

## Mobility on Demand (MOD) Sandbox Demonstration: Valley Metro Mobility Platform *Final Report*

MARCH 2021

FTA Report No. 0188  
Federal Transit Administration

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## COVER PHOTO

*Courtesy of Valley Metro*

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## Metric Conversion Table

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>LENGTH</b>				
<b>in</b>	inches	25.4	millimeters	mm
<b>ft</b>	feet	0.305	meters	m
<b>yd</b>	yards	0.914	meters	m
<b>mi</b>	miles	1.61	kilometers	km
<b>VOLUME</b>				
<b>fl oz</b>	fluid ounces	29.57	milliliters	mL
<b>gal</b>	gallons	3.785	liter	L
<b>ft<sup>3</sup></b>	cubic feet	0.028	cubic meters	m <sup>3</sup>
<b>yd<sup>3</sup></b>	cubic yards	0.765	cubic meters	m <sup>3</sup>
NOTE: volumes greater than 1000 L shall be shown in m <sup>3</sup>				
<b>MASS</b>				
<b>oz</b>	ounces	28.35	grams	g
<b>lb</b>	pounds	0.454	kilograms	kg
<b>T</b>	short tons (2000 lb)	0.907	megagrams (or “metric ton”)	Mg (or “t”)
<b>TEMPERATURE (exact degrees)</b>				
<b>°F</b>	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C

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## ABSTRACT

Valley Metro is actively communicating the value of transit in connecting communities and enhancing lives by exploring innovative solutions to bolster the customer experience and responding to changing values. Through the Mobility on Demand (MOD) Sandbox Program, FTA empowered Valley Metro to explore innovative business models and partnerships to deliver high-quality, seamless, and equitable mobility options. Valley Metro's MOD Sandbox Demonstration project, the Pass2Go® pilot app, provided users with the ability to pay for fares, plan trips, and obtain transportation information through a more convenient and customizable solution. This report discusses the project goals and evolution as well as key challenges and lessons learned during its planning and execution.



## EXECUTIVE SUMMARY

The Federal Transit Administration (FTA) has led the Mobility on Demand (MOD) Sandbox Program aimed at exploring how new technologies can be incorporated to complement and support the traditional functions of public transit. Valley Metro, the regional public transportation authority of Maricopa County, Arizona, was selected as one of 11 recipients of FTA's MOD Sandbox Demonstration projects. Valley Metro provides multimodal transit options, including regional bus and light rail systems, to the 4.25 million residents of Maricopa County (US Census, 2018). It developed the Ridekick™ mobile application (app) that functions as a basic trip planner for light rail and buses; however, the existing app had limited features and was not accessible for people with disabilities. Thus, the Valley Metro MOD Sandbox project, Mobility Platform, was created to provide an updated version of the app with innovative features. The Pass2Go® app was designed to improve trip planning, provide a mobile single ticketing and payment system, and connect users with multiple public and private transportation options.

The envisioned project was planned in two phases—Phase I included developing Pass2Go® as a trip planner with real-time information and a single payment system for public transit, and Phase II included integrating on-demand ride sourcing services into the mobile app environment. Phase II programming was completed for ridesourcing services; however, the project was unable to move forward, as Lyft was not able to delegate the resources needed to move the programming into the mobile environment.

The Valley Metro project had multiple objectives:

- Reducing trip planning, wait, and travel times.
- Encouraging the adoption of mobile-based technology for public transit.
- Improving first/last mile connectivity.
- Improving accessibility and trip planning methods for travelers with disabilities.
- Enhancing the traveler experience.
- Providing an open data platform that allows transit agencies to exchange travel information.
- Producing lessons learned for future projects.

To test and evaluate user response to the Pass2Go® app and its support to the existing public transit system, Valley Metro contracted with WestGroup to develop and implement a user survey. The study was set up in a series of four three-month waves in which participants in each wave were required to take a pre-study survey, use the Pass2Go® app, and then take a post-study survey. An independent evaluation of the Valley Metro MOD Sandbox Demonstration was conducted under a separate contract with the U.S. Department of Transportation (USDOT) to determine the success of the project in meeting

its objectives. Valley Metro and WestGroup collaborated with the independent evaluator throughout the project. Paired observations from both surveys as well as app activity and payment data, the project's open data platform, and insights from expert (stakeholder/project partner) interviews were later used by the independent evaluation team for analysis.

Overall, the analysis showed that the Pass2Go® app was an enhancement over the existing Ridekick™ app. Results showed that trip planning and wait times were reduced, real-time information for public transit and planning methods were improved, and accessibility was enhanced for travelers with disabilities.

The project encountered some technical and contractual challenges. From a management perspective, it was important to reduce the size of the project management team to facilitate response time and gain consensus. However, a larger advisory group remained and was able to be involved and provide feedback about the project. There was no specified timeline to establish project partnerships, but it was noted that discussing strategies with potential partners at the beginning of the project can be useful. This helps identify mutually-desired objectives with a clear assessment of individual control and responsibilities. The project's open data platform allowed transit agencies to exchange information and lessons learned which minimized duplication and increased productivity.

With respect to project evaluation, producing sufficient and usable data was crucial to conduct an accurate analysis. Documenting the data collection and management approach in addition to regularly communicating with the independent evaluator proved beneficial for this purpose. For future projects, it would be best for the project's team to conduct an initial review and analysis of the data followed by a more detailed analysis by the independent evaluator. In addition, the hiring of a professional market research team helped with collecting representative data by identifying target participants that were willing to provide data throughout their ongoing participation.

From an operational perspective, internal and external communication was a key challenge to guarantee that different operators understood how the mobile ticket worked. For this purpose, Valley Metro conducted presentations and trainings for bus and rail operators and other members of the operations teams. Another challenge was testing the developed accessibility features for both Android and iOS, for which a professional testing firm was hired. A technical support system was developed to report bugs and issues and track their resolution status.

Although the fully accessible Pass2Go® app enabled users to receive General Transit Feed Specification (GTFS) information, plan their trips, and purchase ride passes for public transportation modes, it did not successfully integrate non-Valley Metro operated transportation services, such as Lyft and GR:D Bike Share, into a single payment system. The software development partner, Routematch,

formed a relationship with the Transportation Network Company (TNC) partner, Lyft, as there were significant concerns around data privacy and working with a government entity. After this relationship was established, Routematch received the application programming interface (API) keys and wrote the integration to establish a single payment solution for both the transit ticket and the Lyft ride cost. Unfortunately, Lyft was unable to move this into the mobile environment.

Pass2Go® was closed down, and the MOD Sandbox Demonstration ended in December 2019. Building on the experience and lessons learned with it, Valley Metro and partner agencies are moving on to new developments to continue and expand on the functionality achieved during the project. Currently, the City of Phoenix has procured a new fare collection system with VIX and Unwire, which has an existing robust mobile app. The City of Phoenix and Valley Metro ultimately opted to simplify the systems to use a single app that incorporates multimodal transportation options and real-time transit information in a single ticketing and payment system for different fare types. However, the lessons learned from Pass2Go® deployment will serve to inform this new venture and build upon its evaluated performance.

# Introduction

Valley Metro is the regional public transportation authority providing coordinated multimodal transit options to residents of greater Phoenix and the Maricopa County urbanized areas in Arizona. Founded in 1993, the system operates a 38-station light rail line and over 100 bus routes, including 61 local routes and 20 commuter express routes. With an annual ridership exceeding 65 million rides per year, it is Arizona's largest transit agency. Valley Metro faces many of the first/last-mile challenges typical of transit agencies in the present day; it operates in an environment with relatively high auto ownership and navigates the complexities of delivering transit services to a region that spans multiple jurisdictions and land-use environments while trying to keep pace with the ever-advancing state of information technologies. Providing transit services within this operational climate requires advancing the state of practice with respect to customer interfaces. This includes improving the capabilities of trip planning, payments, and first/last-mile connectivity.

In May 2016, the Federal Transit Administration (FTA) announced an \$8 million Public Transportation Innovation funding opportunity for Mobility on Demand (MOD) Sandbox Demonstrations. In October 2016, Valley Metro was selected as one of 11 MOD Sandbox Demonstration projects, Mobility Platform. Valley Metro proposed the Mobility Platform project to address limitations within its existing mobile application (app), Ridekick™, which provides trip planning for light rail and buses. Valley Metro sought to improve trip planning features, including its accessibility for people with disabilities, and to develop an integrated app-based payment mechanism for its public transit services and connecting private transportation modes, such as Transportation Network Companies (TNCs). The app developed and tested within this initiative was called Pass2Go®.

The project built on the functionality of the Ridekick™ app through the development of features not previously available. These enhanced features included a fully-accessible transit app providing users with the ability to purchase tickets for public transit in addition to improvements to the trip planning functionality. The broader objective of these enhancements was to improve the level of connectivity and accessibility throughout the transit network, decrease the first/last-mile challenges facing riders, and allow users to more easily pay for and plan their trips on a mobile platform. These capabilities within a mobile platform also produced useful data, and the mobile application permitted Valley Metro to measure ridership activity. Finally, the project sought to improve connectivity with private transportation providers,

including TNC options. This included an effort to integrate connections with Lyft, whereby users would be able to book Lyft rides from within the app.

The project met most of its stated goals and delivered an improved app experience to users within a test environment. One objective—integration with the TNC within the app—was attempted with considerable good-faith effort but ultimately not achieved. The project was implemented and evaluated via surveys of users within four three-month waves. Three of those waves were used to inform results presented by an independent evaluation sponsored by the U.S. Department of Transportation (USDOT) and are included in this report. Selected preliminary results from the final wave are briefly summarized, with additional analysis in this report. The waves required participants to use the app at least four times per month for three months and complete pre- and post-study surveys. This report provides project insights from Valley Metro's experience implementing the MOD Sandbox Project. In the sections that follow, the report details the project description and evolution, results from data collection and analysis, and key conclusions and lessons learned.

# Project Description

## Overview

The Valley Metro MOD Sandbox Demonstration project was designed around its Pass2Go® app, which initially aimed to provide improved multimodal trip planning, first/last-mile connections, mobile ticketing and payment, incident reporting, and a link to other app-based transportation options.

Valley Metro has provided a Ridekick™ mobile application for its users that features trip planning for light rail and buses. The proposed Valley Metro Mobility Platform was built on the existing functionality of Ridekick™ by developing and testing features not available to users. The initially-envisioned platform enabled users to receive General Transit Feed Specification (GTFS) information, plan their trips, and purchase ride passes for public transportation modes. The enhanced integration was planned to improve the level of connectivity throughout the transit network, decrease the first/last-mile challenge facing public transportation users, and allow them to smoothly complete their trips from origin to destination all within a fully-accessible app. It was also planned to incorporate private ride sourcing services into the mobile application through its own application programming interfaces (APIs). Thus, the project was divided into two phases—Phase I included developing the app as an accessible trip planner that supports mobile ticketing and shows nearby transit stops, and Phase II included the integration of GTFS data for public transit in a fully-accessible application. Devices that support real-time travel information were installed on transit buses; however, that information was not publicly available at the conclusion of this project. Also, in Phase II, a multimodal trip planning feature was planned to provide links to GR:D BikeShare, Lyft, and Uber. The Lyft integration code was written but not executed, as Lyft was unable to move the programming into the mobile app environment. Additionally, incident reporting (e.g., passenger misconduct, disruptive behavior, illegal activity) via the app was discussed with LiveSafe, but LiveSafe was not able to make the features work on the scale needed.

## Project Goals

The Valley Metro MOD Sandbox Project had a number of objectives:

- Reducing traveler trip planning, wait, and travel times.
- Encouraging adoption of mobile-based technology and reducing the amount of paper-based tickets and onboard cash pay.
- Improving first/last-mile connectivity.
- Improving accessibility of the mobile app and enhancing trip planning methods for travelers with disabilities.
- Enhancing the customer experience through improved traveler information.

