MARKET RESEARCH ON REAL TIME TRANSIT INFORMATION NEEDS AND USERS’ EXPECTATIONS

Prepared for Arlington County, Virginia

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MARKET RESEARCH ON REAL-TIME TRANSIT INFORMATION NEEDS AND USERS’ EXPECTATIONS

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The project team at Mobility Lab consisted of Lois DeMeester, Paul Mackie, Dr. Lama Bou-Mjahed, Tasha Arreza, and Jenna Fortunati. Special thanks go to our present and past interns Dr. Sahar Esfandyari, Ana Little-Sana, and Natalie Covill.

The project team at WBA Research consisted of Steve Markenson, Heather Hounkanrin, and Michelle Card.

Find out more about this report at MobilityLab.org.

Project Contact: Paul Mackie, Director of Research and Communications, Mobility Lab, Paul.Mackie@MobilityLab.org
EXECUTIVE SUMMARY

This report explores the level of satisfaction of Arlington travelers with current real-time transit information (RTTI) and their expectations in terms of content, mode and frequency of real-time transit information delivery. This report is the result of the collaboration between the Mobility Lab Research Team, operated by DS&MG and a division of the Arlington County Commuter Services Bureau (ACCS), and the Arlington County Transit Bureau within the county’s Department of Environmental Services.

RTTI, or the information available to riders about the current status of transit through signage or technology, is an increasingly central factor in a transit system’s level of customer satisfaction (Schweiger, 2003; Dziekan and Kottenhoff, 2007) and ridership (Tang and Thakuriah, 2012). RTTI has grown in importance as technology continues to improve and transit riders and would-be riders expect more advanced and efficient methods of accessing and monitoring customized travel information.

In fact, a closer look at the literature pertaining to this topic reveals much interest from researchers in examining real-time transit information. Results indicate that RTTI, among other things, improves the perception of reliability and adaptation to unreliability (Carrel, Halvorsen, and Walker, 2013), changes perceived wait times (Watkins et al. 2011), and increases perception of personal security (Brakewood et al., 2015). Researchers have also suggested that the impact of RTTI on travelers differ according to users’ socio-economic demographics; for example, women and younger riders may benefit more from the availability of RTTI, and income level and age may influence the types of RTTI desired (Rahman et al., 2013; Harmony & Gayak, 2017). Thus, the study of RTTI in a geographical context, in this instance Arlington, VA, is all the more critical.

Limited research has been done on capturing the wants and needs of Arlington users in a setting of abundance of information supply through a multitude of channels. This limitation provided impetus for the work in this report, which aims at answering the following main questions:

(1) What real-time information delivery methods are riders aware of? And which ones do they use? Which methods are they satisfied with and find valuable? Are there winners and losers?

(2) What are some of the visible impacts of real-time information in Arlington? How does it affect perceptions such as reliability and wait time? How can it make public transportation a more attractive alternative?

(3) What are the main barriers to riders using the real-time information provided by Arlington County? What are some of the suggestions to remove those barriers?
(4) Where do riders and potential riders prefer to get their information? And what are the features that riders and potential riders value most in real-time information? Do they want multimodal information?

To answer these research questions, a mixed method approach was used. Qualitative and quantitative inputs were solicited from fourteen focus groups held between July 11 and July 26, 2018, and 346 online panel respondents in September 2018, all traveling to, from or within Arlington (i.e. either living or working in Arlington). Mobility Lab’s research subcontractor, WBA Research, designed the survey, collected the data and analyzed the results. This was done under the supervision of Mobility Lab and using input from Arlington County. All survey material were approved by Arlington County.

The main results indicate that while some travelers are aware of and use real-time transit information, the most-chosen barrier to using Arlington County’s real-time transit information technology in the online survey is awareness. Comparatively, in the focus groups, phone-call technologies have received the least positive feedback and dynamic message boards the most positive feedback from focus group participants. From the online survey, all technologies had a high percentage of respondents who were satisfied and found them valuable.

More generally, riders prefer information before they start their trip and through one-stop-shop apps. They want information on cost, time and convenience. They value the ease of getting the information (e.g. not going through too many options to get information) and its accuracy.

An exploration of the results also shows that travelers find real-time transit information valuable and they often use it before they make a trip. It affects their wait time, helps them relax, and impacts their mode choice. Overall, not much difference arose between segments with different socio-economic demographics.

Some of these conclusions can be summarized through a set of recommendations given to Arlington County and outlined below.

**Recommendation 1: Focus on time, cost and convenience.** Unsurprisingly, focus-group respondents made it clear that they seek out information on the factors that play into how they make mode choices. These include cost, time, and convenience (for example, distance to the nearest bus stop). From the general focus group findings, time was most important, followed by cost and then convenience, but this was not supported by quantitative evidence.

**Recommendation 2: Give solutions.** Several focus-group participants mentioned that they would like the information to provide solutions or suggestions when delays occur. It is not enough just to know their bus has broken down; they would like to be given alternate routes. An action item the county could consider is providing recommendations with communications about major events, delays, and alternatives.
Recommendation 3: **Prioritize providing information before the start of a trip.** A recurring theme across the survey(s) regarding all technologies located at the physical stop or station is that this information is provided too late in the travel process. By the time a rider has access to that information, they’ve already committed to taking that mode of transportation, and are essentially “stuck.”

**Recommendation 4: Provide forward-looking information.** The desire to use real-time information to plan trips creates the need to see not just the next-arriving bus or train, but the following two after that. This would allow a rider to choose which train or bus is most convenient for them based on their plans. For instance, are they running late? Do they have to stop to make errands? Will they be drinking later? This finding is a direct result from comments made by focus-group participants in response to the existing technologies available (BusFinder, Redmon Screen, and TransitScreen).

**Recommendation 5: Prioritize the accuracy of real-time information.** Discussions held during the focus groups uncovered the following: First, misinformation leads people to make poor travel decisions, which creates frustration with public transportation. Second, unreliable information causes some travelers to leave a significant buffer when they travel and others to avoid taking public transportation at all. Third, inaccurate information causes people to stop seeking out real-time information.

**Recommendation 6: Cater to digital riders.** All ages were found in the focus groups to do everything on their phone. Moreover, ART riders appeared to be more technologically inclined than others surveyed. Also, people turn to mobile phone applications first and foremost to look for the real-time information they need.

**Recommendation 7: Re-evaluate phone-call technology – go straight to the information.** Feedback often pertained to the Arlington call center service taking too long, or being “outdated,” “cumbersome,” and “a hassle.” If ever, this is mostly used as a “last resort.” One of the most frequent reactions to this service is that it takes too long to get the information. A few participants explained that by the time they get through to a person or reach the correct option on the menu, the bus may have already arrived. **Is a bar code scan at the bus stop a possible alternative?** Based on the data, we would say that bypassing to operator might be an attractive option, but it was not specifically addressed/presented.

**Recommendation 8: Implement highly customizable or on-demand text message updates.** Text messaging was an appreciated technology but users were worried it might result in too many unwanted and unnecessary text messages.

**Recommendation 9: Modernize BusFinder – add features and instructions.** Some focus-group respondents appreciated the simplicity of BusFinder, but others were unsure of how to use it,
whether it provides real-time information, and wanted it to give information on schedules and routes. Some respondents complained about BusFinder not working.

**Recommendation 10:** Continue providing real-time transit information through the County’s website and LED displays. Ratings for satisfaction and value are high for the County’s website: 80% of respondents who used the County’s website to obtain real-time transit information were either somewhat or completely satisfied, and nearly all of the ART riders surveyed (99%) find this website valuable. Those who had used an LED Display previously appeared to be very satisfied with their experience, with almost nine in ten (87%) indicating that they are mostly or completely satisfied with their experience getting real-time information from these message boards. LED displays are seen as very valuable resources for real-time information, with 96% of the online respondents indicating that it is somewhat or very valuable for Arlington County to provide this at bus stops.

**Recommendation 11:** Diversify the locations of dynamic message boards. The online respondents provided suggestions on the locations of dynamic message boards. Malls and shopping centers (71%), lobbies of commercial buildings (67%), lobbies of apartment buildings (52%), and hospitals (40%) received the most mentions. Less than one in ten respondents (7%) reported that they would not find value in this type of message board at any location.

This study and the recommendations derived from it provide an important roadmap for transit agencies more generally and Arlington Transit more particularly in their planning of real-time transit technology provision. Continued research on the wants and needs of travelers in general and real-time transit information in particular is an important step towards making transit more attractive in Arlington and boosting ridership.
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1 INTRODUCTION

Background
In the age of ubiquitous smartphone usage and rapid advances in real-time technologies and information, transit agencies now have at their disposal an array of tools to make real-time transit information available to riders. Real-time transit information (RTTI), or the information available to riders about the current status of transit through signage or technology, is an increasingly important factor in a transit system’s level of customer satisfaction and ridership. RTTI has become even more critical as technology continues to improve and transit riders and would-be riders expect more advanced and efficient methods of accessing customized and timely travel information.

This gives agencies an important and relatively low-cost solution to tackle limitations in services such as reliability, predictability, and others. However, to do so effectively, transit agencies need to understand how riders perceive different technologies, what they like about available technologies, and what they find to be missing.

Currently, the Arlington County Transit Bureau provides real-time information to its customers through online and phone-based arrival prediction tools for bus and rail services, the BusFinder application at ART bus stops, and LED signs/LCD monitors at several bus stops and rail stations, and is looking to improve and expand these services. However, limited market research exists on the wants and needs that transit riders and potential riders have for real-time information in terms of technology, let alone taking into consideration the geographical and socio-demographic context of Arlington County specifically.

Study Purpose and Objectives
To tackle this limitation, the Mobility Lab research team, operated by DS&MG (a division of Arlington County Commuter Services Bureau (ACCS)), collaborated with the Arlington County Transit Bureau in 2018 to conduct a real-time transportation-information study in Arlington County, Virginia. The main objectives of the study pertain to capturing the following five concepts:

(1) The types of information that customers want and expect
(2) The places that real-time information should be available
(3) The preferred modes of delivery for real-time information
(4) The times when real-time information is most useful and valuable to customers, and
(5) The preferred form and format of real-time information.
Research Approach and Methodology

To do so, the research proceeded in four main steps as schematized in Figure 1 below.

Figure 1 Schematization of the research process.

First, the Mobility Lab research team conceptualized the study and designed the main research approach (Chapter 1). Then, extensive literature and technology reviews (Chapter 2) were undertaken to understand how other researchers have previously examined real-time transit information and to identify the main conclusions of such research. Building on the literature and technology review, a set of qualitative and quantitative data collection methods were developed and analyzed (Chapter 3) by Mobility Lab’s research subcontractor, WBA. This resulted in important conclusions summarized in the concluding chapter of the report (Chapter 4).
2 LITERATURE REVIEW

This chapter summarizes the main studies examining real-time transit information and real-time transit information technologies reviewed by the research team. The first part goes over the literature review and the second over the technology review. All studies are referenced in chapter 5.

Real-time Transit Information Literature Review

Mobility Lab’s extensive review of published research on the provision of real-time information (RTI) on bus, train, and streetcar arrivals, as well as information on service delays, indicates that having RTI produces positive changes in riders’ behavior, improves perceptions of transit service, and slightly, but significantly, grows ridership.

Cost and technological challenges to implementing the types of RTI systems that transit users most desire and which would produce the greatest effects on making public transit more competitive with driving remain. Still, public-transportation agencies from Auckland, New Zealand, to Tampa, Fla., New York, and Seattle have deployed RTI systems that riders find helpful.

Studies have consistently found that providing detailed, route-specific RTI works to increase transit users’ control of trip-making decisions, shorten perceived wait times, reduce total travel time from origin to destination, and increase transit use by offering alternatives in travel choice (make a trip or not) and mode choice.

Research also indicates that public transportation agencies are likely to get the best results from developing RTI systems that employ GPS tracking of vehicles and offer users information via mobile devices, preferably smartphone apps.

Introduction

Public transit plays a vital role in urban transportation systems, and increasing transit use has been deemed of paramount importance for operating a sustainable transportation system (Nesheli, Ceder, & Estines, 2016). Transit reduces congestion, gasoline consumption, and the nation’s carbon footprint (Watkins, Ferris, Borning, Rutherford, & Layton, 2011). It is also one of the safest modes of travel, as evidenced by low passenger-fatality rates. Other benefits of transit include providing personal mobility options for those who cannot or choose not to drive but still need to get to jobs, school, and medical services. Last, public transit use promotes active lifestyles, encouraging positive public-health impacts (Brakewood, Barbeau, & Watkins, 2014).

Despite all this, public transit struggles to compete with other modes of passenger transportation, especially single-occupancy motor vehicles, in many American cities (Nesheli &
Maximizing the social and environmental benefits of public transit requires improving potential riders’ perceptions and current riders’ satisfaction. To achieve both results, service must be fast, frequent, comfortable, and reliable (Brakewood et al., 2014; Watkins et al., 2011).

A public-transportation system has two major phases: planning and operation. The planning phase aims at designing routes, timetables, synchronized transfers, and timed transfers that improve planned transfers on the basis of a priori data (Ceder, 2007). The operations phase aims at improving service reliability using real-time data. Therefore, the question arises as to whether remedies to service-reliability problems exist and, if so, whether the remedies are comprehensive and implementable (Nesheli & Ceder, 2015).

