

44. Do you require transportation vehicles and infrastructure that is ADA compliant to get around?

    - o Yes
    - o No

45. What is the highest level of education you have completed?

    - o Less than high school
    - o Currently in high school
    - o High school/GED
    - o Currently in 2-year college
    - o 2-year college degree
    - o Currently in 4-year college

- o 4-year college degree
- o Currently in post-graduate degree
- o Post-graduate degree (MA, MS, PhD, MD, JD, etc.)
- o Prefer not to answer

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

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

47. What kind of housing do you currently live in?

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

48. Approximately what was your gross (pre-tax) household income in 2017? (Your household includes the people who live with you with whom you share income.)

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

49. Please indicate two streets that cross near your HOME location as well as the city.

    City
    Street #1
    Street #2

50. Please indicate two streets that cross near your WORK location as well as the city.

    City
    Street #1
    Street #2

51. If you had any comments to improve OpenTripPlanner, please feel free to provide them here. Please offer any open-ended comments that are polite, constructive, and helpful to the development team. Your comments will be read by evaluators and system developers. Please do not include any information that identifies you personally.

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