- Providing an open data platform that allows transit agencies to view and exchange travel information.
- Producing lessons learned and recommendations for future projects through expert (stakeholder/project partner) interviews.

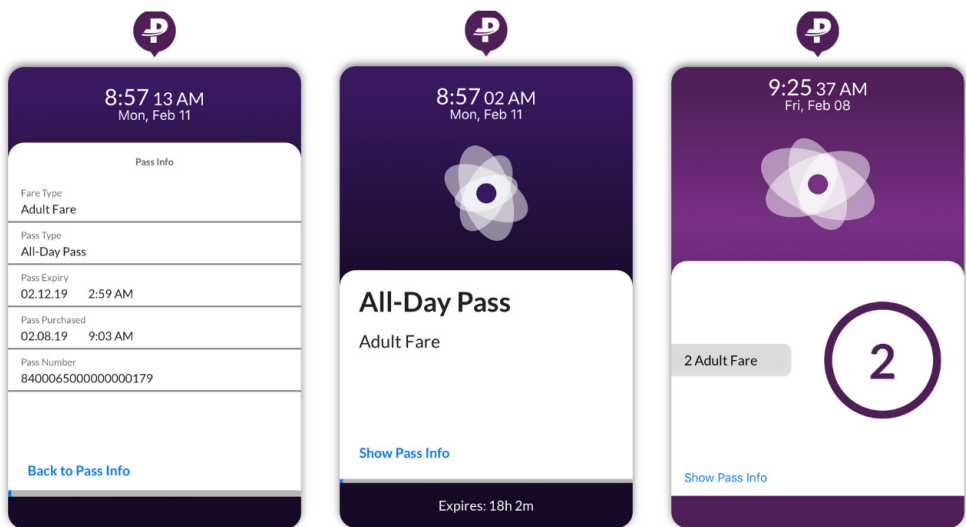
## Project Information

### Problem Addressed

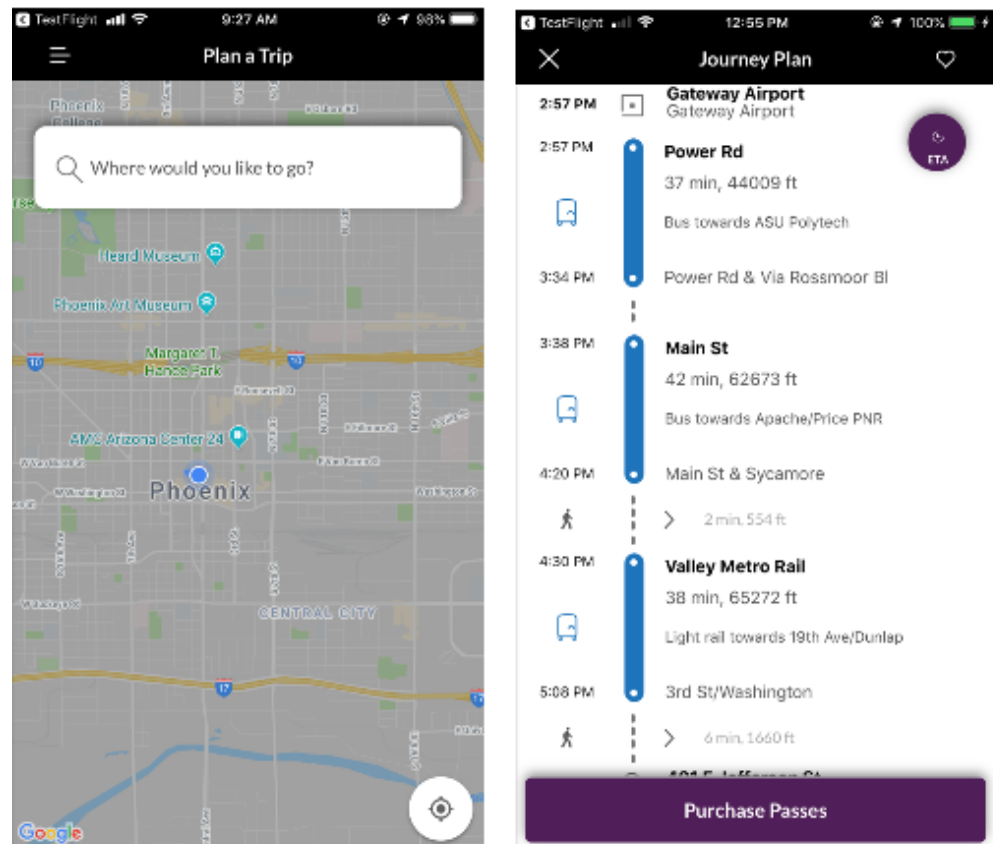
Valley Metro provides multimodal transit options to about 4.25 million residents. It plans and operates regional bus and light rail systems and has provided the RidekickTM mobile application as a trip planning tool for travelers. However, the application was noted for having limited trip-planning features for multimodal trips, and it was not accessible for some people with disabilities. Travelers would need to access different mobile applications to plan, use, and pay for a multimodal trip from their origin to their destination. Thus, Valley Metro envisioned a new mobile application, Pass2Go®, as an accessible trip-planning platform providing real-time transit information with public and private transportation options in addition to an integrated payment system. This aligned with the primary objective of the MOD Sandbox initiative to incorporate new technologies that complement and support the traditional functions of public transit.

Valley Metro launched and deployed the Pass2Go® app to develop, test, and evaluate user response to the integration of these features into the Valley Metro public transit system. The app was designed to provide users with trip-planning capabilities and allow them to purchase transit tickets. Figure 2-1 and Figure 2-2 provide example screen shots of key app functionalities.

**Figure 2-1**  
*Day passes purchased through Pass2Go® app*



**Figure 2-2**  
*Trip planning using  
 Pass2Go® app*



The project was divided into Phase I and Phase II. Phase I was deployed in 2018, and Phase II was delayed and ultimately not fully implemented due to unanticipated challenges. Minor app improvements implemented in Phase II included accessibility fixes, addition of group passes, simplified checkout process for saved cards, a next-ride feature, and interface updates.

Valley Metro contracted with WestGroup Research to develop and implement a series of surveys in four waves. Each wave was designed as a before-and-after survey implemented over successive periods of three months. During these waves, respondents were recruited, invited to take a before survey in the beginning, use the Pass2Go® app, and then take an after survey at the end of the three-month period. Waves 1 through 3 took place in Phase I, and wave 4 took place in Phase II. Data from the waves was compiled, and the independent evaluation team received and analyzed the data in accordance with an evaluation plan for the purposes of completing an independent evaluation.

## Outcomes

Evaluation of Phase I of the project showed that the Pass2Go® pilot app was an enhancement over the existing Ridekick™ app. The analysis, presented



in the [independent evaluation](#) report and based on 12 hypotheses, showed that the project reduced user waiting and planning times, enhanced their trip planning methods and access to real-time information, and improved their accessibility and connectivity to multiple transportation options. Also, the platform allowed Valley Metro and WestGroup Research the ability to exchange travel information and produce lessons learned for future projects.

## SECTION

# 3

## Project Evolution

Before the MOD Sandbox project, Valley Metro provided the Ridekick™ mobile application as a trip planning tool for travelers, and it was still the primary public facing app of Valley Metro during the project. Valley Metro developed the idea for the improved Pass2Go® mobile application with additional features and engaged various stakeholders about its development, including the Maricopa Association of Governments (MAG) and the City of Phoenix. Over time, stakeholder engagement and coordination evolved across the agencies at multiple levels. The process eventually involved approximately 60 people wanting to be part of the planning process. Valley Metro realized that the size of the project management team was becoming large and assigned the effort to a smaller project management team with a larger advisory group that could still be involved and provide feedback in the Pass2Go® development.

The project faced a tough start, as partners were overly optimistic on the time needed to address several technical challenges. Valley Metro and Routematch, the project's technology partner and app developer, had established an ambitious timeline for the project. One of the challenges presented by the timeline was meeting its goals while maintaining the rigors required of the app development cycle and all its required steps. For the app development process, it was important to research integration points such as payments, next stops, and trip planning to ensure compatibility. Certain safety and security features, such as the integration with the LiveSafe app allowing passengers to report incidents as they were in progress or request assistance from the Operations Control Center (OCC), were dropped because of challenges with software limitations surrounding the size and scope of the geographic area.

It was clear very early on that a third party would be needed to confirm or provide feedback on accessibility improvements, including confirming the implementation of a number of features or functional attributes (called Success Criterion), as listed below:

- **Name, Role, Value** – To ensure that assistive technologies (AT) can gather information about, activate (or set) and keep up-to-date on the status of user interface controls in the content.
- **Contrast (Minimum)** – To provide enough contrast between text and its background so that it can be read by people with moderately low vision.
- **Keyboard** – To ensure that, wherever possible, content can be operated through a keyboard or keyboard interface (so an alternate keyboard can be used).

- **Focus Visible** – To help a person know which element has the keyboard focus.
- **Focus Order** – To ensure that when users navigate sequentially through content, they encounter information in an order that is consistent with the meaning of the content and can be operated from the keyboard.

One goal of the project was to incorporate the use of paratransit service into the app, but a challenge was that Valley Metro does not have oversight of paratransit throughout the area. Due to these technical and jurisdictional complexities, the paratransit features were dropped.

Another challenge involved the integration of LiveSafe into the app. LiveSafe's application developer conducted a thorough review and determined that it could not meet the complex requirements to support a region-wide transportation system. Other LiveSafe installations were primarily geofenced within college campuses and sports arenas.

The project encountered challenges advancing agreements with TNCs using traditional contracting terms and vendor relationships. For Valley Metro, TNC partners initially were very interested in integrating their services into the new app. However, there were concerns about data protection, particularly given that Arizona has a relatively open public records law. To overcome these challenges, Valley Metro decided to have Routematch form a relationship directly with Lyft, as no rides were being subsidized by Valley Metro or with FTA funds. In addition to data concerns, Lyft expressed concerns about the user experience and functions (i.e., Pass2Go® app interface) that would occur outside of Lyft's app.

Routematch had already worked with Lyft on another project whereby it developed an integration for another agency that subsidized a portion of its fares. To overcome the integration challenge of the Pass2Go® project, Routematch obtained from Lyft an application API compatible with a mobile environment similar to that developed for another entity that had a subsidized fare program. This enabled Valley Metro's integration to build off of this previous development. As a result, the Mobility Platform project was planned to be implemented in two phases—Phase I included accessibility improvements such as next stop identification, mobile ticketing, and screen reading to the app, and Phase II included the integration of GTFS data for public transit in a fully-accessible application. Devices that support real-time travel information were installed on transit buses; however, that information was not yet publicly available at the conclusion of this project. Another goal in Phase II was integrating ridesourcing services within the app. Ultimately, despite good-faith efforts to achieve TNC integration, Phase II was initiated but not successfully completed.

The pilot study targeted participants who were periodic riders using daily passes for public transit. Valley Metro hired WestGroup Research, a well-known market research firm familiar with the local area, to assist with participant recruitment and to develop an implementation strategy to incentivize participants and solicit feedback. The project team decided to implement the study in four three-month waves. Participants were asked to use the pilot app a minimum of four times per month for three months and complete before and after surveys for a one-time gift card incentive. Results from the surveys were provided to the independent evaluator for analysis and reporting. At the time of the MOD Sandbox Demonstration award, WestGroup was in the middle of a pre-existing five-year contract with Valley Metro, which allowed Valley Metro to bring its expertise into the project as part of that existing relationship. WestGroup linked its project management software with Routematch through an API to enable information-sharing between them for the pilot participation. WestGroup found that a high level of personal engagement was necessary. Initial pilot recruitment was conducted predominantly through social media, e-mail marketing, and news stories.