Unreliable public-transportation services have been found to be one of the main reasons for the considerable reduction in public-transportation service attractiveness (Nesheli et al., 2016). This makes improving reliability one of the most important tasks in public-transit planning and operations. Overall, the goal must be developing an integrated public-transportation system that offers extensive and integrated routes, easy and synchronized transfers, and door-to-door access. Doing all this has been identified as key to retaining existing users and attracting new passengers (Ceder, 2007). Additionally, the U.S. Department of Transportation has provided an ITS Transit Typology that specifies improvements to customer safety and security, as well as calling for convenience factors such as traveler information, automated fare payment, and transportation demand management (USDOT, 2010; Tang & Thakuriah, 2012).

Steps toward creating such a public-transportation system can include elevating light-rail rights of way and reserving dedicated bus and streetcar lanes. Effective supply-side approaches to improving reliability and increasing simultaneous arrival at transfer points include adding slack to scheduled running times, skipping stops, authorizing short turns, and holding vehicles that are ahead of schedule. Each of these come at substantial costs, however (Brakewood et al., 2014).

A less-expensive way to improve the perception of reliability is providing real-time vehicle location and/or arrival information. One way this works is by helping passengers adapt to the inherent unreliability of transit service (Carrel, Halvorsen, & Walker, 2013). For instance, knowing when a bus, train, or streetcar will arrive can help commuters reduce their total travel time from origin to destination by letting them arrive at a stop or station closer to when the vehicle will show up, regardless of whether the vehicle is running ahead or behind schedule.

The dissemination of timely, constantly updated, and accurate transit-schedule information also benefits a public-transportation agency. Such information facilitates the resolution of service disturbances.
Because public-transit travel use is affected by factors ranging from macroeconomic conditions to the weather, previous studies have had difficulty isolating changes in transit ridership due to the availability of RTI (Brakewood, Macfarlane, & Watkins, 2015). Given the rapid increase in the availability of transit apps, quantifying the impact of RTI on actual travel behavior is essential for transit operators who wish to make responsible decisions regarding the implementation and future expansion of such systems. Also, as intelligent transportation systems (ITS) become common, particularly for the purposes of providing RTI, it remains difficult to predict and quantify overall transportation system and user benefits of implementing new technology (Fries, Dunning, & Chowdhury, 2011).

Following is a review of the existing literature on RTI and ITS implementation.
Reducing transit-time unpredictability with real-time information

Currently, most public-transportation systems provide bus, train, and streetcar timetables on the web and on boards at bus stops and rail stations. Even when smartphone apps make this information searchable, the details are usually limited and rarely updated (Xu & Ying, 2017). Lack of information is one of the main reasons people dislike using public transit. Giving users real-time information, or RTI, can help them feel more in control of their trips, safer, and less inconvenienced by waiting.

The relative unpredictability of bus service makes it less attractive (Rahman et al., 2013). One reason is that, as Vincent and Hamilton (2008) showed, transit passengers perceive unexpected waiting time to be 3–5 times as burdensome as in-vehicle time. The lack of accurate information on bus arrival times can result in longer waiting times for passengers or increase the chance of missing the desired bus. Although schedule adherence can be improved by optimizing operational control, transit operations are inevitably disrupted by various stochastic and uncontrollable factors such as traffic conditions, dwell times at stops, weather conditions, and driver behavior. Thus, developing a model timetable that adapts to time-varying traffic and demand conditions while ensuring passengers do not miss their buses is challenging (Xu & Ying, 2017).

Similarly, the operations of a railway system are unavoidably subject to unexpected disturbances and disruptions that result in infeasibilities in the timetable and, possibly, resource duties. Passengers experience these disturbances and disruptions as travel delays, broken connections, insufficient seating capacity, and canceled trains. When commuter trains share tracks with freight trains, business disruptions also occur. Thus, there is a need to recover from a disturbed or disrupted situation, and to restore the normal railway services as quickly as possible (Cacchiani et al., 2014).

Just as advances in mobile-device technology enabled public-transit users to spend their travel time productively (Brakewood et al., 2014), smartphones, tablets, and smart watches are transforming wait times (Nesheli & Ceder, 2015). When public-transportation agencies take an open data approach, they can share RTI with passengers’ devices in a cost-effective manner. Archived and real-time transit data can be utilized to provide updated information to riders.

Here, “taking an open-data approach” means that the transit authority makes its service information freely available to the general public in a computer-readable format. This information can be used by third-party software developers to create transit apps, often at little or no additional cost to an agency. The rapid adoption of mobile devices makes this third-party information dissemination channel directly accessible to an increasing number of riders (Schweiger, 2011).
Research shows that predicted transit-vehicle arrival time can be provided with relatively high accuracy (Khan, 2012). Such information can be disseminated through different media, including electronic display boards at bus stops and rail stations (i.e., countdown timers), on websites, through a call center, and via apps, texts, and Twitter. Mobile RTI changes the actual wait time of transit riders by allowing them to arrive at a stop when a bus is actually approaching rather than leaving for the stop according to the timetable. It also saves a public-transportation agency money by eliminating the need to install displays at stops and stations (Watkins et al., 2011).

Providing RTI is often associated with high installation and operational costs, as these systems rely heavily on the use of Global Positioning System hardware and software, upgraded computer networks, and real-time communication systems. Given the large investments required, it is necessary to understand likely outcomes.

While the perceived and measured benefits of operating an RTI system for public transit vary from place to place (Rahman, Wirasinghe, & Kattan, 2013), RTI for public transit is becoming more prevalent worldwide and all the ways in which public-transit agencies deliver travel information to the public are undergoing great improvements. Systems in cities such as London and New York have improved perceptions of public-transit attractiveness and satisfaction (Schweiger, 2003). The main benefits of RTI for passengers include a reduction in the displeasure of waiting for public transit, alteration in departure times to reduce actual wait times, and changes in modes to minimize travel time (Smith & Gay, 2005).

The positive effects of RTI displays and alerts are largely psychological in nature. Because passengers perceive the time that they spend waiting as more onerous than either in-vehicle travel time or access time, reducing the perception of wait times increases the attractiveness of public transit (Chow, Block-Schachter, & Hickey, 2014). Knowing when the next train or bus will arrive or depart can greatly reduce anxiety, foster trust in the whole public-transportation system, and improve the system’s image (Dziekan & Vermeulen, 2006).

In particular, long waits at bus stops can make people reluctant to take buses. On the other hand, providing accurate information on when the next bus will arrive allows potential passengers to make alternate transportation choices when delays occur. Empowerment improves their satisfaction.

Providing at-stop bus-arrival-time information has also been shown to increase feelings of safety and reduce uncertainty and anxiety (Dziekan and Vermeulen, 2006; Schweiger, 2003). If wait time can be accurately quantified, it can be better utilized, potentially for other activities such as last-minute shopping. It can also lead to adjustments in behavior, with travelers making decisions that lead to more efficient travel regarding the route, the mode, and the end destination. Last,
users may not board a crowded vehicle if the RTI they receive indicates that another will be arriving shortly.

Deploying RTI as a component of an intelligent transportation system

RTI plays an important role in several intelligent transportation systems (ITS), including advanced traffic management systems (ATMS), advanced traveler information systems (ATIS), commercial vehicle operation and emergency-management systems. Having the information can assist and support travelers with trip-planning details such as route choice and departure time, as well as decisions about travel safety. RTI can also support traffic-management administrators in taking actions to alleviate congestion, improve the overall performance of the traffic network, and, consequently, reduce air pollution in urban areas (Bruglieri et al., 2015).

However, with one-way broadcasting from cameras and sensors, most traffic information services lack the capacity to both gather and synthesize RTI in ways that can be communicated to travelers in understandable ways. Another limitation is that producing RTI for an entire traffic network on a continuous basis would require considerable spending, greatly expanded sensor coverage, extremely advanced data processing, and innovative transmission techniques (Lee, Tseng, & Shieh, 2010).

Some of the necessary technologies are coming online, First, in 1991, the use of advanced information and communications technology received a significant boost from Title 6 of the Intermodal Surface Transportation Efficiency Act, which spurred development of intelligent vehicle highway systems (IVHS) (Tang & Thakuriah, 2012). IVHS were subsequently retitled intelligent transportation systems to reflect the multimodal uses of information and communications technology in transportation, including public transit. ITS rely on the timely exchange of traffic information so users and system administrators can make informed decisions and implement appropriate strategies. Wireless communication technologies enable this, as do handheld devices such as smartphones (Zhou, Dey, Chowdhury, & Wang, 2017).

A principal use of RTI is improving traffic conditions by reducing travel delays by enabling better utilization of available capacity (Li, Li, White, & Wu, 2013). Traffic-management centers receive data from roadside devices, process it, and share information about traffic and road conditions with motorists. The optimal result is improved traffic flow with minimum interruption (Zhou et al., 2017). Now, the rapid proliferation of automatic vehicle location (AVL) technology by transportation agencies facilitates tracking vehicle locations, arrival time, connections, and other related pieces of information that can be shared with the public.

Recent advances in data acquisition, storage, and processing allow system administrators to create visual information management tools. Additionally, motion analysis, vehicle tracking, and
machine learning constantly expand capabilities, though, at present, computational complexity still limits accuracy (Fishbain & Mehrubeoglu, 2010).

The basics of real-time information for public transit

At its most basic level, gathering and sharing RTI involves tracking transit-vehicle locations and predicting arrival times at stops and stations based on distance left to travel and mean speed (Gammer, Cherrett, & Gutteridge, 2014). The predictions typically get updated at least once per minute. More advanced RTI systems provide trip makers with various kinds of information, including the estimated arrival and departure times of the next transit vehicles, locations of all transit vehicles along a route, service disruptions or delays, alternative routings, and other service-related information.

The first systems for providing RTI to transit users employed signs at stops and stations to display predicted arrival times (Dziekan & Vermeulen, 2006). More recently, providing RTI to transit riders via web-enabled and mobile devices has become ubiquitous (Schweiger, 2011). Riders currently have a range of options for obtaining bus-arrival information while waiting at bus stops, with a paper timetable being the most traditional method. LCD displays have gained in popularity, giving passengers updated service-arrival times as static timetable information (i.e., scheduled time of arrival) or as RTI feeds that show the time remaining until the bus arrives.

Because of its expected user benefits, such as reduced travel time, reduced uncertainty, increased ease of use, and a greater feeling of security, RTI is considered an important factor in increasing public transit ridership (Tang, Ross, & Han, 2012). A growing body of research aims to measure the impacts that this has on riders’ behavior. Some researchers have utilized simulation modeling techniques. Others have employed stated-preference techniques, posing hypothetical scenarios to survey participants instead of directly observing riders’ behavior (Brakewood et al., 2015; Tang and Thakuriah, 2012).

*Learning what types of RTI transit users want*

Several studies have looked at travelers’ response to RTI. However, the use of AVL only began in the last decade and the provision of actual RTI to riders is an even more recent development. Before many transit agencies even had real-time bus tracking capabilities, Polak and Jones (1993) investigated travelers’ requirements for different types of travel information and methods of inquiry, as well as the relationship between the processes of information acquisition and changes in travel behavior. The study was carried out using a stated-preference approach that involved surveying people on the use of a computer-based simulation of an in-home pre-trip information system that offered information on travel times from respondents’ home to the city center by bus and car. The results suggested that there is considerable scope for the improvement of the
current generation of pre-trip information systems which largely offer only uni-modal information. The findings also recommended that the quantity and type of pre-trip information requested by travelers depended on a range of personal, journey related, contextual and national factors.

Hickman and Wilson (1995) considered public-transit information systems that delivered information on projected vehicle travel times in real time to passengers. The authors developed an analytical framework to evaluate path choices and travel time benefits from receiving RTI. The results suggested that RTI yields only very modest improvements in passenger service measures such as origin-to-destination travel times and variability of trip times.

Kitamura, Reddy, Vaughn, and Jovanis (1995) conducted in-laboratory interviews with 50 subjects who used a PC-based transit-pretrip-information system prototype. The subjects' ratings of the system indicated that age is an important variable for defining market segments for such information systems. Reed (1995) conducted a conjoint analysis of the response to RTI using ratings of hypothetical situations. He found that RTI was expected to reduce the burden of waiting as the degree of certainty increased.

Khattak, Noeimi, and Al-Deek (1996) surveyed technology suppliers about the features, functions, and performance of transit technologies; their testing and deployment in transit agencies; and their potential impacts on travelers and transit operators. The survey dealt with advanced public-transportation systems in general, and information systems specifically. The survey results suggested a trend toward transfer of data in real time through electronic media and increased automation.

Defining travel time

A body of literature has emerged that presents a demand-side strategy to improving the perception of transit-service reliability. While providing RTI helps passengers adapt when service is unreliable, doing so can also help riders feel more in control of their trips, particularly during the time they spend waiting for transit vehicles (Brakewood & Watkins, 2015). As options for delivering RTI to transit passengers in cost-effective ways via web-enabled and mobile devices have flourished, growing numbers of public transportation agencies have started doing so (Schweiger, 2011).

As a concept, travel time can be defined as the total time it takes to move from one distinct spatial position to a second distinct spatial position. This definition is broad enough to apply to any mode of transportation or combinations of modes regardless of inherent differences. It also accommodates the measurement of travel time as a one-dimensional quantity that accounts for the time it takes to move from the point of origin to the final destination, as well as the measurements of components of a trip such as point of origin to station and wait time in station.
Consider, then, that public transit travel time includes waiting time, in-vehicle time, transfer time, and other measurable periods.