Prospective users who passed an on-line pre-qualification survey were placed into an internal dashboard, which was a management software used to track participation and communicate with participants.

WestGroup then called these individuals to make sure they understood the program's terms, conditions, and requirements. The API also allowed WestGroup to provide targeted marketing and technical support throughout the pilot. Project stakeholders indicated that personal assistance was particularly valuable for iOS users who had a more complicated sign-up and installation process via the Apple store.

The recruitment process was subject to considerable attrition. Recruitment statistics from Waves 1 through 4 revealed that about 53% of the 3,222 who completed the recruitment survey passed this screener. However, only 49% of this 53% (~26% of the 3,222) fully registered to participate. Of this smaller fully-registered population, only 50% fully completed Waves 1 through 4. This means that of those who started the process, only about 13% made it all the way through the study and completed the requirements. This attrition rate shows the common challenges with maintaining sustained participation in the study. Table 3–1 presents the summarized participation statistics, those who fully registered to participate, for Waves 1 through 4.

**Table 3-1***Study Participation Results (Waves 1–4)*

<b>Pass2Go® Pilot – Recruit Info</b>	<b>Wave 1</b>	<b>Wave 2</b>	<b>Wave 3</b>	<b>Wave 4</b>	<b>Total</b>
Completed recruit survey	680	682	804	1,056	3,222
Disqualified/screened out	324	295	346	413	1,378
Qualified, opted out at end of recruit survey	66	18	32	31	147
Qualified to participate via recruit survey	290	369	426	612	1,697
<b>Registration and Participation</b>	<b>Wave 1</b>	<b>Wave 2</b>	<b>Wave 3</b>	<b>Wave 4</b>	<b>Total</b>
Fully registered to participate	166	199	274	195	834
Dropped out	64	96	127	118	405
Current participants	101	103	147	77	428
Completed pre-evaluation survey	101	103	147	77	428
Registered in Pass2Go® pilot app	100	103	147	77	427
Ready to Go! (pre-eval + app)	100	103	147	77	427
Completed post-evaluation survey/completed study	86	103	147	77	413
<b>App Pass Purchases &amp; Activations</b>	<b>Wave 1</b>	<b>Wave 2</b>	<b>Wave 3</b>	<b>Wave 4</b>	<b>Total</b>
Purchased 1 or more passes	105	121	188	91	505
Activated 1 or more passes	105	116	184	86	491
Activated 4+ unique passes	95	106	161	74	436
Activated 6+ unique passes	90	104	151	71	416
Activated 8+ unique passes	90	104	151	65	410
Activated 10+ unique passes	86	103	149	54	392
Activated 12+ unique passes (study requirement)	86	103	147	41	377
Wave Notes	Complete	Complete	Complete	Complete	Goal: 400 Total Completes

Another component in the evolution of Pass2Go® was communication and training for bus drivers, rail operators, security, and operations teams to understand how the pass functioned. Valley Metro released several documents including internal memoranda, frequently asked questions (FAQs), PowerPoint training presentations, and posters for operations and customer service facilities. Valley Metro also had internal monitors with custom messages and held team-building and lunchtime activities to demonstrate the app on different devices and what constituted a valid pass. At times, Valley Metro had challenges conducting outreach to contractors it did not directly employ. Valley Metro Regional Public Transportation Authority (RPTA) is one of two major operators providing regional service marketed as “Valley Metro” and, together with the City of Phoenix, they contract with several private providers. This resulted in occasional situations in which riders would encounter bus operators unfamiliar with the app-based pass, thus requiring app users to purchase another pass. Valley Metro also created a webpage with

a phone number and email address to report technical issues and an internal dashboard for tracking customer service help tickets. A high percentage of customer service tickets were filed either to inquire about how to join the pilot or about how to install the app once a user had been enrolled in it.

In the section that follows, results of data collected and analyzed by the project evaluation are presented, including data collected across the four waves of test users and an extended user survey, as are insights about project impacts from these data sources.

## SECTION

# 4

## Evaluation

This section presents the results of a Valley Metro evaluation of the MOD Sandbox Demonstration project in conjunction with the USDOT-sponsored independent evaluation. The study was set up in four three-month waves. Participants were asked to use the app four times per month for three months and to complete pre-and post-study surveys. Participants were provided with a gift card upon completion of all study requirements. It was necessary to identify participants who were willing to provide ongoing participation in the pilot program to provide statistically-valid data. WestGroup was hired to assist with participant recruitment and to develop an implementation strategy to incentivize participants and solicit feedback.

The project evaluation, conducted by the independent evaluator, consisted of testing 12 hypotheses guided by the project's main goals and objectives. The analysis was based on before and after survey data for the completed three waves, app activity and payment data, the project's open data platform, and insights from interviews with the Valley Metro MOD Sandbox project partners. The evaluation of these 12 hypotheses was executed using the data from the first three waves and is detailed in full within the independent evaluation report. A fourth wave was subsequently completed, and selected results from the first three waves and this final wave are presented in this section. Also presented in this section are results of an extended user survey implemented at the end of the study for Waves 1–3. Selected insights from these instruments detailing project impacts are discussed below.

### Selected Insights from Waves 1–3

The evaluation of the data collected in the first three waves showed a statistically-valid number of responses. Of the 332 participants in Waves 1–3, 58% were male and 42% were female. There was a small number of people with disabilities within the sample; 1% of respondents indicated that they used a wheelchair and 2% indicated that they had other disabilities that required specialized accommodations for transportation or Americans with Disabilities Act (ADA) accessible vehicles and infrastructure. This translated to 11 of the 332 participants identified as people with disabilities. Figure 4-1 shows that 80% of respondents lived in households of three or fewer individuals.

**Figure 4-1**

*Household size  
distribution  
(Waves 1–3)*

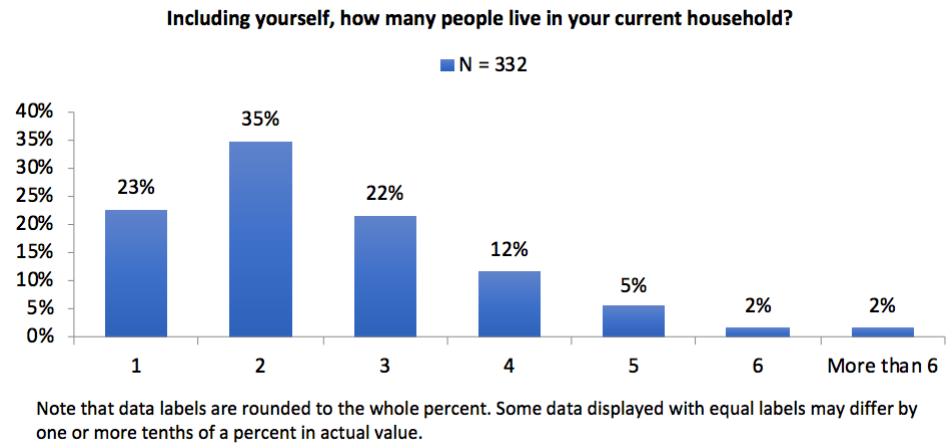
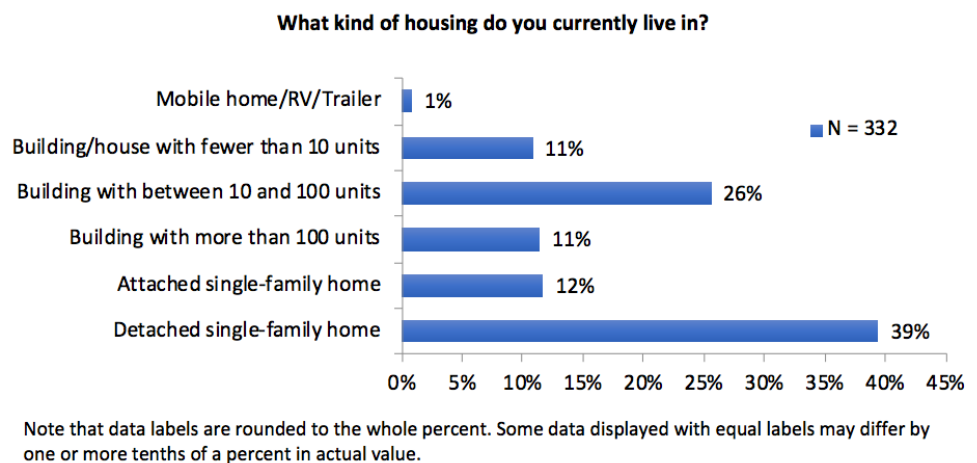


Figure 4-2 shows the distribution of housing stock in which participants lived, with 51% living in attached or detached single-family homes and 26% living in apartment buildings containing 10–100 units.

**Figure 4-2**

*Housing type  
distribution  
(Waves 1–3)*

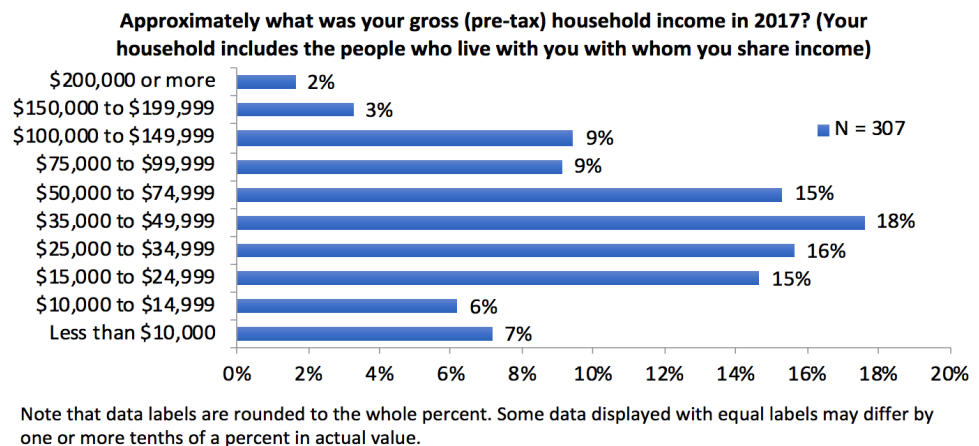


Participants had varied income and education levels as well as diverse racial and ethnic backgrounds, as shown in Figures 4-3, 4-4, and 4-5. Participants were generally of middle income, with the mode (the most frequently selected category) of the distribution at \$35,000–\$50,000. The distribution showed that the survey population had a median income falling within this category, slightly lower than the median income of \$61,606 in Maricopa County (US Census, 2018).



**Figure 4-3**

*Household  
income  
distribution  
(Waves 1–3)*



The participant sample had an education level relatively similar to the general population of Maricopa County. Figure 4-4 shows that 24% had a bachelor's degree compared to 20% of the population, 14% had a graduate degree compared to 12% of the population, and 42% completed a high school education or were currently pursuing a 2- or 4-year degree compared 47% of the population (US Census, 2018).

**Figure 4-4**

*Highest education  
level distribution  
(Waves 1–3)*

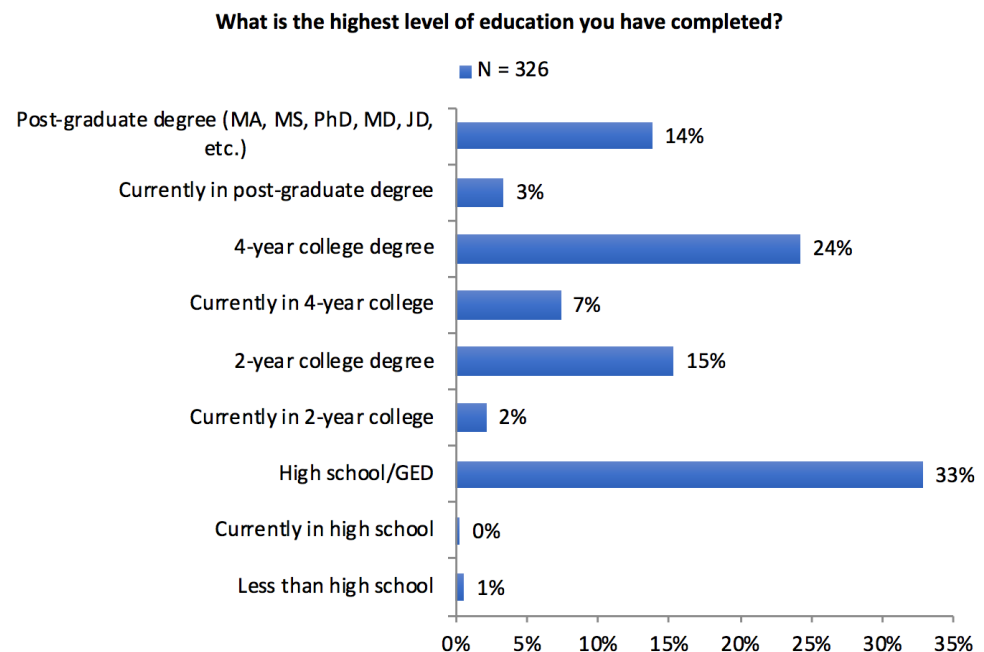
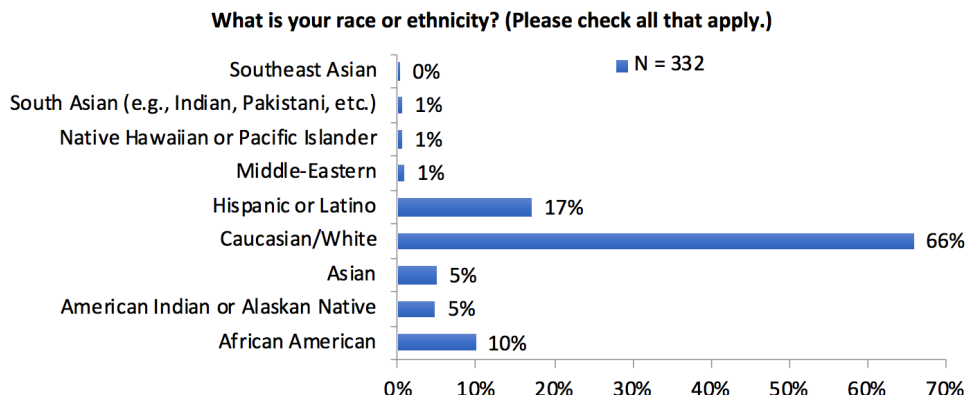


Figure 4-5 shows the racial/ethnic distribution of the sample distribution of the participants. The dominant racial and ethnic backgrounds of participants, for which respondents could select all that apply, were White (66%), Hispanic/Latino (17%), and African American (10%). This represents a slight overrepresentation of

the White (56%) and African American (5%) populations, accurately represents the Asian population (4%), and underrepresents the Hispanic/Latino population (30%).

**Figure 4-5**

*Race or ethnicity  
distribution  
(Waves 1–3)*



As shown in Figure 4-6, participants reported different levels of car ownership, with 35% of the 332 respondents indicating that they did not own or lease a car.

**Figure 4-6**

*Vehicle ownership  
distribution  
(Waves 1–3)*

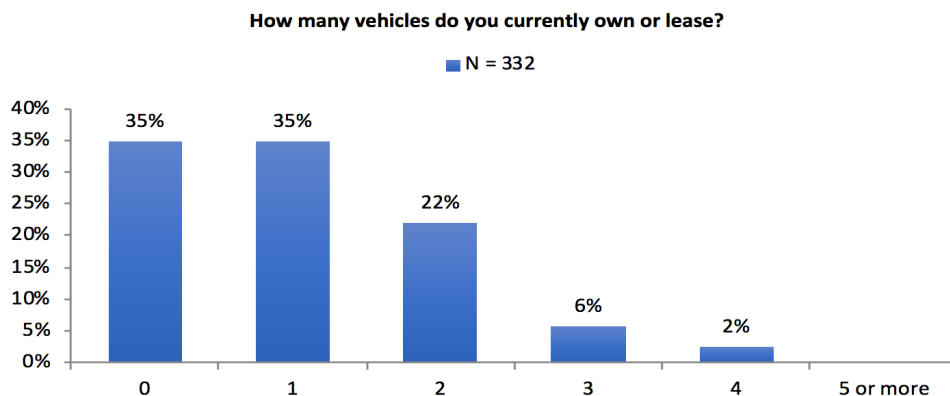
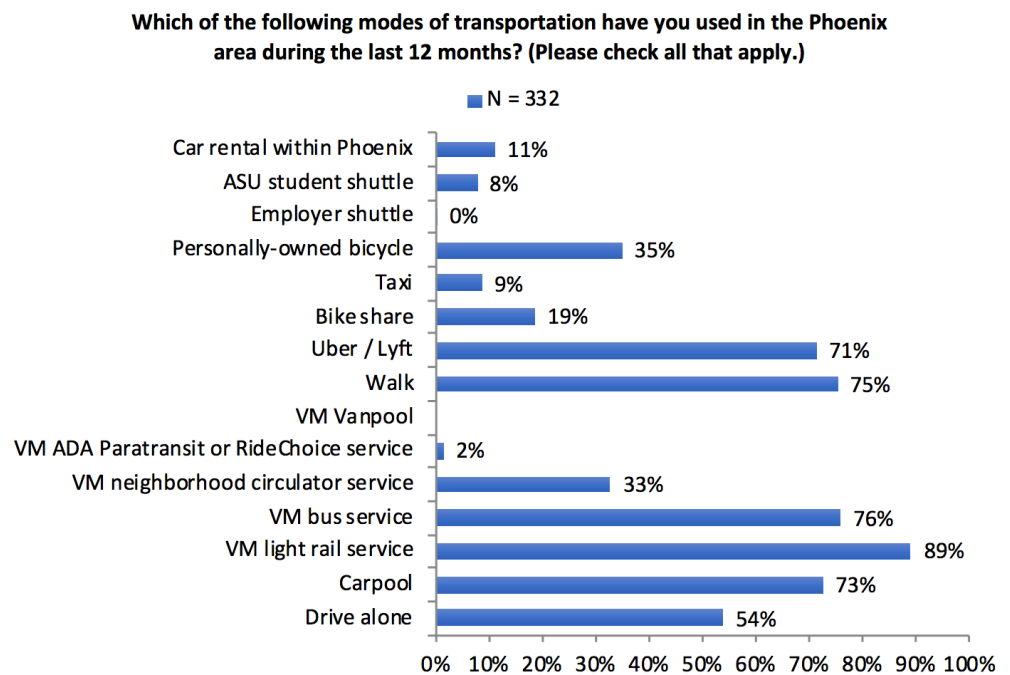


Figure 4-7 shows the distribution of modes of transportation used by participants during the 12 months preceding the time of the survey, in which respondents were allowed to select all that apply. The responses show that participants were generally heavy public transit users, and only 54% had driven alone in the last 12 months. The most common mode selected was the Valley Metro light rail service (89%), followed by Valley Metro bus service (76%), walking (75%), carpooling (73%), and Uber and Lyft (71%).

**Figure 4-7**

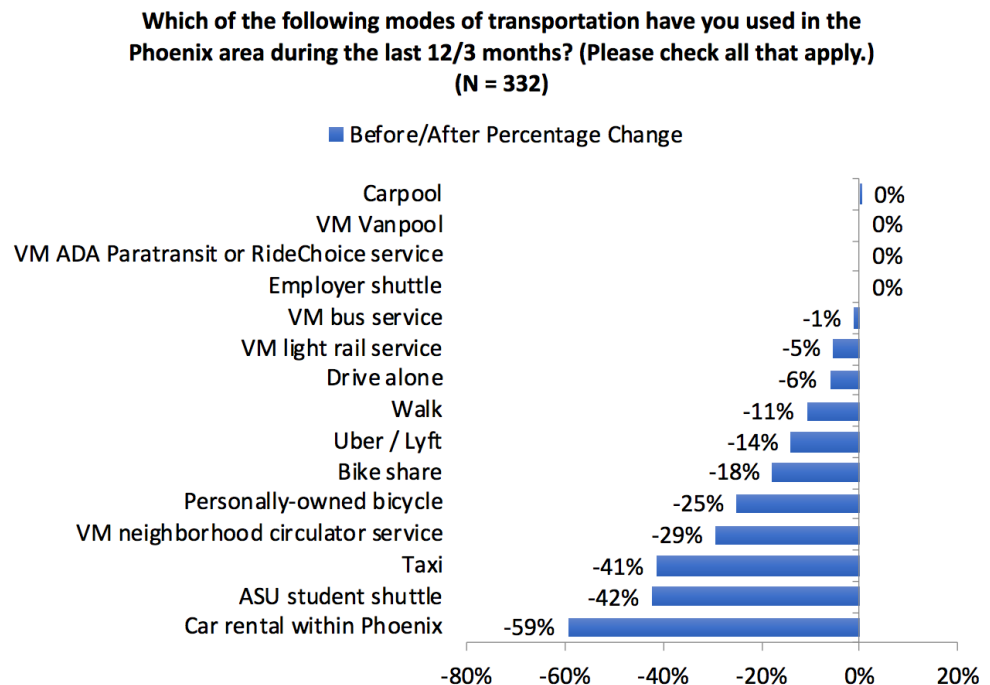
*Transportation  
mode use  
distribution  
(Waves 1–3)*



The post-survey asked participants about their mode use during the past three months (the duration of their participation in the pilot). Figure 4-8 shows the percentage changes between before and after distributions of mode use. An across-the-board decline in mode use is evident and may be due to a variety of factors, including the shorter period of three months assessed in the post-study survey. However, the magnitude of decline varies across the modes, and thus, it can be inferred that in addition to the consistent partial decline due to the shorter study period, a marginal decline is present for certain modes due to an actual decrease in their use. A decrease in mode use was evident and significant for car rental within Phoenix, the ASU student shuttle, taxi, Valley Metro neighborhood circulator service, personally-owned bicycle, bike share, Uber and Lyft, and walk. The relative declines in Valley Metro bus and rail usage were negligible compared to the declines of other modes, and only the carpool mode showed a negligible increase in use.

**Figure 4-8**

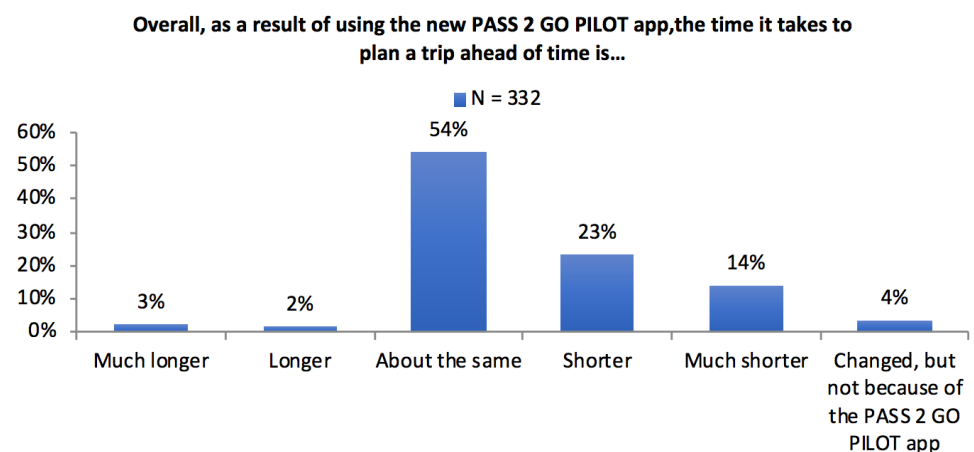
Before/after  
change in  
transportation  
mode use  
(Waves 1–3)



A primary goal of the Pass2Go® app was to provide a convenient trip planning platform for users to plan multimodal trips and save time. Paired observations of self-reported travel, wait, and trip planning times of 332 users in the before and after surveys showed that the app decreased planning and wait times of users but did not significantly affect their total travel times. This finding aligned with the functionality of the app as a planning tool aimed to enhance a user's planning experience and optimize their arrival to bus or rail stations. Figures 4-9 and 4-10 show user perceptions of their planning and wait times as a result of using the Pass2Go® app, with 37% perceiving shorter planning times and 28% reporting shorter wait times.