Public-transit time is also subject to predictable variations such as traffic congestion that are expected by travelers and to unpredictable variations like track outages. In principle, travelers can make the adjustments needed to minimize predictable variations. An example would be departing earlier to avoid traffic and arriving late at work. Such events and adjustments are of interest to many researchers who focus on traffic flow theory (Carrion & Levinson, 2012). Du and Nicholson (1997) conducted one of the few analyses of uncertainty as a variation in transit flows. They found that unpredictability exists on both the demand side and supply side. Two of the most important sources of unpredictability are traveler behavior and traffic-signal failure.

Travel-time reliability is closely linked to unpredictable variations. This suggests that travelers choose, say, their departure times in an environment of uncertainty because they cannot consistently predict their exact travel times. When only predictable variations exist, travelers are able to adjust their departure time choice and, therefore, be certain of arriving at their destinations on time. This will be true even in a transportation system with high congestion.

Another thing to understand is that because travelers make choices in an uncertain environment, it is a mistake to consider only predictable variations when assessing travel-time reliability (Bates, Polak, Jones, & Cook, 2001). Reflecting this understanding, travel-time reliability is used interchangeably with travel-time variability (or unpredictable variation) in the transportation research literature; high variability means high unreliability, and vice versa.

As a result of all of this, travel time must be viewed as the result of factors that determine frequency of service and magnitude of use and capacity. In other words, public transit-travel time should be conceived of as a distribution in the probability-theory sense. Distinct approaches have been proposed to model travel-time reliability, and they are reviewed in the subsequent section. Moreover, lessons about the predictable and random elements that determine travel time can be drawn from research on other modes of transportation such motor vehicle road use (Carrion & Levinson, 2012).

Perceived and actual wait times

As of 2003, when the Transit Cooperative Research Program synthesis document on real-time bus-arrival information systems was written, only three public-transportation agencies in the United States and five agencies in other countries had measured riders’ reactions to RTI. According to the synthesis, Transport for London’s Countdown program, which used at-stop real-time arrival signage, produced a decrease in perceived wait time from 11.9 minutes to 8.6 minutes. In addition, passengers felt less stress and believed that reliability had improved even
though it had actually declined (Schweiger, 2003). Transit Watch, a program in Seattle that communicated RTI via video monitors, was found to be useful but not to increase overall satisfaction with transit. One major finding was that customers wanted the information via websites and at malls or office buildings close to transit (Mehndiratta et al., 2000).

In order to determine the possible benefit of RTI, Mishalani, McCord, and Wirtz (2006) looked at the difference between perceived and actual wait times at a bus stop. The study was conducted at campus bus-service stops on The Ohio State University campus in Columbus by lurking at bus stops, recording bus arrival times, and asking riders how long they had waited as the bus approached. The researchers found a statistically significant difference between perceived wait time and actual wait time. However, the difference was small, and no effects from providing actual RTI on bus arrivals was tested.

Iseki and Taylor (2009) argued that public-transit users’ perceptions of wait times depends on waiting conditions such as personal safety, connection reliability, and comfort. They also cited studies showing that transit users consider the perceived length of a wait to be more onerous than the actual wait.

Dziekan and Vermeulen (2006) conducted a before-and-after study of tram riders’ perceptions of wait times in The Hague. The information for the second part of the study was collected following installation of real-time arrival information signs at stops. Respondents replied to surveys before the signs went up, 3 months after RTI became available, and 16 months after the installation. The pre-installation survey presented questions on boarding time, tram use, and passenger demographics. Surveys were distributed on station platforms, and respondents were asked to return the survey by mail. Average perceived wait time decreased from 6.22 minutes before RTI to 5.00 minutes at the first follow-up survey and to 4.81 minutes after more than a year of having access to RTI.

Watkins et al. (2011) found that bus riders who used RTI had actual wait times that were almost two minutes less than those of riders who did not use real-time arrival information. Further, the perceived wait times of RTI users were approximately 30% less than those for nonusers. These results suggest that bus passengers utilized RTI to time their departure from their points of origin to a bus stop so they could minimize the time they spent waiting at stops, and also that doing this led RTI users to feel like they spent less time waiting for buses.

Ceder, Chowdhury, Taghipouran, and Olsen (2013) investigated the effects of uncertainty in out-of-vehicle times during transfers on public-transit users’ willingness to use routes that required transfers. Their findings show that increasing consistency in out-of-vehicle times increases the attractiveness of transit trips that include more than one ride, thus enabling the design and operation of a more efficient, integrated network of routes and promoting increased ridership. In separate research, Nesheli et al. (2016) found that the uncertainty over whether transit
vehicles would arrive simultaneously at transfer points could be alleviated by holding vehicles, skipping stops, and doing short turns in order to correct schedule deviations.

*Travel signage*

Research into the effects of RTI on service perception goes back 25 years. In 1993, real-time-of-arrival signs were installed along a Transport for London bus route and operated for six months. Cross-sectional surveys of riders were conducted before and after the signs were put up (Mishalani, Lee, & McCord, 2000).

The intent was to evaluate the usefulness of RTI to waiting customers. Passengers were asked to rate the reliability of service, rate the accuracy of the information, and report their attitudes toward countdown systems and fares. The results showed a 26% reduction in expected wait time after the signs went up. The study also put a value on passengers’ willingness to pay for RTI based on the reduction in perceived wait time. A supplementary survey explored how much people would increase transit fares to have countdown information available. Respondents estimated they would pay $0.31 more, or an increase of up to 20%.

The studies in London and The Hague surveyed passengers in multiple stages and compared the psychological effects of providing RTI. Results from studies aimed at documenting ridership gains from RTI have been inconclusive. Confounding factors such as simultaneous service changes and fare increases have made isolating RTI effects difficult (Chow, Block-Schachter, & Hickey, 2014). Tang and Thakuriah (2012) conducted a study of RTI provision by the Chicago Transit Authority (CTA) that controlled for such factors.

They created a mixed-effects route-level model for ridership using nine years of data. The model accounted for weather, unemployment, socioeconomic status, and transit service attributes. The results showed a modest increase in ridership after the introduction of RTI for bus arrivals. Previously, Tang and Thakuriah (2012) had surveyed 99 CTA users to confirm a correlation between the psychological benefits of RTI and increased ridership.

A web-based study in Seattle looked at the effects of offering RTI to transit users online. Ferris, Watkins, and Borning (2011) asked existing riders whether they changed their trip behavior as a result of receiving RTI on their mobile devices. Most survey respondents indicated that they did not alter their travel behavior, but approximately 20% did increase the number of trips they took on public transit as a result. Trips unrelated to commuting were more likely to increase.

*Key benefits of real-time information*

When Dziekan and Kottenhoff (2007) looked at riders’ reactions to at-stop RTI displays, they found that having the information increased feelings of security, reduced uncertainty, increased ease-of transit use, improved customer satisfaction, and prompted adjustments in travel
behavior. Most importantly for the purposes of this literature review, displaying real-time arrival information at transit stations brought travelers’ perceptions of wait times into line with actual wait times.

Other studies have shown the following:

- Providing RTI helps passengers adapt to the unreliability of transit service (Carrel, Halvorsen, & Walker, 2013).
- RTI increases perception of personal security and increases satisfaction with transit services (Brakewood et al., 2015).
- RTI users can time their departures from points of origin to minimize wait times at stops and stations.
- RTI reduces perceptions of time spent waiting.
- But the effectiveness of RTI is mixed, with outcomes dependent on the socioeconomic characteristics of users, transit-service characteristics, trip characteristics, and network familiarity (i.e., whether travelers are familiar with the routes needed to complete their trips) (Rahman et al., 2013).

While a number of studies support the hypothesis that RTI plays a significant role in attracting transit riders, other studies suggest more conservative estimates of modal shifts resulting from the provision of RTI (Rahman et al., 2013). Hickman and Wilson (1995), for instance, investigated how RTI influenced path choice among transit users. They found that RTI could not improve travel time or system time variability because most riders were not willing to change their travel patterns.

Independent of any increased transit ridership, studies that examined passengers’ perceptions of and attitudes toward the provision of RTI have shown that riders appreciate getting information on when the next bus or train would arrive and the length of any delay. Furthermore, various studies have demonstrated an association between the provision of RTI at stops and stations and reductions in perceived waiting times. An analysis of such studies conducted by Rahman et al., (2013) indicated that passengers overestimated their wait times by 9 to 13% when RTI was given but by 24 to 30% when they did not receive RTI.

Customer satisfaction

In theory, transit passengers who spend less time waiting or who perceive their wait times to be less lengthy will feel more satisfied with overall transit service. Looking at surveys of riders of a University of Maryland shuttle bus, Zhou, Shen, & Clifton (2008) found a significant increase in overall satisfaction after the introduction of RTI. Supporting this finding, a 2009 web-based survey of RTI users in Seattle showed that 92% of respondents were somewhat more or much
more satisfied with overall transit service. A follow-up in 2012 produced similar results (Ferris et al., 2011).

Travel-time reliability is one of the most important factors for determining customer satisfaction among rail passengers. The more unreliable the travel time, the higher so-called scheduling costs become. As scheduling costs increase, travelers grow less likely to choose trains. If daily commuters are confronted with low reliability, they will start choosing different modes of transportation when options are available.

**Increased ridership**

Studies based on comparing actual transit ridership before and after the implementation of RTI provide the strongest support for the hypothesis that providing vehicle-arrival-time information leads to ridership gains (Schweiger, 2003). However, simple pre- and post-implementation comparisons do not account for all the factors that influence transit use. Population, fuel prices, fares, and unemployment rates are just a few of the factors that influence ridership that do not relate to the availability of RTI.

Additionally, work done on socio-technical systems indicates that the complex interplay of technologies, riders, institutions, rules, procedures, and policies for tracking and communicating bus locations governs the extent to which RTI may be effective in leading to increases in ridership (Tang & Thakuriah, 2012). Thus, it would be problematic to conclude that an observed increase in ridership is “a direct result of the [traveler information] system” based on this type of study (Schweiger, 2003, p. 3).

Pointing to a reason that providing RTI might contribute to increased transit patronage, Tang and Thakuriah (2011) employed cognitive models of behavior to reach the conclusion that the psychological effects of RTI will eventually lead to gains. Taylor and Fink (2003) reviewed previous research on factors that contribute to increases in transit ridership. They described internal factors as the ones that transit-system managers can control to some extent, such as fares, service coverage and frequency, and service quality (e.g., onboard safety, provision of traveler information). External factors are beyond the control of the transit system and include socioeconomic factors such as employment, income, car ownership, and fuel prices; spatial factors such as the availability and price of parking, service-area population density, and employment density; and public financing. Weather conditions, which Taylor and Fink do not discuss, have also been found to affect transit ridership (Tang, Ross, & Han, 2012).

If RTI users can adapt to unreliable service more easily, spend less time waiting, feel safer, and experience more satisfaction with overall service, it follows that they will take more trips, either by choosing transit over alternative modes of transportation or taking trips that they would not
have otherwise. Not every study of whether providing RTI increases transit ridership has produced positive results, however.

A panel study conducted on the University of Maryland campus measured changes in use of university shuttle buses after the implementation of an RTI system (Zhang, Shen, & Clifton, 2008). Using a fixed effect ordered probit model to sort out the causal relations between ShuttleTrac system information of individual travelers’ monthly shuttle trips, researchers concluded that having access to RTI did not significantly affect trip frequency. A proposed explanation was that the post-implementation data was collected just two weeks after the new RTI system was marketed to potential riders, and this may have allowed insufficient time for riders to change their travel behavior. Another possibility was that the population under study was an academic community with potentially inelastic travel behavior. Class and activity schedules may be relatively fixed and, therefore, not substantially affected by gaining access to new information.

A behavioral experiment conducted in Tampa, Fla., randomly divided participants into an RTI user group and a control group without RTI (Brakewood et al., 2014). Both groups were asked to complete a survey on travel behavior before the study began and a second survey after three months. Both surveys asked participants to self-report the number of bus trips they had taken in the past week. Responses indicated neither group of study participants significantly changed how often they took buses. The researchers did note, however, that many study participants were dependent on public transit and, thus, had limited ability to increase the number of bus trips they took. Further, the study participants were recruited from among people who were already in the sphere of influence of the transit provider. This meant researchers had no opportunity to accurately assess the potential of RTI to attract new riders.

Two studies that did show that use of mobile RTI can increase transit trips were conducted in Seattle. In 2009, a web-based survey of more than 400 RTI users asked respondents if their average number of transit trips per week changed as a result of RTI (Ferris et al., 2011). Approximately 31% of users reported increases in non-commute trips, and a smaller percentage reported increases in commute trips on transit. A follow-up web-based survey of RTI users in 2012 found similar results (Gooze, Watkins, & Borning, 2013). Two significant limitations in each study were the fact that transit-trip numbers were self-reported and that no members of a control group of people who did not use RTI was surveyed.