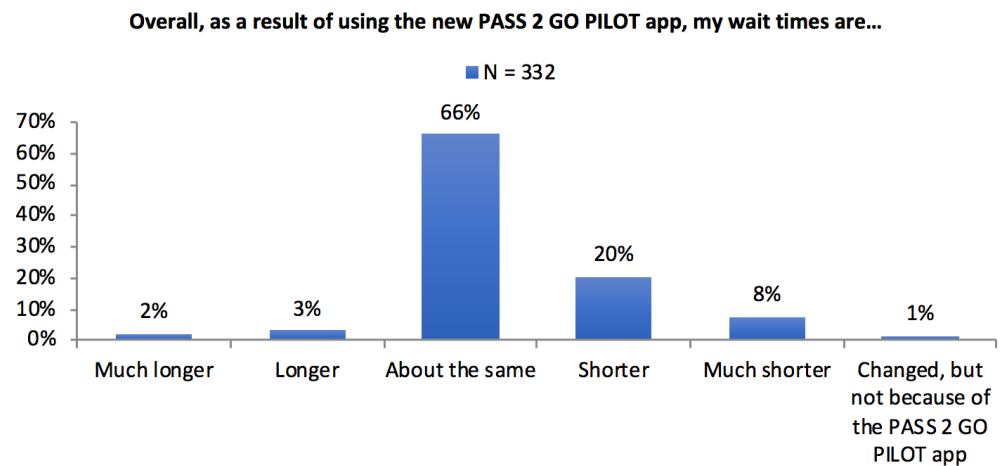
**Figure 4-9**

Change in  
planning times  
as a result of  
Pass2Go® pilot  
(Waves 1–3)



**Figure 4-10**

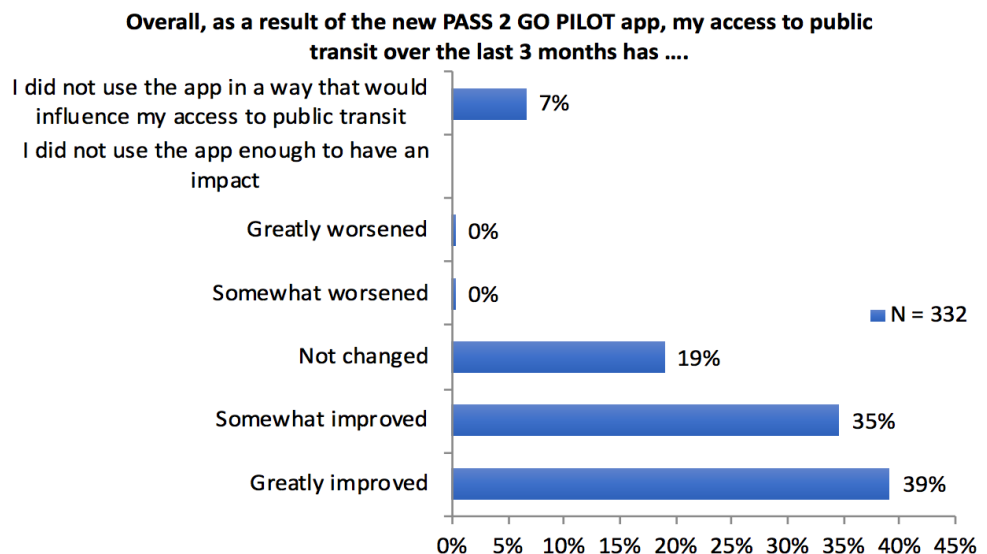
Change in wait times as a result of Pass2Go® pilot (Waves 1–3)



Another goal achieved by the project was to provide an integrated platform with different transportation options and encourage travelers to adopt mobile-based technology to connect with public transit. A time series analysis of app downloads and activity data showed an increasing trend in app activity following implementation of each of the three waves. Statistical analysis showed that the app significantly increased user abilities to get to/from the Valley Metro bus services, the Valley Metro rail line, and public transit in the Phoenix area in general. Figure 4-11 shows that 74% of the 332 participants felt that they had experienced improved access to public transit due to the Pass2Go® app.

**Figure 4-11**

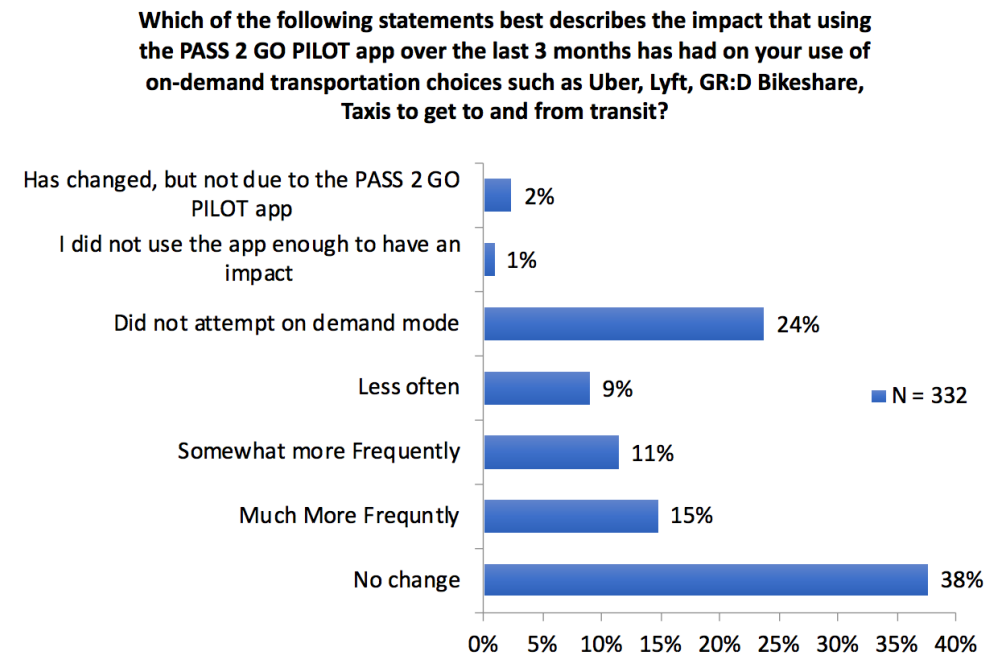
Change in access to public transit as a result of Pass2Go® pilot (Waves 1–3)



In addition to directly connecting travelers with public transit, the Pass2Go® app also increased traveler use of on-demand transportation such as Uber, Lyft, and GR:D Bikeshare to get to and from transit, as shown in Figure 4-12. The app provided a link to Uber, Lyft, and GR:D Bikeshare even though it did not directly integrate with these transportation providers (i.e., the link opened another app external to the application).

**Figure 4-12**

*Change in use of on-demand transportation as a result of Pass2Go® pilot (Waves 1–3)*



From an accessibility point of view, the project successfully enhanced trip planning methods for travelers with disabilities and improved their access to real-time traveler information for public transit. However, this result was based on only 11 people with disabilities out of 332 survey participants. Of the 11 participants, 6 experienced improved planning methods and access to real-time traveler information due to the Pass2Go® pilot.

A key objective of the project was to provide an integrated payment system for multiple transportation options and reduce the amount of paper-based tickets and onboard cash pay. Travelers were able to purchase one-day ride passes using the app at a flat fare of \$4. A pass could be purchased anytime in advance and needed to be activated before the rider used it or on the day the rider planned to use it. Once activated, a pass would expire after 24 hours. The analysis of app payment data included 12,239 transactions for 626 users from March 2018 to November 2019. Results showed that the average user purchased 20 passes, of which 19 were activated. On average, passes were purchased about four days in advance. The analysis showed relatively robust payment activity and use of the app for transit pass purchases that continued after the waves were over; in other words, respondents continued to use the app even though their trial use of it was complete.

From a qualitative perspective, expert interviews with those close to project implementation revealed several lessons learned from the project in addition to recommendations for future research and deployment. At the beginning of the project, one challenge was assembling a project management team of suitable size to be effective while keeping a larger advisory group that could still be involved and provide feedback in the Pass2Go® development. However, the main challenge was going through the app development cycle and all its institutional requirements, which were more complicated and time-consuming than anticipated. Establishing contracting terms and relationships with ridesourcing service providers was difficult because of data concerns in addition to the challenge of programming ridesourcing services into the mobile app environment itself.

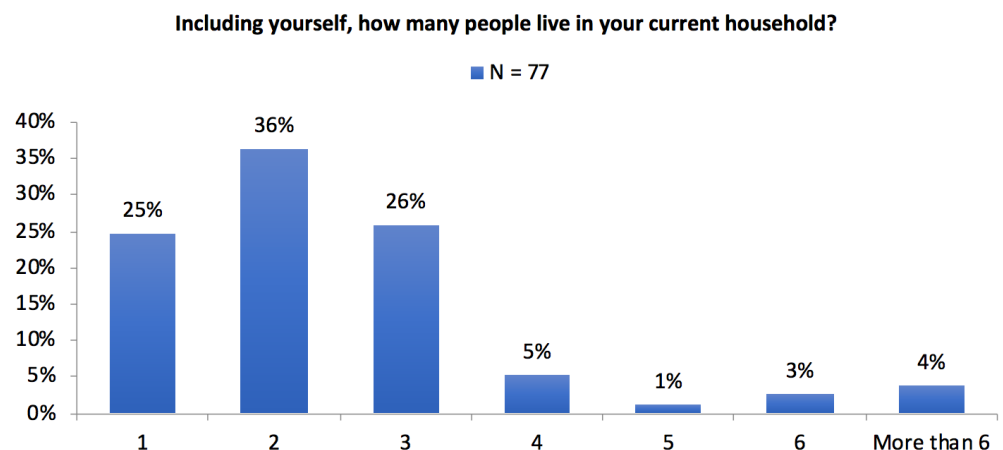
## Selected Insights from Wave 4

Wave 4 was the final participant wave of the project. It finished with 77 completed respondents, bringing the total participants with completed surveys to 409. Select insights from Wave 4 are presented in this section, including new survey questions in addition to questions previously asked in the first three waves. Similar to participants in the first three waves, participants in the fourth wave had diverse socio-demographic characteristics. Of the 77 participants, 64% were male and 36% were female. From a mobility and accessibility perspective, 1% (1 of 77) indicated using a wheelchair and 3% (2 of 77) indicated having other disabilities that required specialized accommodations for transportation. This translated to 2 of 77 participants identified as people with disabilities.

Figure 4-13 shows that 87% of respondents lived in households of three or fewer individuals.

**Figure 4-13**

*Household size  
distribution  
(Wave 4)*

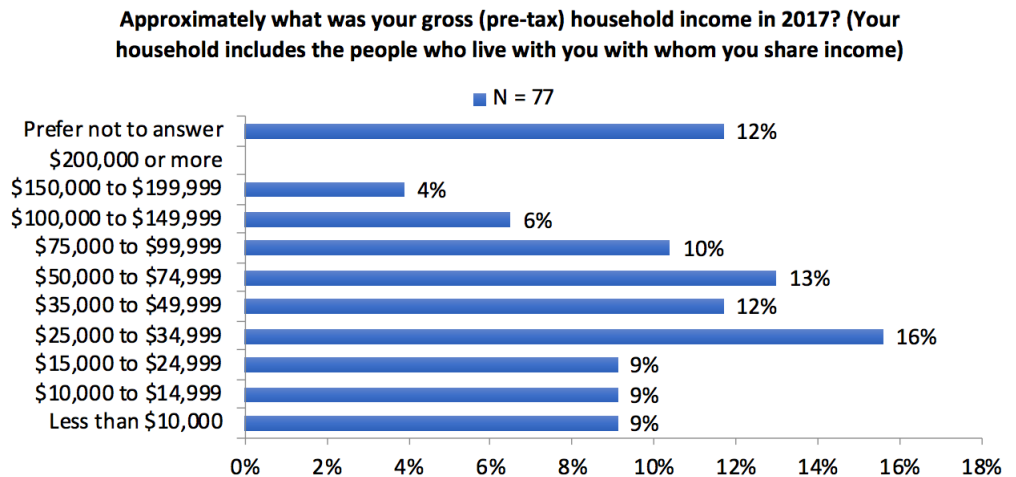


Participants had varied income and education levels in addition to diverse race and ethnic backgrounds, as shown in Figures 4-14, 4-15, and 4-16. The demographic distributions of Wave 4 were similar to Waves 1–3, with participants generally of middle income; the mode (the most frequently selected

category) of the distribution at \$25,000–\$35,000, which was lower than the first three waves. The distribution showed that the survey sample had a median income falling within \$35,000–\$50,000—again, lower than the median income of \$61,606 in Maricopa County (US Census, 2018).

**Figure 4-14**

*Household income  
distribution  
(Wave 4)*



Also similar to Waves 1–3, the participant sample had an education level relatively similar to the general population of Maricopa County. Figure 4-15 shows that 21% of respondents had a bachelor's degree compared to 20% of the population; 12% had a graduate degree, equal to 12% of the population; and 53% had completed a high school education and were currently pursuing a 2- or a 4-year degree compared 47% of the population (US Census, 2018).

**Figure 4-15**

*Highest  
education level  
distribution  
(Wave 4)*

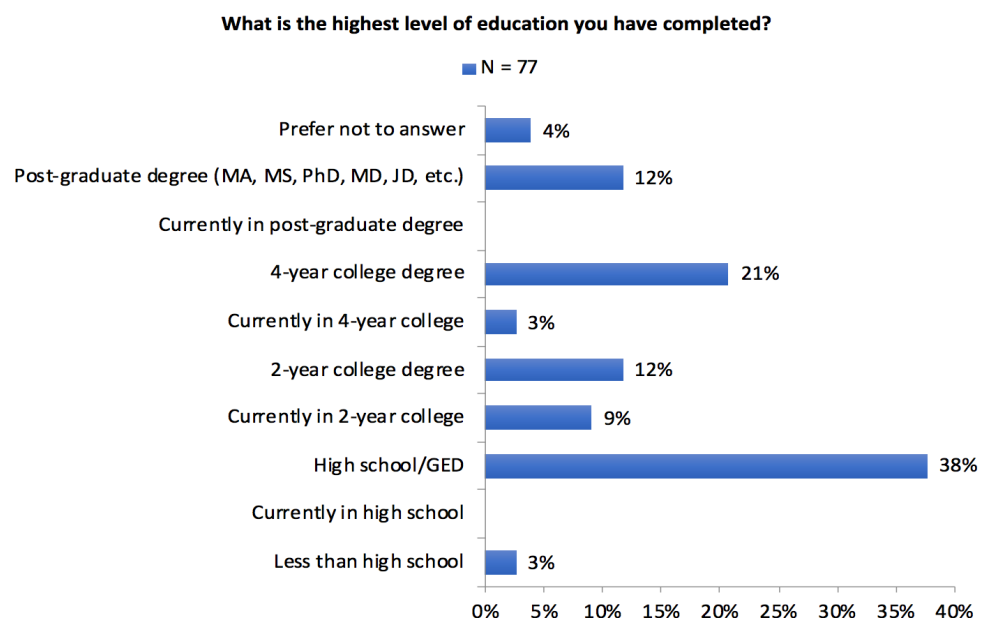
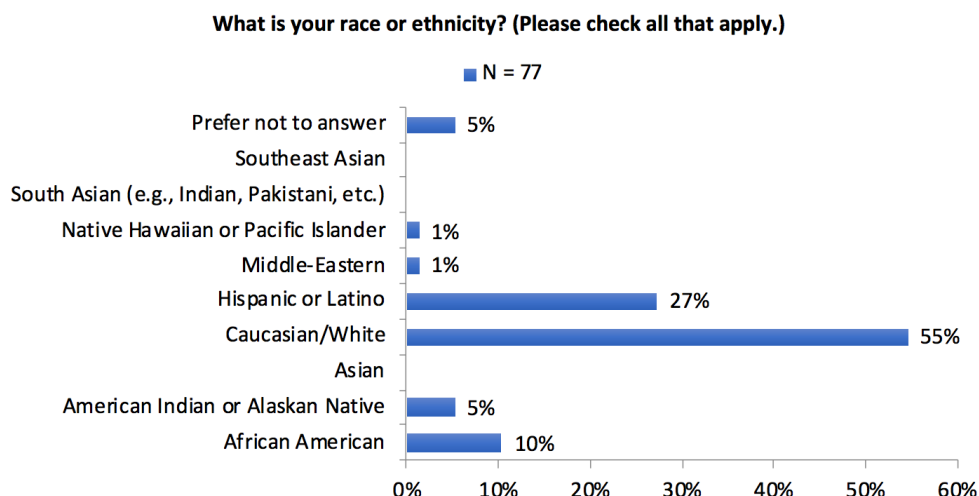




Figure 4-16 shows the racial/ethnic distribution of the sample distribution of participants. The dominant racial and ethnic backgrounds of participants, where respondents could select all that apply, were White (55%), Hispanic/Latino (27%), and African American (10%). This represents a slight overrepresentation of the African American population (5%), closely represents the White (56%) and Hispanic/Latino (30%) populations, and underrepresents the Asian population (4%).

**Figure 4-16**

*Race or ethnicity  
distribution  
(Wave 4)*



As shown in Figure 4-17, participants reported different levels of car ownership, with 46% of the 77 respondents indicating that they did not own or lease a car.

**Figure 4-17**

*Vehicle ownership  
distribution  
(Wave 4)*

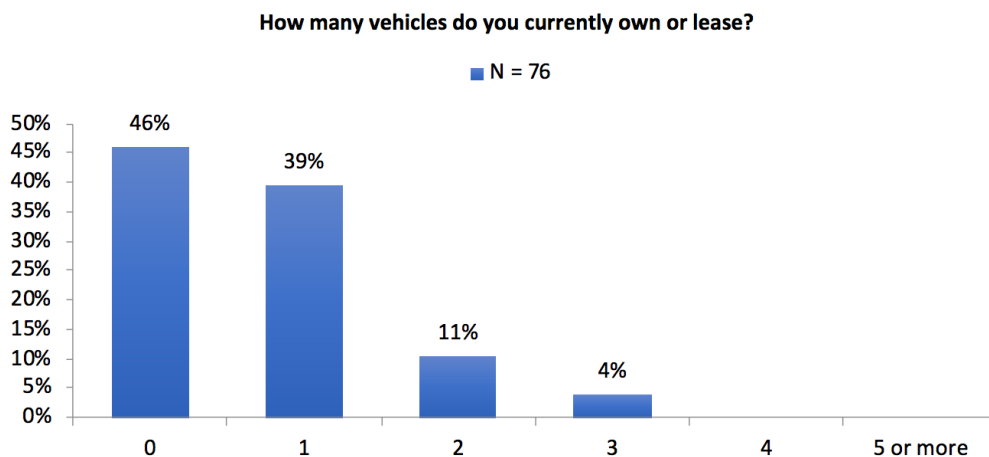
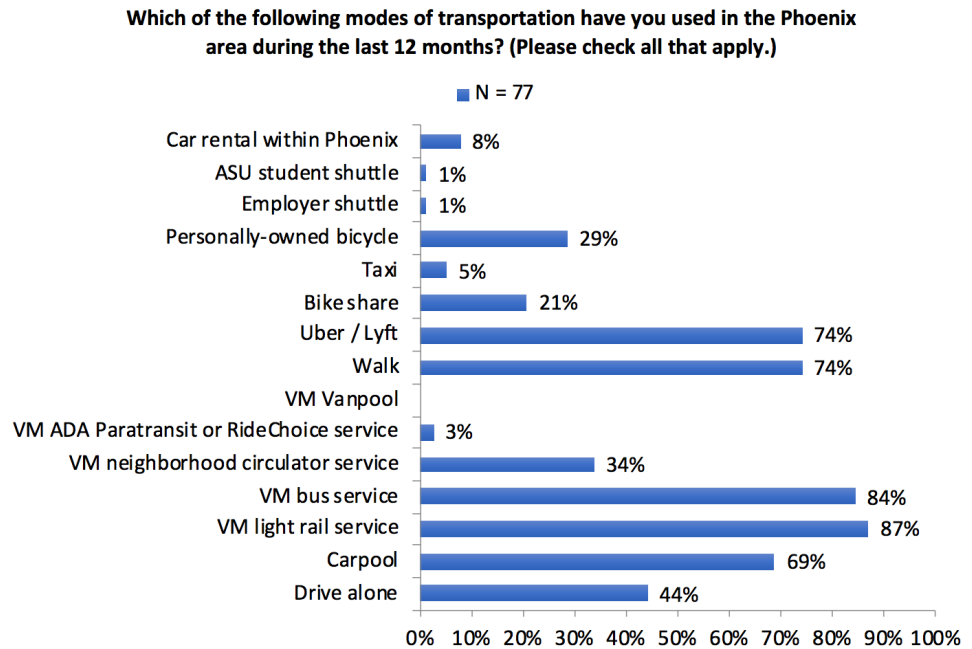


Figure 4-18 shows the distribution of modes of transportation used by participants during the last 12 months, in which respondents were allowed to select all that apply. The responses show that participants were generally heavy public transit users, and only 44% had driven alone in the last 12 months. The

most common mode selected was the Valley Metro light rail service (87%), followed by Valley Metro bus service (84%), walking (75%), Uber and Lyft (74%), and carpooling (69%).

**Figure 4-18**

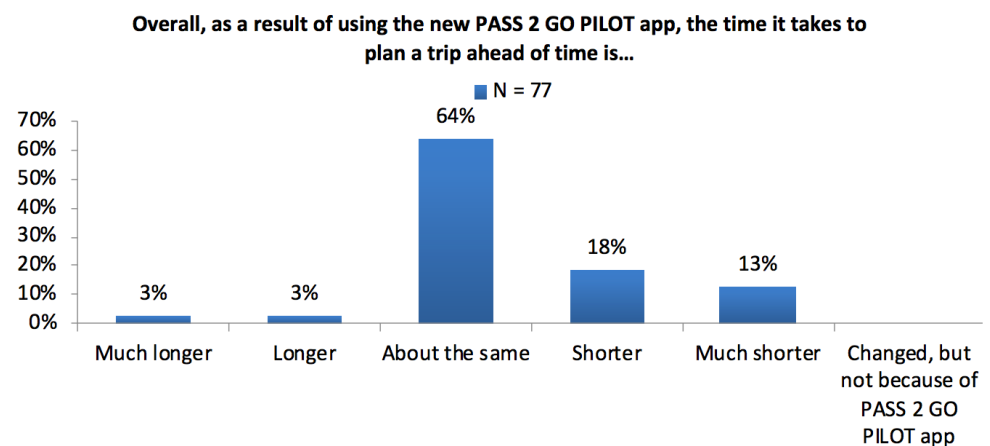
*Transportation mode  
use distribution  
(Wave 4)*



A primary goal of the Pass2Go® app was to provide a convenient trip planning platform for users to plan multimodal trips and save time. Figures 4-19 and 4-20 show user perceptions of their planning and wait times as a result of using the Pass2Go® app, with 31% perceiving shorter planning times and 32% reporting shorter wait times.