An empirical evaluation of the real-time bus-tracking system in Chicago provides the results that readers of this literature review may find most relevant. Tang and Thakuriah (2012) modeled average weekday route-level bus ridership for each month from 2002 until 2010, during which time Chicago’s real-time vehicle tracking system called Bus Tracker was incrementally rolled out between August 2006 and May 2009. Controlling for unemployment levels, weather, gas prices, population, and transit service attributes such as fares and frequency of service, they found a
significant but “modest” increase of 126 average weekday trips per route attributable to RTI, which was an increase of approximately 1.8–2.2%.

Tang, Ross, and Han (2012) followed up the Bus Tracker study in Chicago by looking at the impacts of bus RTI on rail ridership. They found a small (0.3%) increase in average station-level train ridership could be attributable to bus RTI. The researchers argued that this increase in rail ridership may have been due to increased intermodal transfer efficiency between buses and trains, which suggests a complementary effect of the provision of bus RTI on connected rail service.

Mode share

Factors that influence travelers to change their choice of transportation from personal vehicles to public transit have also been studied frequently. Throughout the world, programs have begun to encourage car drivers to explore new modes of transportation such as transit, walking, or biking. These encouragements typically increase awareness of travel alternatives through marketing and are generally described as travel-feedback programs. These programs have encouraged reductions in car use between 7 and 19 percent in different countries such as Australia, European Union, and Japan.

Research findings suggest that while prompting changes in travel behavior is difficult, particularly among travelers who habitually use automobiles, a travel-feedback program has the most potential to encourage less personal car use when compared to other methods. A finding worth highlighting here is that offering RTI as part of a traveler-feedback program plays a role in discouraging personal vehicle use and encouraging transit ridership (Fries et al., 2011).

Real-time information supply and demand

Harmony and Gayak (2017) claim that key stakeholders influence what type of RTI is desired by transit users and what type of RTI is actually provided to them. To reach this conclusion about information supply and demand, the researchers conducted two surveys. Transit passengers completed one and the other went to public-transportation agencies. The survey questions were written to gain better understandings of experiences with and preferences for RTI.

Survey responses showed that young people and people from low-income groups (< $25,000/year) were more dependent on public transit and less likely to have access to a car. Further, when low-income people used transit, they were more likely to ride buses.

More than half of all transit users indicated they would not be willing to pay for RTI. Also, respondents from all income groups expressed a preference for receiving RTI on their smartphones. The internet/websites and direct messages followed as the second and third preferred methods for receiving RTI. The least preferred method was phone calls. Interestingly,
bus riders and train passengers differed in the degree to which they wanted smartphone access to RTI. Train riders were more likely to opt for internet/website information.

The most significant differences revealed themselves in terms of what types of information groups of transit riders preferred to see. Bus riders expressed a greater preference for receiving seat availability information while train passengers wanted information about the operational status of elevators and escalators. It makes sense that bus riders prefer seating information more than train riders because buses generally allocate more space to seating and buses tend to be more uncomfortable for standing than trains. Further, crowding seems to be more prevalent on buses than on trains. Last, train stations are much more likely to have elevators and escalators than are bus stops.

Fifty-eight public-transportation agencies from across the United States provided responses to Harmony and Gayah’s survey, and 24 completed the entire survey. The agencies varied in size and the types of services they offered. Approximately 69 percent offered some form of RTI, with agency size, geographic location, and types of services provided influencing whether RTI was provided. While all responding moderate and large agencies stated they provided real-time information, only 44 percent of small agencies said the same. In addition to this, a trend between geographic areas and the provision of real-time information was identified: regions that were more urban were more likely to offer real-time information.

The information most often provided by transit agencies was vehicle location, route disruption, and emergency alerts. Few agencies provided information on seat availability, the type of transit vehicle being used, and parking availability.

In terms of how agencies provided RTI, websites ranked first as the most common method, followed by smartphone apps and direct methods. Agency characteristics and the types of information shared were correlated with different methods for sharing RTI. Funding and staff resources were most frequently cited as factors that limited the provision of RTI. The following ranking indicates factors influencing the development of RTI in the participated agencies:

1. Cost of system
2. Customer demand
3. Technological availability
4. Service reliability (tied with Service frequency)
5. Differently-abled user (people in different ages and abilities) requirements
6. Other factors
Collecting data for real-time information systems

Travelers, fleet managers, and ATMS administrators who use and operate intelligent transportation systems depend on RTI. However, the availability of data for RTI systems suffers from cost, coverage, and temporal issues that can only be partially overcome using existing technologies and data collection techniques. Finding compromise solutions must be a consideration for any public transportation agency looking to implement RTI. Available options are described in the sections that follow.

Automatic vehicle identification

Traditionally, there are three schemes for collecting RTI: site-based, sensor-based, and probe vehicle-based. Site-based data collection involves scanning or visually reading license plates when vehicles arrive at designated checkpoints and computing the time it takes to travel from checkpoint to checkpoint.

Sensor-based schemes rely to a greater extent on automatic vehicle identification (AVI) technology. Raw data for RTI gets collected when vehicles pass over or through stationary sensors like loop detectors, transponders, or radio beacons installed along arterial roads. Probe vehicles communicate their locations directly, and timing their arrival involves using the location data in conjunction with information from a geographical information system.

Each data-collection scheme has drawbacks and limitations. For example, site-based and sensor-based methods have the spatial coverage problem due to the fixed and limited number of sensors or AVL devices. Vehicle-based schemes incur significant costs while also presenting spatial and temporal coverage problems due to the difficulty of maintaining a dedicated fleet of probe vehicles that get heavy use in an urban environment. Moreover, the cost of real-time data transmission under each scheme is quite high (Lee, Tseng, & Shieh, 2010).

Bluetooth

Bluetooth sensor systems have many applications in ITS. These include measuring and comparing traffic presence, density, and flow over time. A basic Bluetooth sensor system for traffic monitoring consists of a Bluetooth probe device that scans for other Bluetooth-enabled devices within range of its radio signal and stores the data it receives for future analysis and use. The devices found are typically onboard electronics and devices carried by the driver and passengers, which serve as reasonable proxies for the vehicle itself. It is also possible to record drivers’ cellphone trajectories and to overlay those trajectories on a map to produce a rough estimate of vehicle travel time and traffic flow (Friesen & McLeod, 2015).

The earliest reference to employing Bluetooth technology to collect data for traffic monitoring and ITS management appears to be Contain (2008), where the author wrote, “One could easily
imagine a battery-powered, Bluetooth enabled, smart cell phone in a plastic case chained to the side of the road to collect much more substantive travel time estimates over 24 hours or 7 days to much more precisely characterize operational characteristics of either a signalized corridor or a construction work zone. Those data might be logged for later download.” Four years before this, Sawant, Tan, Yang, & Wang (2004) noted only that Bluetooth could improve communications between vehicles.

The first studies of Bluetooth as a component of ITS typically focused on gathering data for vehicle travel time estimates that factored in delays due to roadway obstructions and for estimates of total travel time from origin to destination on urban arterials and freeways. Potential applications to network analysis (shortest path), congestion reporting, bicycle and pedestrian travel times, and before-and-after studies were also proposed. Other research assessed the quality of data collected by Bluetooth-enabled mobile devices for travel time forecasting and for generating estimates of time-dependent origin–destination matrices within an ATIS that supplied information to drivers (Friesen & McLeod, 2015).

**Wi-fi**

Transportation agencies and professionals have explored different wireless technologies to support diverse ITS applications. A Federal Highway Administration (FHWA) survey identified wi-fi, worldwide interoperability for microwave access (WiMAX), cellular, and satellite as the potential wireless technologies for ITS applications. The Virginia Department of Transportation evaluated the performance and capability of wi-fi and WiMAX for statewide transportation operations.

Media access control (MAC) addresses of wi-fi and Bluetooth devices have also been used extensively in origin–destination survey and travel-time estimation studies. Using MAC address readers to estimate travel time was found to be more reliable than a traditional floating car-based method. However, factors such as communication range, achievable throughput, operating environment, and line of sight (LOS) between devices can degrade communications and, thereby, system performance. There are also concerns related to the functional ability and reliability of using wireless technologies in adverse weather conditions and terrain with foliage that obstructs LOS (Zhou et al., 2017).

**Mobile phones**

Mobile phones are primarily used to obtain transit-vehicle travel information by tracking cellular signals to estimate average speed or time spent on road segments and by using GPS to determine the precise location of a phone. These methods of data collection yield different types of information that can be used for different purposes.
Tracking cell signals involves employing proprietary algorithms to determine road-segment speeds based on calculations of where and when signal handoffs from one cell tower to another occur. Mobile phone users’ permission is not required to use the signal data, although privacy advocates are pushing for more control over telecommunications records.

Travel time and estimated travel speed on a specific road segment are the only items of information available from cell tracking. That information may be sufficient for managing traffic operations, but more-robust RTI systems will also account for travel path, individual travel behavior, and origin and destination (Barbeau, et al., 2009).

Evaluations by various state transportation departments have revealed varying accuracy among cell-tracking systems offered by different companies (Wunnava, et al. 2007). The general conclusion has been that the systems work well at free-flow speeds but become less accurate when traffic moves at lower speeds. This may happen because fewer cell-tower handoffs occur when phones do not cover significant distances.

Using GPS-enabled mobile phones, as the TRAC-IT system does, overcomes that problem by permitting the continuous collection data on a phone’s position, speed, and waiting time on stations. GPS fixes can be collected with a frequency of up to once per second, and it they are highly accurate. The location of a phone can be pinpointed to within 3 meters of its actual location, and the speed at which a phone is traveling can be calculated with an accuracy of 0.2 meters/second (Witte & Wilson, 2004).

RTI systems that rely on GPS-enabled cell phones generate a wealth of information on individuals’ travel behavior, yielding origin-destination and travel-path information for each person aboard a given transit vehicle. In earlier times, getting this information required transit users to keep detailed travel diaries. Eventually, the need to conduct surveys of transit users may be eliminated by the availability of GPS data (Barbeau, et al., 2009).

**Smartphones and QR codes**

Smartphones’ GPS capabilities facilitate the provision of personally relevant RTI by using a passenger’s location. Apps like Bus Checker (FatAttitude Ltd.) in London couple this with the ability to purchase tickets from the transit-service provider’s website.

The camera built into a smartphone can also enable transit users to access RTI by scanning barcodes affixed to physical infrastructure. This eliminates the need to download an app.

Conventional barcodes have strict character limits that restrict the type of RTI that can be provided. Subsequently, two-dimensional QR codes that redirect transit users to webpages have
come into use for providing RTI. QR codes can also be used in combination with radio-frequency identification tags to expand access to electronic ticketing.

In the United Kingdom, the Hertfordshire County Council operates a QR-based system that covers all bus stops in the county. Riders who scan the codes are redirected to the Intalink website, which offers arrival time information for specific stops.

First Group, a major UK bus operator, displays QR codes at more than 5,000 stops across the Greater Manchester area. The codes link to the homepage of the company’s mobile website, which does not offer stop arrival information. The stated aim is to make it easier for travelers to get information about services (Gammer et al., 2014).
Case studies in real-time information

The following table is the summary of the case studies:

**Table 1: Cities using Real Time Information Applications**

<table>
<thead>
<tr>
<th>City</th>
<th>Year of study</th>
<th>Transit mode</th>
<th>Tool</th>
<th>Study method</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern California</td>
<td>2001</td>
<td>Multi Modal</td>
<td>Advanced Transit Information System</td>
<td>Telephone interview</td>
<td>Offering ATIS increase the acceptance of transit. Also, the frequency of service, number of transfers, seat availability, walking time to a transit stop, and fare information were high among the types of information commuters desired.</td>
</tr>
<tr>
<td>Seattle</td>
<td>2011</td>
<td>Bus</td>
<td>OneBusAway (app)</td>
<td>Survey in stations</td>
<td>The riders who used the app waited almost 2 minutes less than those who did not access real-time bus arrival information via a mobile device. Furthermore, accessing mobile RTI can change bus riders’ pre-trip behavior.</td>
</tr>
<tr>
<td>Chicago</td>
<td>2012</td>
<td>Bus</td>
<td>GPS Bus Tracker</td>
<td>longitudinal analysis</td>
<td>Significant increase of 126 average weekday trips per route attributable to RTI, which was an increase of approximately 1.8 to 2.2% of total ridership.</td>
</tr>
<tr>
<td>Calgary, Alberta, Canada</td>
<td>2013-2014</td>
<td>Bus and train</td>
<td>RTI technology</td>
<td>paper-based survey in person and ANOVA tests, ordinal regression, and binary</td>
<td>A significant portion of respondents (82%) stated that uncertainty over when the next bus would arrive led them to board the first bus to reach their stop even if doing so would mean they took longer to complete the trip.</td>
</tr>
<tr>
<td>Location: Massachusetts Bay, Boston</td>
<td>2014</td>
<td>Light Rail</td>
<td>LED signs</td>
<td>In-station surveys before and after RTI</td>
<td>logistic regression</td>
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<tr>
<td>Location: Tampa, Florida</td>
<td>2014</td>
<td>Bus</td>
<td>OneBusAway (app)</td>
<td>Before-after control group (for three months) /web based survey</td>
<td></td>
</tr>
<tr>
<td>Location: Atlanta</td>
<td>2015</td>
<td>Bus</td>
<td>OneBusAway (app)</td>
<td>Online survey</td>
<td></td>
</tr>
<tr>
<td>Location: New York</td>
<td>2015</td>
<td>Bus</td>
<td>RTI system</td>
<td>On-board survey /Panel regression</td>
<td></td>
</tr>
<tr>
<td>Location: Auckland, New Zealand and Lyon, France</td>
<td>2016</td>
<td>bus, train, and ferry</td>
<td>Various operational tactics</td>
<td>Identical user-decision and preference surveys</td>
<td></td>
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</table>
In 2012, the Massachusetts Bay Transportation Authority (MBTA), which serves the Greater Boston area, activated RTI signs for its heavy rail system. MBTA operates three heavy rail lines in addition to offering an extensive light-rail network, 170 bus routes, a commuter rail, and water transportation. The Red, Orange, and Blue heavy rail lines radiate from downtown Boston and collectively carry approximately 500,000 passengers each day.