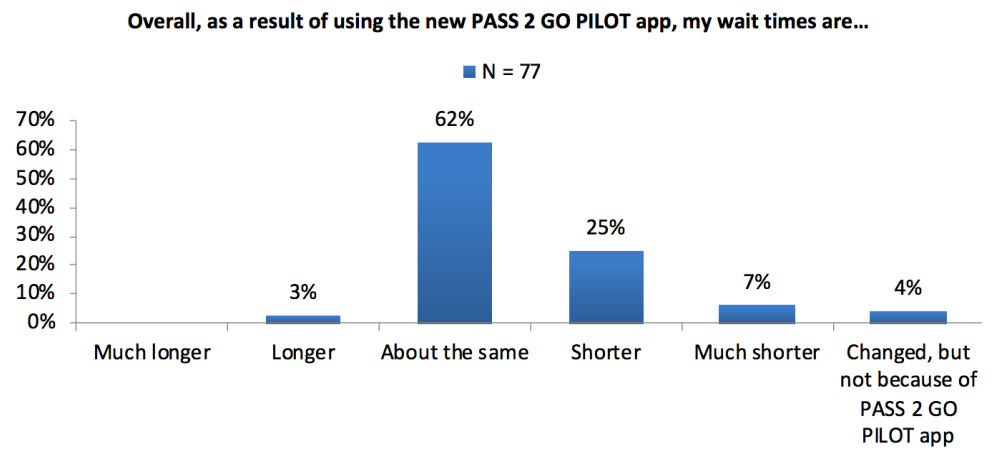
**Figure 4-19**

*Change in planning  
times as a result of  
Pass2Go® pilot  
(Wave 4)*



**Figure 4-20**

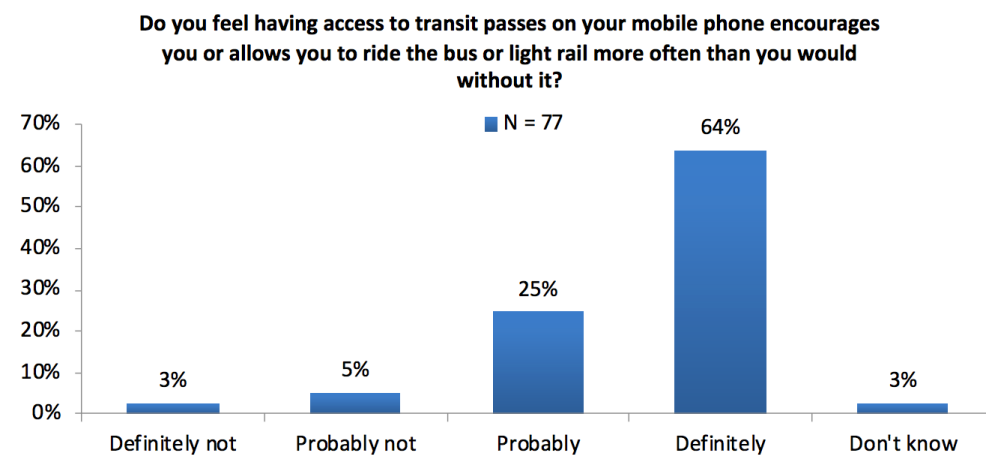
*Change in wait times as a result of Pass2Go® pilot (Wave 4)*



Within the Wave 4 responses, 89% felt that having access to transit passes on their mobile phone encouraged them to ride bus and/or rail more often than they would without it, with 64% reporting “definitely” and 25% reporting “probably” to this question, as shown in Figure 4-21.

**Figure 4-21**

*Effect of access to transit passes on public transit use (Wave 4)*



Respondents were also asked if they would use the Pass2Go® app in another city if it was offered there. As shown in Figure 4-22, 68% reported “definitely” and 26% reported “probably” (94% in total) to this question.

**Figure 4-22**

*Use of Pass2Go® in a different city (Wave 4)*

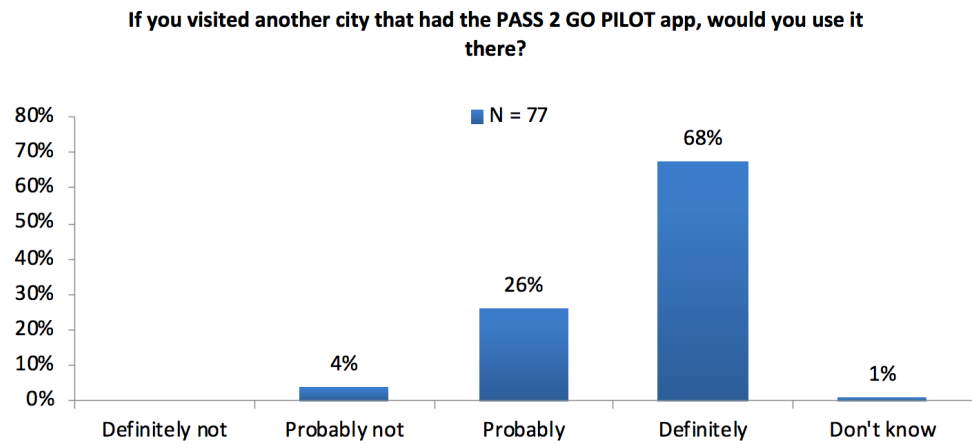
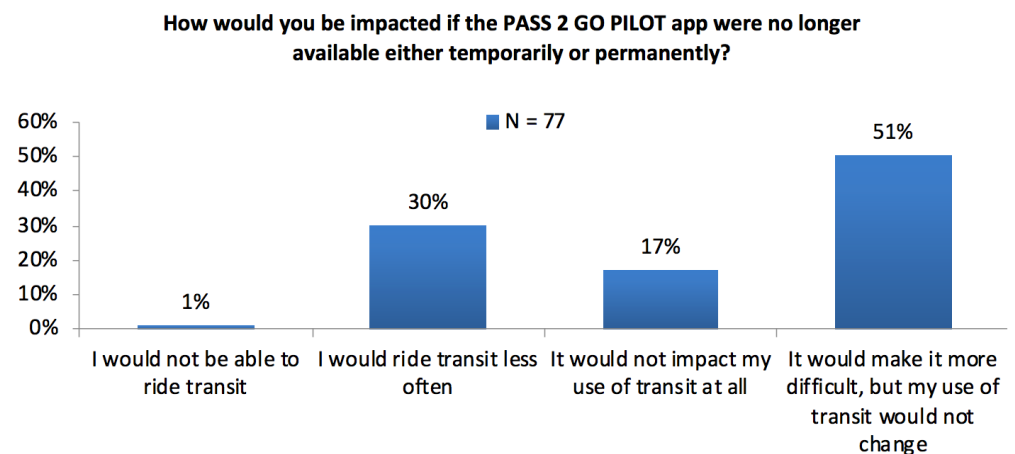


Figure 4-23 shows that 1% (1 of 77) reported that they could not ride transit without the app, and 30% (23 of 77) reported that they would ride it less often without the app.

**Figure 4-23**

*Impact of Pass2Go® pilot availability (Wave 4)*



These selected insights from the Wave 4 deployment suggest that the services provided by the app were useful to the testing population and positively impacted their experience using Valley Metro public transit.

## Selected Insights from Extended Tester Survey from Waves 1–3

An extended tester survey was implemented for select users from Waves 1–3 who continued to use the app after their study period had ended, with 69 responses obtained. Figure 4-24 shows that the most-used app features included ticket purchasing/ticket activation (used by 93% of 69 users), trip planning (41%), viewing trip schedules (39%), and viewing nearby stops (35%). Also, users were asked if they would continue using the Pass2Go® app as long as it was available, with 88% (61 of 69) answering “yes.”

**Figure 4-24**

*Pass2Go® pilot  
used features  
(extended  
tester survey)*

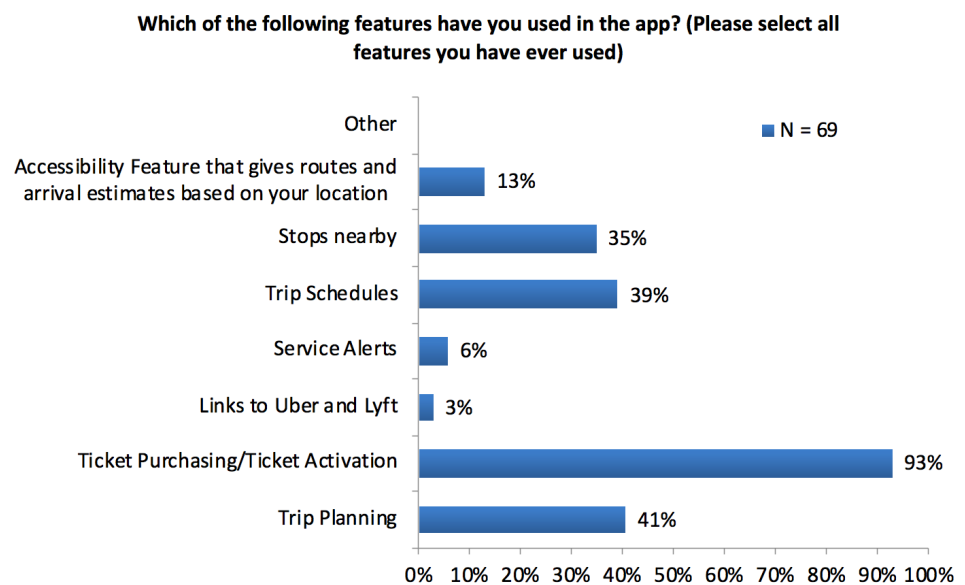


Figure 4-25 shows that 1% (1 of 69) reported that they could ride transit without the app, and 39% (27 of 69) reported that they would ride it less often without the app.