To display RTI in stations, MBTA repurposed LED signs that had been installed at all 51 heavy rail stations in 2007 but had been showing only the current time, announcements that the next train was approaching, and information about service irregularities. MBTA staff developed software that combined real-time train movement data from more than 500 track circuits with schedule information, including real-time schedule changes made by dispatchers, to produce predicted arrival times at stations and departure times from terminals. The signs displayed the estimated arrival of the next two trains from each direction.

At the time Chow, Block-Schachter, and Hickey (2014) studied MBTA’s heavy rail RTI system, more than 70,000 train movement messages, more than 3,000 schedule messages, and more than 350,000 countdown messages were being sent to station signs on a typical day. The countdown messages were sent to the signs by way of MBTA’s public-announcement system. To accept those messages, the announcement system required an upgrade by the vendor.

Chow et al. examined whether the introduction of real-time arrival signage led to reduced expectations of wait time, improved satisfaction with MBTA, and increased ridership. They conducted in-station surveys before and after RTI was introduced to gauge changes in passengers’ satisfaction and wait-time expectations. Survey respondents’ expectations were compared with headways data collected from automated train-tracking devices. Ridership changes were measured via automated fare counts provided by MBTA.

The survey results revealed that after the introduction of the countdown signs, people reduced their overestimation of wait time by 50%. Satisfaction with MBTA did not change significantly as a result of the real-time signage. People reported that they felt more relaxed with real-time signage if the next train arrival occurred within a scheduled headway but less relaxed when the headways were much greater than scheduled. Minor improvements in ridership were detected at stations with the RTI signs after other factors were controlled for, but the results were preliminary.

The study findings suggest that real-time arrival signage would be a positive addition to heavy rail systems to increase passenger comfort and to improve perceptions of system performance in a relatively cost-effective manner with the use of existing technologies.
Chow et al. wrote:

The research results presented here led to the following insights and implications for MBTA:

- New amenities, such as real-time information, increase the attractiveness of service but also raise passenger expectations, because the amenities make irregular service more visible.
- Increased visibility of real-time information means that passengers will incorporate this information into wait-time estimates.
- Inaccurate estimates reduce trust in the system and increase wait anxiety, beyond what it would have been without the information, and thus decrease satisfaction with the system. This research and MBTA’s experience also had several implications for other transit agencies as follows:
  - Real-time information improves the passenger experience at a relatively low cost. This research and MBTA’s experience provide strong support for other agencies to pursue real-time signage, especially when the implementation cost is compared with that of other customer improvement measures (e.g., new trains, renovated stations, more frequent service).
  - A natural extension of in-station, real-time information is to release real-time predictions to third-party app developers, who can create apps for customer use. MBTA chose to release a new version of its real-time prediction feed to developers, in addition to the activation of countdown timers in stations. Other agencies could implement an even more low-cost solution than the one chosen by MBTA, however, and release only a real-time prediction feed to developers and avoid the cost to maintain a network of signs in stations. Passengers would not have the real-time information prominently displayed in stations, however, and would need instead to seek out this information. Thus the positive impacts on customer experience seen at MBTA might not be as pronounced.

*Seattle*

The OneBusAway transit-traveler information system provides real-time next bus countdown information for riders in King County, Wash., via a website, an automated telephone system, text messaging, and smartphone apps. Watkins, Ferris, and Borning (2011) observed riders arriving at bus stops to measure their wait times and also asked riders a series of questions, including how long they perceived their wait time to be. The researchers found that riders who lacked RTI perceived their wait times to be greater than their actual measured wait times. Riders who did
use OneBusAway, however, did not perceive their wait times to be longer than their measured wait times.

This difference was also reflected in the wait times that RTI users and nonusers reported. Those who used OneBusAway said that their average wait time was 7.5 minutes while riders who did not use OneBusAway said they waited 9.9 minutes.

Based on this large and statistically significant discrepancy, Watkins et al. developed a model that included measured wait time to predict how bus riders would perceive wait times. The model also factored in use of RTI, travel during the peak period of late afternoon/early evening, bus frequency per hour, and an indicator for self-reported aggravation from waiting. Running that model showed that accessing RTI decreased perceived wait times by 0.7 minutes.

A critical finding from this study is that providing mobile RTI reduced actual waits for OneBusAway users. Those riders waited almost 2 minutes less than did riders who did not access real-time bus arrival information via a mobile device. This suggests that mobile RTI has the ability to improve the experience of transit riders.

Watkins et al. further found that transit riders feel that they wait an average of 0.83 minutes longer at bus stops than they actually do. Last, the study indicated that accessing mobile RTI can change bus riders’ pre-trip behavior. OneBusAway users routinely commented that they knew whether they had time to grab a cup of coffee because they knew there would be a 10-minute delay on a particular day or if they needed to literally run to their bus stop.

New York City

In New York City, most bus service is operated by New York City Transit (NYCT) under the umbrella of the Metropolitan Transportation Authority. This makes NYCT the largest bus system operator in the United States with approximately 805 million unlinked passenger trips each year along approximately 200 fixed bus routes (Federal Transit Administration, 2012).

The gradual roll out of Bus Time that began in 2011 and during which riders on some routes had RTI via web-enabled and mobile devices while others did not allowed Brakewood, MacFarlane, and Watkins (2015) to conduct a natural experiment in which they tracked route-level ridership over multiple years. To account for other factors that affect bus ridership, they performed a panel regression that controlled for changes in service, fares, weather, and local socioeconomic conditions among other factors. As the primary unit of analysis, NYCT reports used average weekday route-level ridership for all bus routes; because, actual ride counts were not available from sources such as smartcard fare records.

A fixed effects model of average weekday unlinked bus trips per month revealed an increase of approximately 118 trips per route per weekday, or a median increase of 1.7% of weekday route-
level ridership, that could be attributed to providing RTI. Further refinement of the fixed effects model suggested that this ridership increase might only be occurring on larger routes; specifically, the largest quartile of routes defined by revenue miles of service realized approximately 340 additional trips per route per weekday, or a median increase of 2.3% per route. Although the increase in weekday route-level ridership may appear modest, on aggregate the increases exerted a substantial positive effect on fare box revenue.

**Tampa**

In the Tampa Bay region, most bus service is operated by Hillsborough Area Regional Transit (HART). This smaller bus system has an annual ridership of approximately 14 million unlinked bus trips along approximately 40 fixed bus routes (Federal Transit Administration, 2012).

In 2012, HART granted the University of South Florida and research partner Georgia Tech special access to its real-time bus data so a team from the schools could develop a HART-specific version of OneBusAway. Since HART bus riders had never previously had access to RTI via web-enabled or mobile devices, this project presented a unique opportunity to compare the behavior of a controlled population who accessed RTI with that of riders who had no access to RTI.

Brakewood and Watkins (2014) performed a behavioral experiment using a before-after control group design in which the treatment was access to OneBusAway over a study period of approximately three months. The data used to measure behavior change came from a web-based survey administered before the provision of RTI and a second web-based survey administered after the completion of the study period. The surveys measured changes in transit trips, as well as other possible benefits of RTI such as wait times and satisfaction with transit service. HART, like NYCT, lacked newer methods for collecting transit data, such as smart cards.

The number of transit trips by RTI users and by nonusers did not differ significantly. The researchers did not find this surprising since the majority of bus riders in Tampa are transit-dependent, meaning they lack other transportation alternatives.

Analysis of “usual” wait times revealed a significantly larger decrease of nearly 2 minutes for RTI users. Additionally, RTI users had significant decreases in levels of anxiety and frustration when waiting for buses. These findings provide strong evidence that accessing RTI significantly improves the passenger experience of waiting for the bus, which is notoriously one of the most disliked elements of transit trips (Mishalani et al. 2006).

**Atlanta**

In Atlanta, the Metropolitan Atlanta Rapid Transit Authority (MARTA) operates a bus system with an annual ridership of approximately 61.6 million unlinked bus trips along approximately 95 fixed
bus routes (Federal Transit Administration, 2012). RTI became available for all MARTA bus routes via a beta version of OneBusAway in the late spring of 2013, and MARTA apps offering RTI for all buses and trains launched in the fall of 2013. Complete OneBusAway service for all MARTA buses and trains was in place by February 2014.

Brakewood and Watkins (2015) used the gradual ramp up of RTI options in Atlanta to conduct a before-and-after analysis of changes in transit travel by MARTA riders between the spring of 2013 and the spring of 2014. MARTA’s reliance on a contactless smartcard ticketing system presented a unique opportunity to examine changes in trip-making patterns using ride counts.

In order to understand which smartcard users were also RTI users, a short online survey was administered. Respondents were asked about their use of OneBusAway and for their unique 16-digit smart card ID number. The ID number was then used to link survey responses to card trip history. This permitted the researchers to compare the behavior of smartcard users who also used RTI directly with the behavior of smartcard users who did not use RTI.

Difference of mean tests and a regression analysis of before-and-after differences in monthly trips suggested that RTI was not associated with a significant change in monthly transit trips; however, the final sample size that resulted from the data cleaning methodology was very small.

The studies in Tampa and Atlanta did not find a substantial change in transit travel associated from the use of RTI, but the methodologies did not permit identification of completely new riders. Also, in Tampa, many bus riders were dependent on transit and had limited ability to increase their trips because they were already using transit for all or a majority of their trips.

The New York City study did show an increase in ridership associated with the availability of RTI, and this likely occurred on the routes with the greatest level of preexisting transit service. Since New York City has substantially more bus routes, greater span of service and higher frequency of service on most (if not all) routes than either Atlanta or Tampa, the potential for ridership gains due to RTI may be greatest in areas that already have high levels of transit service (Brakewood & Watkins, 2015).

**Chicago**

CTA implemented Bus Tracker service incrementally on 149 bus routes between August 2006 and May 2009. Some of the routes were discontinued after May 2009. Bus Tracker uses GPS devices to locate buses in real time.

At launch, Bus Tracker provided only general estimates of bus-arrival times via a website and wireless devices. Starting in spring 2009, the Bus Tracker system allowed CTA riders to receive
customized emails or text messages with estimated arrival times of the next bus at customers’ preferred bus stops. Later in 2009, a track-by-text feature became available to customers, allowing them to receive arrival times for the next two buses at their bus stops via text messages. Additionally, third-party developers have released apps that allows users to download information to handheld devices.

Tang and Thakuriah (2012) performed a longitudinal analysis of route-level monthly average weekday ridership across the entire CTA bus system from January 2002 through December 2010 to evaluate how RTI affected ridership. To account for alternative explanations for bus ridership changes during the study period, they controlled for unemployment levels, gas prices, weather, transit-service attributes, and socioeconomic characteristics. Using a quasi-experimental design, they created a linear mixed model to show how route ridership changed from before Bus Tracker implementation to after the provision of RTI. The average increase was modest.

Results showed a significant increase of 126 average weekday trips per route attributable to RTI, which was an increase of approximately 1.8 to 2.2%. Further, temporal variations in ridership were revealed, with the “winning” routes being those that were more likely to have Bus Tracker implemented in the later phases of the roll-out.

Working with the same CTA data, Tang, Ross, and Han (2012) found that the Bus Tracker service for CTA buses positively affected train ridership. Though the effect was not statistically significant, finding it implies that receiving unfavorable information about bus arrivals leads some transit users to switch modes of transportation. That further suggests that the provision of real-time bus information should be integrated with efforts to improve overall transit service quality, especially in terms of delays or disruptions.

Another lesson from the work of Tang, Ross, and Han is that transit systems that operate bus routes and rail lines could benefit from integrating the design of intermodal connections with the provision of RTI because the two complement each other in ways that can increase transit ridership.

These studies did suffer from some acknowledged shortcomings related to research design and data limitations. First, the delivery of Bus Tracker information to users changed and developed over the study period. This might have affected travelers’ use of the CTA system. Because the changing ways in which Bus Tracker users could access RTI could not be controlled for, the researchers assumed that RTI delivery methods had no influence on ridership. Further, the effects of RTI on ridership for individual buses on the same route were assumed to be the same along the entire route and for a connected train station. Making these assumptions simplified the analysis but did not reflect actual conditions in which service levels differ.
Second, some data limitations might affect the predictive power of the model of route-level monthly average weekday ridership. Data of factors such as income and availability of devices to access Bus Tracker information that might influence changes in transit ridership were not available and, therefore, not considered. Also, data at the individual train station level was not available, so city- and system-level data were used for some of the control variables in the analysis, including unemployment and vehicle revenue miles. Last, historical information for control variables such as population density around train stations and parking capacity at each train station was not always available. This led to using current data and a trend variable as proxies.

**Northern California**

Abdel-Aty (2001) conducted computer-aided telephone interviews in two metropolitan areas in northern California. The survey employed an innovative stated-preference design to collect data on whether an Advanced Transit Information System (ATIS) would increase the acceptance of transit and to determine the types and levels of information commuters wanted.

The survey included a customized procedure that presented realistic choice sets, including respondents’ preferred information items and realistic travel times. The ordered probit modeling technique was used.

Abdel-Aty found that offering an ATIS had potential for increasing the acceptance of transit as a means for commuting. Survey results also showed that the frequency of service, number of transfers, seat availability, walking time to a transit stop, and fare information were high among the types of information commuters desired. Commute time by transit, income, education, and whether a commuter was currently carpooling were among the factors that contributed to respondents’ likelihood of using transit if an ATIS was offered.

**Auckland, New Zealand and Lyon, France**

In 2016, Nesheli used tactic-based guidelines to assess public transit users’ perceptions and decision making in Auckland, New Zealand, and Lyon, France. Identical user-decision and preference surveys were administered in both cities to investigate attitudes toward various control actions. Responses were analyzed, and decision models were built using both multinomial logistic regression (MLR) and a decision-tree-based method.

A large majority of travelers in Auckland and Lyon gave strong importance to reductions in wait times and improvements in real-time performance. Survey respondents in both cities also expressed a willingness to use a decision-support tool. The statistical analysis revealed that, in certain situations such as waiting at a stop for longer than 10 minutes, more than 60% of the travelers would employ an available decision-support tool to adapt their travel behavior. Results
such as this from the MLR model show that given an acceptable public transportation user database, it should be possible to predict the decisions of travelers.

The decision-tree-based model, which used the chi-squared automatic interaction detector method, confirmed the predictions from the MLR method and provided guidelines for offering decision support for various situations while waiting at transit stops. Both models revealed that the most significant predictor of a traveler’s decision is delay time. Factors such as the purpose of trip transfers, travel time, and traveler age also influence transit users’ decision making to lesser extents.

To complete the decision-support tool guidelines, tolerated wait-time models were developed using real-time tactics and users’ perceptions of operational tactics employed by public-transportation agencies. The purpose of the wait time models was to produce suggestions for tactics to reduce wait times given certain events and desired outcomes. In each iteration of the tolerated wait time model, transit users were expected to tolerate extra wait time of no more than 3 to 9 minutes. Average extra tolerated wait time increased significantly—by up to 75%—when the decision-support tool informed users that a seat was being held for them.

The report on this study also notes that “an important result for policy-makers and agencies is the higher average extra time tolerated related to walking. The results show that although the waiting-time tolerated can be compensated by giving a bonus to users, it is difficult to do so with the extra walking time.”

The limitation of this study is that the results presented describe tendencies rather demonstrating strong conclusions about transit users’ behavior. Also, while the methods offer a good framework for future studies, the inferences made apply only to the public-transportation systems in Auckland and Lyon. A more comprehensive and accurate study could show the tactics, situations, and passengers for which decision-support tools could be efficient.

*Calgary, Alberta, Canada*

In 2013, Rahman, Wirasinghe, and Kattan (2013), investigated bus riders’ and light-rail passengers’ views toward and perceptions of the possible availability of RTI. They administered a paper-based survey in person and used ANOVA tests, ordinal regression, and binary logistic regression to analyze responses.

Overall, 35.5% of respondents agreed or strongly agreed that the information system then in use deterred or discouraged them from using public transit. A significant portion of respondents (82%) also stated that uncertainty over when the next bus would arrive led them to board the first bus to reach their stop even if doing so would mean they took longer to complete the trip.
Women, younger riders, current car users, and infrequent transit users showed a higher interest in RTI. In general, light-rail passengers showed the least interest in RTI.

As for preferred content, information on next-bus arrival time received the highest priority. Display boards at bus stops were chosen as the preferred medium for communicating en route information, and a website or call center was preferred for pre-trip information. A majority of the respondents (88%) indicated that RTI would not be necessary if buses were dispatched more frequently than every 10 minutes (Rahman et al., 2013).

Later, Bai and Kattan (2014) modeled light-rail riders’ behavioral responses to RTI in Calgary. A survey presented two hypothetical scenarios. The first described an estimated arrival time of 10 minutes for the next train and the second described a service interruption attributable to an incident or weather with no information on expected recovery time.

The survey received 505 responses. Four multinomial logit models were developed and calibrated to explore the factors affecting trip decision making for the described scenarios for commuter and non-commuter trips. Running the models led to the conclusion that travelers’ behavioral responses to RTI were strongly influenced by socioeconomic attributes such as age, gender, and number of autos per household; familiarity with an APIS and perceived accuracy of the APIS; and use of transit as the primary mode of transportation, frequency of light rail use, and familiarity with light rail. Analysis of the data also determined that travelers’ actions varied by trip purposes, travel time, and weather conditions.
Real-Time Transit Information Technology Review

Real-time transit information (RTTI)’s significant implication for transit provision and ridership as highlighted in the literature review warrants a review of its underlying technology as described in this section.

Overview of Real-Time Transit Information

Real-time transit information can be provided to the public in two main ways: mobile devices and public displays. Mobile devices include: (1) the web/Internet (including mobile social networking websites), (2) short message signs (SMS)/text messages, (3) phone/call centers, (5) e-mails (Schweiger 2011) and (4) smartphone applications. Public displays come in the form of dynamic messaging boards (DMB) located inside or near transit facilities. Transit agencies in the US use one or more of these channels to provide real-time transit information. A survey of APTA’s transit agency members in 2014 reported that nearly 59 percent of transit agencies used agency website, 41 percent used text/SMS services, 40 percent used agency smartphone applications and 30 percent used the phone system (APTA 2015).

Web methods require users to access a website and input their stop and/or route information. Examples include NextBus (NextBus), CARTA bus travel (CARTA) for Charleston and Arlington Transit (ART) in Virginia. Websites could also be interactive by allowing users to contribute to the website’s content.

Real-time information provided by means of SMS is two-way messaging requiring “the mobile user to send a text message formatted in a specific way to a five- or six-digit common short code (CSC). The user will receive a text message [in response] containing the requested information” (Schweiger 2011). Areas using text messaging include Oregon (Schweiger 2011) and the Chicago Area. For example, in Chicago, users can send a “cta bus 14624” to 41411 (the CSC) to request bus information for stop 14624 (Schweiger 2011). In some cases such as Virginia, users can sign up for automatic text messages for their regular routes.

Call centers use Interactive Voice Response (IVR) technology to give information. They are used by TriMet in Portland and in Virginia where users can call 511 for real-time transit information. E-mail updates are also available for travelers in Arlington where users can choose to get updates on their regular routes (ART). E-mail update/alert services are offered across Maryland’s transit systems (MTA) and in Connecticut’s CT Transit system, allowing users to customize alerts by routes and times.

Finally, with 77 percent of Americans owning smartphones (Pew Research Center, 2018), the ability to access real-time information on smartphones is essential – and a great opportunity to improve passenger experience and even increase ridership.
Smartphone users can use apps that combine public transportation information with traffic information or can use localized apps that report real-time information for private systems, such as university or hospital shuttles. When users open these apps, they are asked to choose from a list which system they would like to receive information for. Rider by TransLoc, a prominent transportation-technology company, is an example of one of these apps (“TransLoc Rider | Bus and Transit Tracking App,” n.d.).

Starting in the early 2000s, many transit agencies in the United States began to offer static information on mobile devices, including timetables, service alerts, and trip planning (Schweiger 2011) with applications often developed in-house. For instance, in the late 1990s and early 2000s, Bay Area Rapid Transit in the San Francisco Bay area developed its own applications for the Palm operating system (OS).

Because of the difficulty of using Apple Maps or Google Maps to access real-time transit information, riders often turn to local apps, such as DC Bus and Metro (“DC Metro and Bus on the App Store,” 2017). However, these apps tend to be difficult to use. Rather than intuitively giving users real-time transit information immediately upon opening the app according to their GPS location, these apps tend to make users find their bus route through a long list of routes, and then find their particular stop through a long list of stops. While it is possible to save favorite stops to a page on the app, a rider has to repeat this process for every new stop or train station they visit. This is particularly difficult for riders using transit for non-work trips, as these trips tend to not be as consistent in terms of the route as commute trips.

Other apps are more intuitive to use and better serve the needs of people just seeking real-time information. These apps include Transit (formerly known as Transit App) and Citymapper, the latter of which also tells riders how many calories they save with different trip options (similar to Arlington’s CarFreeAtoZ, which uses static General Transit Feed Specification (which will be discussed more in-depth later in this report) to compute trips and compare them by calories, money, time, and carbon emissions saved). While they both have trip-routing functionality, they are best at giving riders real-time information immediately upon opening the app. Transit, for example, gives users arrival information for the nearest transit services based on the user’s GPS location. Citymapper allows users to scroll on a map and press their bus stop or train station to find real-time information.

Instead of releasing self-produced apps, some transit agencies are endorsing Transit as their “official” app or the app that they recommend riders use. Boston’s Massachusetts Bay Transportation Authority (MBTA) is one such agency, along with Toronto, Calgary, Columbus, and Connecticut’s statewide transit agency (“MBTA- Endorsed Apps,” n.d.; “Transit-Transit Agencies,” n.d.). According to both MBTA and Transit, this partnership benefits both parties: Transit gets
more users, and MBTA can review trip data collected by riders to learn about problems in their system and service.

OneBusAway transit traveler information system provides real-time next bus countdown information for riders of King County Metro in Seattle via website, telephone, text-messaging, and smart phone applications. It uses a variety of methods such as web, phone, SMS and mobile devices. Providing more than one method of information could help the app come off as a more user-friendly option (Watkins 2011).

Smartphone applications opened the way for providing different types of “informal” real-time information. Recently, “Google’s in-house incubator made a Waze-like –traffic avoidance- app for the New York city subway (Liao 2018). Their app “Pigeon” is a smartphone application that helps commuters avoid delays as detected by other users – including comments on specific “annoying” incidents along their commute.

Furthermore, some of the smartphone applications provide multimodal real-time information. Transit, Citymapper, and Moovit include docked bikeshare on their apps. Only Transit and Citymapper include dockless bikes, electric bikes, and electric scooters. Similar to Motivate’s Capital Bikeshare app, this allows users to see how many bikes or docks are at a particular station. These apps also include transportation network companies (TNCs) such as Uber and Lyft. Apple Maps, Google Maps, and local apps like DC Bus and Metro do not include these modes.

Agencies across the United States also use Dynamic Message Boards (DMB) to communicate information to customers who are on-board, or at-station. The screens can show train destination, arrival, and departure information. When placed on loading platforms, they may flash to alert riders of an oncoming train or bus (Schweiger 2013). The rate of adoption of DMB vary across the U.S. For example, Schweiger 2013 reports on the 2007 ITS deployment statistics contrasting the deployment of DMB at 75 of 6,000 bus stops in Alameda-Contra Costa Transit District in California compared to all 46 rail transit stations for the Bay Area Rapid Transit (Schweiger 2013).

Both public displays and mobile devices have advantages and shortcomings in disseminating real-time transit information. For instance, public displays can reach users who do not own mobile (or smart) phones or who have low coverage (Schweiger 2013). However, they can be costly, limiting their scope of application or the number of stops at which they can be supplied (Watkins 2011). Mobile devices offer the opportunity for transit providers to reach more users with less cost and to intercept a rider before they are waiting at the station and stop, potentially minimizing their wait time (Watkins 2011). Also, call centers can save on cost and promote equity. TriMet argues that call centers allow the agency to produce fewer print materials and serve low-income and older riders better (Schweiger 2011). Still, some people might not have access to mobile devices.
or might suffer from service coverage. SMS services in particular could also suffer from slow response time.

**RTTI Technology Providers for Transit Agencies**

Some of the main companies that provide DMB services for transit agencies include: Clever Devices, Syncromatics and Luminator Technology Group (LTG). Clever Devices’ “CleverVision” product provides real-time and other information onboard transit vehicles, such as buses and trains. New York City MTA is a client. Syncromatics produces real-time arrival LED and LCD weather-proof signs for both transit agencies and cities and can present real-time information for multiple transit agencies on the same screen. Luminator has provided LED lighting for WMATA and the Chicago Transit Authority (CTA). In 2015, Luminator had installed 450 LED displays that provide arrival prediction at bus stops for the CTA (Rubin 2015) and were installing 170 for WMATA. Other providers are used throughout the U.S. A survey of APTA’s transit agency members in 2014 reported that 24 percent of agencies used Trapeze to power their real-time systems, around 13 percent used ACS/Xerox, 12 percent used Clever Devices, 6 percent used Init and more than 20 percent used other providers (APTA 2015).

DMB providers of different nature include TransitScreen and The Redmond Group. TransitScreen – a start-up that was incubated at Mobility Lab – provides easy-to-read DMB for not just governmental clients, but residential and commercial properties. Similar to Clever Devices and Syncromatics, the real-time information presented is location-based, meaning that real-time information is only provided for nearby transit services. However, unlike these two companies, TransitScreen also displays bikeshare, TNCs, carshare, and flight information. The company also has a smartphone app. The Redmon Group, a multimedia company that also produces DMB, is very similar to TransitScreen by presenting multiple transportation options – regardless of transit agency or mode – and their location-based real-time information.