**Figure 4-25**

*Impact of Pass2Go®  
pilot availability  
(extended  
tester survey)*

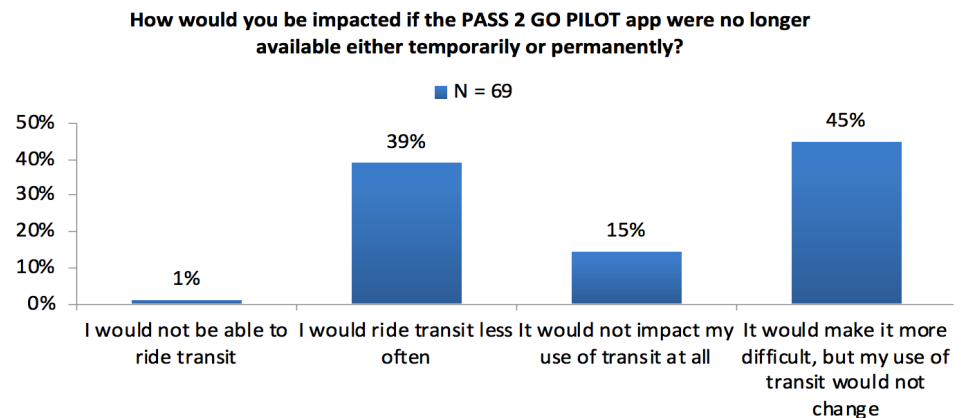
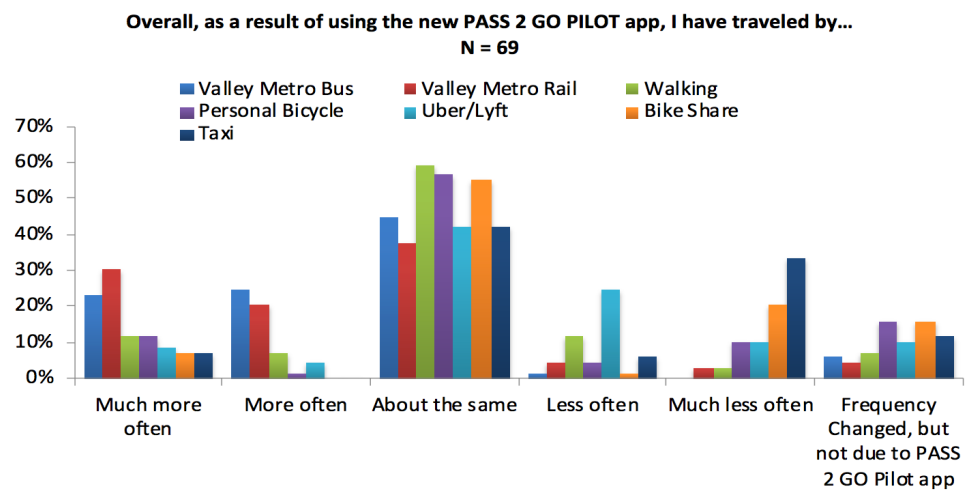


Figure 4-26 shows the reported impact of using the Pass2Go® app on the use of different transportation modes. Results show that a significant share of users indicated the same or a higher frequency of use for bus and rail as a result of the Pass2Go® app. At the same time, 33% (23 of 69) indicated using taxi much less often, and 25% (17 of 69) indicated using Uber/Lyft less often, which aligns with a similar decrease in use of these modes shown previously in Figure 4-8. These insights combined might be due to having access to a convenient trip planning platform, the Pass2Go® app, leading to an increase in use of Valley Metro public transit, which, in turn, can act as a substitution for taxi and Uber/Lyft trips in some cases.

**Figure 4-26**

*Impact of Pass2Go®  
pilot on transportation  
mode use (extended  
tester survey)*



# Conclusions and Recommendations

## Lessons Learned

### Project Planning

Different lessons learned were observed during the early stages of project development. There was no definite timeline on establishing project partnerships; however, it made sense to identify several partners at the beginning and then specify their levels of involvement once all project details were known. One lesson learned was that it would be useful to **develop a strategy with potential partners at the beginning of the project** to see how agreements could be expedited in the future to save time and to establish partnerships that enhance and provide subject matter expertise in the project. Another lesson learned was to **limit the size of the project management team** that can be effective in maintaining response times and gain consensus.

As the project was being developed, interests grew from different stakeholders to reach around 60 people wanting to be involved in the planning process; however, a smaller project management team was formed with a larger advisory group that could still be involved and provide feedback about the project. To guarantee alignment across all cross functional stakeholders from all parties, it was helpful to **conduct frequent meetings and clarify expectations and responsibilities**. As the project's scope evolved through a continuous feedback loop with multiple iterations, it was essential to have a proper communication and feedback system.

Throughout the process, it was beneficial to **identify and exchange mutually-desired outcomes and goals** with a good understanding of who is in charge of advancing individual goals. Also, the project highlighted the importance of **proactively sharing knowledge** nationwide with other agencies and projects to ensure lessons learned were shared and duplication of unproductive efforts and strategies was minimized. This helped in reaching a comprehensive vision of the project, but also a realistic goal of what the pilot could accomplish.

### Technological Development

A lesson learned from the implementation of Phase I and the fare ticket validation mechanism was that **integrating old and new technologies may not be always feasible**. In the case of fare ticket validation, this was resolved by using visual validation and clicker counter on board rail cars. For future projects

of similar magnitude, it would be best to conduct an overall review of legacy technology to ensure it is compatible before moving forward.

### Data Collection and User Engagement

Regarding the evaluation of the project, data should be checked towards the beginning of the project for sufficient quantity, quality, and completeness for the independent evaluation team to be able to conduct its analysis effectively (as opposed to providing the data at the end of the project). The recommendation is to **document the data collection and management approach in the evaluation plan** and to **communicate regularly with the independent evaluator**. It would also be beneficial to conduct frequent initial reviews of the data produced followed by periodic reviews. The project team should ideally conduct an initial cursory review and analysis of the data, and the independent evaluator would conduct a more detailed review and analysis on a periodic basis. Also, it was important to **recruit twice the number of participants needed** to ensure a statistically-viable sampling size and mitigate the risk of a significant participant attrition rate. For example, in Waves 1–4 of the Pass2Go® surveys, 49% who passed the pre-recruit screening ultimately completed the registration process and committed to participating, but only half of those (50%) who committed continued on to meet all requirements. This resulted in the need to qualify four times the number of participants (24% who qualify to participate ultimately meet all study requirements), as this is typical for this type of engagement.

Another lesson learned was that there was a need to **identify participants who are willing to engage in sustained participation** in the pilot program. This level of sustained involvement in research can be challenging, given the many other demands that people have on their time and attention. Often, research implemented over time requires incentivization to encourage continued participation. Given the challenges in recruitment and maintaining participant engagement, the project team used a professional market research firm to identify participants and gather data. As shown by the extensive attrition experienced with participant recruitment, the market firm proved to be a critical asset to the project attaining the level of research participation presented in the data.

### Technical Expertise

As pilot projects are by their nature attempting to take on new and non-routine innovations, transit agencies can often lack onsite staff or consultant expertise in app development. Having this experience on-hand is necessary to troubleshoot technical issues that can arise. When possible, it would be advisable to **engage expertise either through hired internal staff (if project size warrants it) or third party support to assist in pilot projects**. Having technical support close at hand can better facilitate overcoming the challenges that will inevitably



arise with experimental projects where everyone is learning through first-time implementation.

## Challenges and Next Steps

### App Development

From an app development perspective, the most challenging aspect was providing a single payment solution and integrating it with project partners' APIs. One way this can be addressed in the future is through **research and discussion of integration points to ensure compatibility with project partner systems**. Another important point was to **develop safety and security features** which should also be ensured for compatibility with project partners. In this case, the vendor was unable to meet the project objective, and thus, this portion of the project was removed. Another aspect removed from the project due to its complexity was the integration of paratransit service. In addition, integrating reduced fare pass types into the app was challenging since a reduced fare database was not in place. Thus, the ability to purchase reduced fare passes was not part of the pilot project as there was no method in place to validate eligibility. The project was limited to the purchase of full fare, all-day passes only, which provided a relatively reliable use case and continuity of feedback. Regarding the integration of ride sourcing services in Phase II, much discussion and negotiation took place, but it was concluded that this integration was not a viable option due to a number of technical and institutional barriers.

### Stakeholder Training

From an operational perspective, a key challenge was maintaining internal and external communication with project partners in addition to conducting necessary training for different operators to understand how the ride pass worked. This was addressed in Phase I by ensuring a six-week period of training from the time of app acceptance.

### Project Evolution

Some project goals were refined to meet scope and time requirements, especially to satisfy grant requirements with operational needs. Previously, it was necessary to provide a consistent trip-planning experience using both the application and a redesigned website. However, these two aspects were separated, and the project continued to include only the app version, which was sufficient to produce lessons learned.

Another challenge was that the financial portal was behind schedule—it was not delivered in time to allow for adequate testing before the launch, and thus, the go-live date was moved to ensure adequate testing time. A professional testing firm, DeQue, was engaged to test the accessibility features for both Android

and iOS, and some changes were made to address issues and ensure compliance, including the following:

- Contrast for those with moderately low vision
- Ability of the app to be operated through a keyboard or keyboard interface
- Focus visibility – knowing which element has the keyboard focus
- Ensure that when users navigate sequentially through content, they encounter information in an order that is consistent with the meaning of the content and can be operated from the keyboard.

To better communicate bugs and issues to the developer and track resolutions, a platform was developed to track issues and their resolution status, which could be updated by both the developer and the technical team.

In the Phoenix metropolitan region, the City of Phoenix manages the fare collection system, Phoenix IT staff support it, and revenue is distributed to metro partners. The City of Phoenix has procured a new fare collection system with VIX and Unwire which includes a white-label, semi-custom mobile app and thus, Pass2Go® was closed down at the end of 2019. Valley Metro prefers to have a single app that incorporates a suite of modal and transportation demand management options, such as shared mobility, vanpooling, carpool matching, transit information (including trip planning, ticketing, and fare payment), and telecommuting information. Additionally, discounted fares for seniors, youths, and people with disabilities can be purchased on-board the bus, at vending machines, and at sales outlets. People were not able to purchase discounted fares in the Pass2Go® app.

In the future, Valley Metro hopes to incorporate these additional fare options with some type of validation to reduce misuse of fare discounts. One option Valley Metro is considering is some type of smart card identification tied to a user's profile, thereby enabling its use as an instrument for correct fare estimation. In doing so, a person's profile and smartcard could also be linked with his/her smartphone app, extending the verification to digital fare payment as well.

## Conclusions

Valley Metro faces many first/last-mile challenges typical for a transit system in addition to the challenge of keeping up with continuously developing information technologies. Previously, the transit agency developed its Ridekick™ mobile application that provides trip planning features for light rail and bus service. The envisioned Valley Metro Sandbox project was built on the existing functionality of Ridekick™ to provide an accessible platform with additional planning features, real-time transit information, and an app-based payment system for public and private transportation options. The project also aimed to improve connectivity to public transportation by integrating ridesourcing services into the mobile app

environment. This goal included an effort for a partnership with Lyft, but that partnership could not be completed due to contractual and technical limitations.

The project met most of its stated goals and delivered an accessible trip planning platform with enhanced features to its users within the test environment. The study was set up for evaluation in four three-month waves. Participants were required to complete a pre-study survey, use the app at least four times per month for three months, and complete a post-study survey. The first three waves informed the key analysis to date, and results from the analysis are presented in this report and the evaluation report developed by the independent evaluator. Overall, data collected showed that participants were generally representative of the population in terms of income and education. The sample was balanced towards men (58%) while overrepresenting Whites and African Americans and underrepresenting Hispanic/Latinos relative to the population. From an activity perspective, participants reported relatively low car ownership levels (70% owning one car or less) and having a transportation use profile balanced towards public transit. The analysis showed that the Pass2Go® app was an enhancement and improvement over the existing Ridekick™ app.

Ultimately, the Pass2Go® app reduced trip planning and wait times, provided real-time information for public transit vehicle activity, and improved the accessibility for travelers with disabilities. It demonstrated the capabilities of a trip planning app to shift traveler behavior, streamline the payment process, and improve the traveler experience. Valley Metro will share the lessons learned from this experience as it enters into a new phase of mobile platform engagement with its rider population.

The new platform is expected to present users with a single, multimodal mobile application that consolidates functionality currently distributed among multiple applications and allows them to customize the user experience to their particular desires and transit needs. The app will provide riders with enhanced trip planning including real-time information for public transit and TNC integration, online payment and mobile ticketing, improved accessibility for travelers with disabilities including proof of service eligibility or reduced fare and paratransit trip scheduling, carpool and vanpool matching, security or safety incident reporting, and instant access to customer service.

## ACRONYMS AND ABBREVIATIONS

ADA	Americans with Disabilities Act
API	Application Programming Interface
FTA	Federal Transit Administration
GTFS	General Transit Feed Specification
IT	Information Technology
MAG	Maricopa Association of Governments
MOD	Mobility on Demand
TNC	Transportation Network Company
USDOT	United States Department of Transportation

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