**RTTI Underlying technology**

**Mobile Devices**

Disseminating real-time information through mobile devices requires (1) monitoring transit service (i.e. location, arrival times etc.), (2) predicting real-time information and (3) transmitting it to the public.

At the information level, the **automatic vehicle location system (AVL)** technology is an important one. AVL is a smart technology that monitors the real-time location of transit vehicles through one of several tools such as the global positioning systems (GPS) in combination with the vehicle odometers. AVL data contains “polling records (bus location reported when queried by a central computerized system, a round-robin polling of “time-at-location”), stop records (time-at-location
of a stop), and time point records (time-at-location at time points on route)” (Lawson 2016). According to Okunieff (1997) as cited by Lawson 2016, AVL technologies were first used in Chicago 1969. To help transit agencies share their AVL information, U.S. DOT started promoting integrating transportation infrastructure (ITI) by the late 1990s.

At the publishing level, the General Transit Feed Specification (GTFS) has emerged as an industry standard (Wessel 2017). GTFS was developed by Google and TriMet in 2005 allowing transit agencies to display their data (schedules, routes, stops) in an open-source format that can be used for Google Transit Web-based trip planner. Schweiger 2011 explains that once the data are exported, an agency published their data through either a developer website (within the agency website) or another host website. They further explain that many agencies create a license agreement or terms of use agreement to govern how developers can use data (Schweiger 2011). The contribution of this collaboration was the generation of static schedule information (e.g., stop location, route geometrics, and stop times) in a standard format (Lawson 2016). The format “defines transit schedule information in a format that is essentially a routable spatiotemporal network graph with stops as nodes, scheduled travel between stops as edges, and estimated travel times as the cost” (Lawson 2016).

This technology has allowed users to plan their trips in applications such as CarFreeAtoZ and researchers to examine important questions when combining the data with other sources (ridership-by-hour, by-trip, and by-stop, trip activity ranking, stop activity ranking, and activity-by-period) (Liu 2017). Liu 2017 explains that 323 agencies (the majority) in the US have made their GTFS data available. This technology has also allowed transit agencies to publish their real-time information. Indeed, GTFS-R and the Service Interface for Real-time Information, or SIRI, allow agencies to share real-time data feeds with developers (Watkins 2016).

GTFS-R is a feed specification that extends GTFS by integrating AVL data allowing public transportation agencies to provide real-time updates about their fleet to application developers. SIRI is an Extensible Markup Language (XML) protocol that provides a similar service to GTFS-R, allowing distributed computers to exchange real-time information about public transport services and vehicles (Lawson 2016). Schweiger 2011 explains that SIRI is “an XML protocol to allow distributed computers to exchange real-time information about public transport services and vehicles”. It is a European-based standard used in Bus Time in New York City (Jaffe 2018).

Finally, the technology enabling the transfer of real-time transit information is evolving and will permit the prevalence of those apps even more. Efforts such as NATCO’s (NATCO 2017) collaboration with the World Bank to use Open Traffic – a repository that “translates vehicle GPS data into anonymous historical and RT travel information and statistics” equipping transit vehicles with Automated Vehicle Location (AVL) systems will promote this technology.
Dynamic Message Boards (DMB)

The literature on electronic signage for public transit posits that originally most signs were light-emitting diode (LED), with liquid crystal display (LCD) technology just beginning to be deployed. Currently, the literature reports a trend towards to full-screen displays using LCD or plasma technology. The availability of LCD widened the volume and depth of information that can be provided (Schweiger 2011).

Aside from LED and LCD, the literature also discusses Electronic Paper Displays (EPD) that have been used since 2005. It is “an electronic sign capable of presenting text and images on a flexible surface that can be changed over time”. It offers the benefits of better readability and lower power consumption compared to LED, LCD and DMB. CHK America supplies solar powered electronic readers (Business Wire 2016). Its SmartStop DMB is a solar-powered technology that combines an interactive tablet (like an iPad) with CHK’s Digital Bus Stop, and utilizes low-power E-Ink signage similar to that of a Kindle screen. It provides departure times and alerts as well as the ability to interact with the tablet regarding any query a customer might have, including trip planning. The screens can also display any additional information an agency may need, such as Uber and Lyft details, or advertisements with map locations plotted. The digital bus stops are already used in cities like Pittsburgh, Dallas, Las Vegas, and San Antonio (Metro 2016).

Connexionz also uses solar-power and battery driven real-time information systems such as BusFinder in Virginia. The technology allows to “cost-effectively deliver arrival information to passengers at bus stops along their routes” (Connexionz 2018). Travelers in Arlington can use BusFinder to check how far away the bus is in minutes, as long as the bus is less than 28 minutes away. For longer wait times, they are asked to refer to timetables (ART).

Successful cases

There are many companies in the real-time transit information field that do not adhere strictly to either smartphone applications or DMB, yet still rely on real-time transit information at the core of their business.

TransLoc previously mentioned in this report as the company that produces the app Rider, sells software to transit agencies that enables them to build their own microtransit services (Jaffe, 2015). Similar to Uber Pool, Lyft Line, Chariot or Via – yet owned by transit agencies – TransLoc’s Microtransit Simulator, Microtransit OnDemand, and Microtransit Pilot programs allow transit agencies to assess demand for transit services and provide flexible bus routing in real-time. TransLoc was acquired by Ford earlier this year (Ohensorge, 2018).

Sacramento Regional Transit District (SacRT) in California launched an agency-owned microtransit pilot service with TransLoc this past February. The service, which connects
residential and commercial areas lacking extensive transit, has enjoyed steady and growing ridership. Its success has led the Sacramento Transportation Authority to grant an additional $12 million to SacRT to expand the pilot. In an interview with Mobility Lab, Aaron Berdanier, a data scientist at TransLoc who works on microtransit projects, said, “goals for this pilot were to increase ridership, which they’ve done dramatically, and to plug into this area they didn’t have access for – Citrus Heights [a city within Sacramento County]. The agency has been very innovative and forward thinking.” (Mackie)

TripSpark, an operating division of Trapeze Group (a major player in the public transportation industry), focuses exclusively on small and mid-sized transit agencies (“About TripSpark Technologies,” 2018). They sell hardware and software that provides real-time transit information for small and mid-sized transit agencies, university and hospital transit systems, K-12 bus systems, and non-emergency medical transportation (NEMT) programs.

NEMT is large sector of real-time transit information companies’ customer base. Schedule Viewer’s MediRoutes program provides real-time dispatching for NEMT operators, as well as scheduled reminders for customers of their upcoming trip, reducing the amount of “cancel at door” and “no-shows” that impair NEMT services.

Tiramisu, a research project turned smartphone app by Carnegie Mellon University’s Rehabilitation Engineering Research Center on Accessible Public Transportation (RERC-APT), relies on both real-time GTFS and crowdsourced information to make transit more accessible to people with disabilities (Stirling, 2012). When using public transportation, users report information, such as how full a bus is, which is important for passengers with wheelchairs, in real-time to the app. Tiramisu is currently only live in Pittsburgh and New York City. While the app is still live, the company’s website has been deactivated.

Similar in theory to route-planning apps, but behaving more like TransLoc’s microtransit programs, there is also software that coordinates carpool rides. RideAmigos’ ridematching software for employers lets employees schedule and join their most convenient carpools (“RideAmigos | Commuter Management & Ridesharing Software,” n.d.). Brandeis University outside of Boston, MA. reported that in 2017, RideAmigos helped double the number of carpool trips by staff commuting to the campus (Cardillo).

Intersection is a digital communications company that is the most cross-disciplinary of the companies mentioned (“About Us,” 2018). They partnered with New York City on LinkNYC, a city-wide program that converted old payphone booths into WiFi hubs with large touchscreens that present information on city services, as well as real-time transit information ("LinkNYC,” 2018). With the Bus Time (New York City’s MTA real-time bus tracker program) LinkNYC pilot launching this past April, updated ridership numbers have not been yet released (Rosenberg). However, the study “The impact of real-time information on bus ridership in New York City” by Candance
Brakewood, Kari Watkins, and Gregory MacFarlane cited in this report and focuses on New York’s Bus Time suggests that the LinkNYC Bus Time program might have a positive effect on bus ridership.
### Table 2 Most Prominent Smart Phone Application

<table>
<thead>
<tr>
<th>App</th>
<th>Description</th>
<th>Year founded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google Maps</td>
<td>Trip-planning and real-time app (only when using trip-planning function)</td>
<td>Google Transit was launched online in 2006, and Google Transit on the Maps mobile app launched in 2008</td>
</tr>
<tr>
<td>Apple Maps</td>
<td>Trip-planning app</td>
<td>2012</td>
</tr>
<tr>
<td>Transit</td>
<td>Trip-planning and real-time transit app</td>
<td>2013</td>
</tr>
<tr>
<td>Citymapper</td>
<td>Trip-planning and real-time transit app</td>
<td>2011</td>
</tr>
<tr>
<td>Moovit</td>
<td>Trip-planning and real-time transit app</td>
<td>2012</td>
</tr>
<tr>
<td>DC Metro and Bus</td>
<td>Real-time transit app</td>
<td>2013</td>
</tr>
</tbody>
</table>
### Table 3 Comparing Presentations of Real Time Information

**Presentation of Real Time Information**

<table>
<thead>
<tr>
<th></th>
<th>Easy to access real time info immediately upon opening the app</th>
<th>Symbols denoting if information is from real-time information or schedule data</th>
<th>Presentation/Clarity</th>
<th>Ability to see real-time info for transit not near your GPS location</th>
<th>Favorite station</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Google Maps</strong></td>
<td>No - must plan trip to access real time</td>
<td>No</td>
<td>Not clear</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Apple Maps</strong></td>
<td>No - must plan trip to access real time</td>
<td>No</td>
<td>Not clear</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Transit</strong></td>
<td>Yes - nearby transits' real time appears immediately when you open the app</td>
<td>Yes</td>
<td>Appears immediately when you open the app</td>
<td>Yes - search for location and it will show you its closest transit lines and their real time</td>
<td>Yes - search for location and it will show you its closest transit lines and their real time</td>
</tr>
<tr>
<td><strong>Citymapper</strong></td>
<td>Somewhat - must press the icon of a bus or train station</td>
<td>Yes</td>
<td>Must press the icon of a bus or train station</td>
<td>Yes but you have to manually scroll</td>
<td>Yes but you have to manually scroll</td>
</tr>
<tr>
<td><strong>Moovit</strong></td>
<td>No – must scroll through lists</td>
<td>Yes</td>
<td>Somewhat clear - you have to read through the options in the &quot;station&quot; section</td>
<td>Yes - when you search, it will immediately give you the real time info for a stop on that line that is closest to you</td>
<td>Yes - when you search, it will immediately give you the real time info for a stop on that line that is closest to you</td>
</tr>
<tr>
<td><strong>DC Metro and Bus</strong></td>
<td>Takes a while to scroll through the different bus stops/Metro stations if you haven't marked them as favorites or are on a new journey</td>
<td>Yes but not obvious: it will tell you in red if its scheduled data or not</td>
<td>Clear once you figure out which stop is yours</td>
<td>Yes - have to scroll through many lists to find them</td>
<td>Yes - have to scroll through many lists to find them</td>
</tr>
<tr>
<td>Route Information</td>
<td>Trip Planning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Table 4: Presentation of Route Information and Trip Planning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Visualization of bus route</strong></td>
<td><strong>Offline maps</strong></td>
<td><strong>Favorite destinations</strong></td>
<td><strong>Presentation of trip options (clarity of different modes/agencies)</strong></td>
<td><strong>Variety of trip options (i.e. requesting a route with minimal walking)</strong></td>
<td><strong>On-trip notifications</strong></td>
</tr>
<tr>
<td><strong>Google Maps</strong></td>
<td>Only in trip planning</td>
<td>No</td>
<td>Yes - can save and classify multiple locations</td>
<td>Transit is not default option - default is car. That said, very easy to understand the different legs of your trip: arrows and symbols for different lines and modes. Shows Metro &quot;M&quot; but not symbols for other agencies</td>
<td>Walking the whole way is an option but not included under transit. No options that emphasize walking, minimize walking, bus only, or incorporate biking.</td>
</tr>
<tr>
<td><strong>Apple Maps</strong></td>
<td>Only in trip planning</td>
<td>No</td>
<td>Yes - can add multiple locations to your favorite</td>
<td>Transit is not the default option - default is car. That said, very easy to understand the different legs and modes of your trip. Does not have Metro &quot;M&quot; but uses the Metro line branding (i.e. orange line circle in same</td>
<td>No variety - just different combinations of transit and walking. No &quot;less walking,&quot; &quot;bus only,&quot; etc.</td>
</tr>
<tr>
<td>Service</td>
<td>Can search for routes and see in real time where the buses/trains are</td>
<td>Can save multiple destinations and categorize them as &quot;work,&quot; &quot;school,&quot; &quot;food,&quot; etc.</td>
<td>A little bit confusing - the Metro logos are very hard to see - but Transit App is the best at comparing the different options by time and when each leg of your journey will take place and how long it will take</td>
<td>Option to minimize walking but only if you select it under &quot;options.&quot; Shows you Capital Bikeshare, dockless bikeshare, your personal bike, and if you walked the whole way</td>
<td>Very clear - shows logos of different agencies, different route lines and bus lines</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Transit</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes - can save multiple destinations and categorize them as &quot;work,&quot; &quot;school,&quot; &quot;food,&quot; etc.</td>
<td>A little bit confusing - the Metro logos are very hard to see - but Transit App is the best at comparing the different options by time and when each leg of your journey will take place and how long it will take</td>
<td>Option to minimize walking but only if you select it under &quot;options.&quot; Shows you Capital Bikeshare, dockless bikeshare, your personal bike, and if you walked the whole way</td>
</tr>
<tr>
<td>Citymapper</td>
<td>Yes/No - can't search for it, but when you press &quot;bus&quot; it shows you the bus options by you, and then when you press one route's name, you can see the entire route on a map</td>
<td>Yes</td>
<td>Yes - can put one option for home, one for work, and then multiple saved or favored locations - these appear under &quot;get me somewhere&quot; instantly when you open the app</td>
<td>Option to minimize walking but only if you select it under &quot;options.&quot; Shows you Capital Bikeshare, dockless bikeshare, your personal bike, and if you walked the whole way</td>
<td>Very clear - shows logos of different agencies, different route lines and bus lines</td>
</tr>
<tr>
<td>Moovit</td>
<td>Yes - can search for routes but can't see real time buses</td>
<td>Yes</td>
<td>Yes - can put one option for home, one for work, and then multiple saved or favored locations</td>
<td>The red bus icon is confusing - it looks like it would be the logo of an official agency but it's not</td>
<td>Will give you bike-only routes (personal or shared), just transit, transit and biking, or just Uber</td>
</tr>
<tr>
<td>DC Metro and Bus</td>
<td>No</td>
<td>No trip planning</td>
<td>No trip planning</td>
<td>No trip planning</td>
<td>No trip planning</td>
</tr>
</tbody>
</table>
Table 5: Comparing Applications’ Display of Bikeshare, Carshare, and Ride-hailing

<table>
<thead>
<tr>
<th></th>
<th>Bikeshare: Docked</th>
<th>Bikeshare: Dockless</th>
<th>Ride-hailing</th>
<th>Carshare</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Google Maps</strong></td>
<td>No</td>
<td>No</td>
<td>Yes, both Uber and Lyft</td>
<td>No</td>
</tr>
<tr>
<td><strong>Apple Maps</strong></td>
<td>No</td>
<td>No</td>
<td>Yes, both Uber and Lyft</td>
<td>No</td>
</tr>
<tr>
<td><strong>Transit</strong></td>
<td>Yes - shows how many bikes and spaces</td>
<td>Yes - explains what it is, gives link to that company, and gives link to that company's app so you can unlock the bike. Also displays dockless electric scooters.</td>
<td>Yes, just Uber (but both UberX and Pool)</td>
<td>Yes, car2go</td>
</tr>
<tr>
<td><strong>Citymapper</strong></td>
<td>Yes - shows how many bikes and spaces</td>
<td>No</td>
<td>Yes, both Uber and Lyft</td>
<td>Yes, car2go</td>
</tr>
<tr>
<td><strong>Moovit</strong></td>
<td>Yes - shows how many bikes and spaces</td>
<td>No</td>
<td>Yes, just Uber</td>
<td>No</td>
</tr>
<tr>
<td><strong>DC Bus and Metro</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

This literature and technology review informed much of the survey design and resulting data that is analyzed in the next section.
3 RESULTS

RESULTS SUMMARY

Background, Objectives, and Methodology

- In the transportation industry, research has found that real-time information is critical to customer satisfaction and ridership. Real-time information refers to information about the current status of transit, such as the location or arrival time, through signage and/or technology. Arlington County sought to understand the needs and expectations that surround real-time information in Arlington County.

- Specifically, the objectives of this research were:
  - To understand what information riders are looking for and expect from transit agencies when they seek out real-time information (including which mode of delivery, form and format transit customers prefer),
  - To identify when in the travel process riders look for real-time information and where they look for this information,
  - To identify where the information should be made available to transit travelers, and
  - To gauge satisfaction with the sources of information currently available.

- To accomplish the aforementioned goals, WBA employed a mixed methods research approach. This allowed the opportunity to explore the experiences of Arlington transit users in-depth through focus groups, and the benefit of collecting opinions from the wider Arlington population through an online quantitative survey.

Cost, Time, and Convenience as Real-time Information

- Traditional factors that influence travel choices arise in this research as important to those who travel in and around Arlington County. Specifically, the three main factors visible in this research are: cost, time, and convenience. People trade-off on these factors based on the conditions of their trip to decide which mode or route to take. For example, they will pay more for a quicker trip if they have an appointment, or they may choose a less convenient trip to save money.

- This research suggests that people look for information about these three main factors to help inform their travel choices. Therefore, real-time information is not just about time

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1 This section of the report was compiled by WBA Research (Mobility Lab’s research subcontractor)
it is about all of the information that impacts a trip. Specifically, people want information that pertains to the cost of the trip, the length of the trip, and the convenience of the trip (for example, distance to the nearest bus stop).

Impacting the Travel Experience

- Real-time information is viewed as an important part of the travel experience. The majority of the online respondents agree that “having real-time information is important to me when using public transportation” (81% mostly or strongly agree) and that “having real-time information when using public transportation helps me relax” (73% mostly or strongly agree). Notably, when looking just at those who use public transportation, there are no statistically significant differences between ages, genders, races, or income levels when it comes to opinions of real-time information’s importance, indicating that this information is equally important to all different types of people who use public transportation in Arlington County. Furthermore, even those who do not regularly check for real-time information indicate that this information is important to them (66%).

- The real-time information provided by transit agencies impacts mode choice. The focus group findings reveal that people look up the status of their bus or train to see when the next one is arriving before deciding which mode of transportation to use for that trip. While a few focus group participants demonstrate situations when this information encourages the use of public transportation, others present examples of how this information works to dissuade potential riders from using public transportation (e.g. when they see the Metro is 45 minutes away, they’ll choose Uber or Lyft).

- Interestingly, findings from the online research reveal that those who check for real-time arrival information prior to arriving at the stop or station are less bothered by delays than those who do not seek out this information (23% vs. 10%). Perhaps this is because they are seeking out information and can prepare and plan around the delay.

- The results from the focus groups indicate that real-time information is most critical before someone starts a trip and at key decision-making junctures on the trip. People turn to real-time information to decide which mode to take and what time to leave the house, so they need access to this information before they can begin the trip. This information is also important during the trip, especially when making transfers between bus or rail lines, or switching modes of transportation entirely.

- The accuracy and reliability of the real-time information provided is critical for several reasons. Discussions held during the focus groups uncovered the following: First, misinformation leads people to make poor travel decisions, which creates frustration with public transportation. Second, unreliable information causes some to leave a significant
buffer when they travel and others to avoid taking public transportation at all. Third, inaccurate information causes people to stop seeking out real-time information.

Real-time Information Technologies

- Across the focus groups, Millennials are most likely to express comfort using new technologies, but their older counterparts are not far behind. Even those 38 and older feel they do ‘everything’ on their smartphones.

- Of the online respondents, ART riders appear to be more technologically inclined than others surveyed. These respondents were the most likely to indicate that they are comfortable using new technology (91% agree) and that they are often one of the first to get new technology or devices (62%).

- Almost two-thirds of online respondents (64%) check the arrival time of their bus or train prior to arriving at the bus stop or station. About nine in ten ART riders surveyed (91%) indicate that they seek out real-time information before arriving at the bus stop or station, confirming that this is information ART riders need, want and use.

- Notably, those who check for real-time information about their bus and/or train are significantly more satisfied with the information provided by public transportation agencies than those who do not seek out this information (50% vs. 38%).

- People are overwhelmingly turning to personal technology as a source of real-time information. Google Maps, WMATA Trip Planner, and Twitter were all mentioned in the focus groups as useful websites. However, it appears that people turn to mobile phone applications first and foremost to look for the real-time information they need.

- While most use modern technology to access this information, such as an app or dynamic screen, some focus group participants in the 38 and older groups are also turning to more traditional sources of information. A handful of these participants mentioned checking the news to listen for traffic or travel related information, a resource that was never mentioned in the under 38 groups.

- A recurring theme for all technologies stationed at the physical stop or station is that this information is provided too late in the travel process. By the time a rider has access to that information, they’ve already committed to taking that mode of transportation, and are essentially ‘stuck.’

- In the same vein, this desire to use real-time information to plan trips creates the need to see not just the next arriving bus or train, but the following two after that. This would allow a rider to choose which train is most convenient for them based on the conditions
of their day (for example, how much time they have to make the trip, the weather, if they will be making multiple stops, etc.). This finding is a direct result from comments focus group participants made in response to the existing technologies available (BusFinder, Redmon Screen, and Transit Screen).

**Phone Number at the Bus Stops**

- Providing a phone number at the bus stop to call for real-time information received the most negative feedback from the focus group participants. **Feedback often pertained to this service taking too long, or being ‘outdated,’ ‘cumbersome,’ and ‘a hassle.’** If ever, this is mostly used as a ‘last resort.’

- One of the most frequent reactions to this service is that it takes too long to get the information. A few participants explained that by the time they get through to a person or reach the correct option on the menu, the bus may have already arrived. At the same time, those that have never used this service say that their willingness to try it depends on how long it would take to get the information they need (for example, how many automated lists they had to listen to).

- Many participants offered suggestions for delivery methods they would prefer instead of calling the phone number. In a couple focus groups, participants recommended installing a barcode or QR code that someone could scan that would then tell them the information.

- Among the online respondents, 65% of those who have used this phone number before were satisfied with their experience, and 78% of everyone surveyed indicates that this technology is valuable. However, **these figures represent the lowest value and satisfaction ratings received across all the technologies included in this research.**

**Text Messages**

- An attractive concept to these focus group participants is that a **text message could help them plan their travel and decide when to leave for the stop or station,** allowing them to use their time most productively. Or, if they are already en route, a text could let them know if they need to run to catch the next bus or if they have time to stay for one more cup of coffee.

- Among focus group participants, **there was abundant concern that this option could result in too many unwanted and unnecessary text messages.** To combat the possibility of receiving too many or unwanted text messages, the participants stated that **this service must be highly customizable.** They should be able to select not only the routes they would like text message updates for, but also the days of the week and times of day that they typically travel on those routes.
• Another suggestion to reduce the number of messages is to implement on-demand text message updates where riders could initiate the interaction by texting a code. The current alert system sends unprompted updates whenever there is a notification about service. This suggestion would reduce the possibility of being inundated with text messages and would guarantee that they are only getting information that is relevant to them in that moment.

• The younger focus group participants commonly suggested that the delivery method could be improved by switching from a text message to a push notification, as that is their preferred way to be notified through their smartphone. This came up in each segment of Millennials focus groups but was never mentioned by the older participants.

• Those who have ever used text messages as a way to receive real-time information are generally satisfied, with 78% of those who have used this service saying they were mostly or completely satisfied with their experience. Notably, almost all of the ART riders report being satisfied with their experience (95%). The majority of online respondents view this as a valuable delivery method for real-time information (90%).

Arlington Transit Website

• This vehicle was included in the online research after appearing in focus group discussions. Ratings for satisfaction and value are high for this service, with 80% of those who have used the website before indicating that they were mostly or completely satisfied with their experience, and 94% of all online respondents indicating that it is valuable for Arlington County to provide this website. Notably, nearly all of the ART riders surveyed (99%) find this website valuable.

BusFinder

• While some appreciated the BusFinder for its sheer simplicity, many felt that it was missing key functionality that would make it a useful delivery method for real-time information. One of the main complaints is that it cannot be used as a tool to help inform decisions. Updating this technology to include the bus route and/or schedule would give customers a better picture of what buses are available to choose from.

• As for the technology itself, many felt that it is ‘antiquated,’ ‘juvenile,’ and ‘outdated.’ Some thought this could be improved by adding a feature that would allow customers to track the bus like an Uber or Lyft, while others suggested implementing another type of technology altogether, such as a scannable QR code or LED display.

• While the perception of this technology is that it is easy to use, several focus group participants explained that they have had problematic experiences with this device. Some
had difficulties with the basic functionality (i.e. making sure their finger was in the correct spot), while others cited experiences when the device seemed to not be working at all.

- **Some focus group participants were unsure if the information provided was real-time arrival information or scheduled time of arrival.** Adding instructions may work to clear up some of the confusion about the type of information being provided as some participants were unsure if the BusFinder provides real-time information or the scheduled time of arrival.

- Reactions to this device were more positive among the online respondents. Of those who have used a BusFinder, 78% were mostly or completely satisfied with their experience. Furthermore, more than nine in ten respondents (95%) consider this a valuable device for Arlington County to provide at bus stops.

**LED Displays**

- This technology was included in the online research after appearing in focus group discussions. Those who have used an LED Display before tend to be very satisfied with their experience, with almost nine in ten (87%) indicating that they are mostly or completely satisfied with their experience getting real-time information from these message boards. Those who ride ART are significantly more likely to be mostly or completely satisfied with their experience than those who ride other modes of public transportation (94% vs. 80%).

- These displays are seen as very valuable resources for riders to get real-time information with 96% of the online respondents indicating that it is somewhat or very valuable for Arlington County to provide this signage at bus stops. Those 38 and older find this type of display particularly valuable, with nearly all of those respondents (99%) indicating that this is a valuable resource.

**Dynamic Message Boards**

- Two different dynamic message boards were tested in this portion of the research to ensure that the opinions collected were not specific to one design. Furthermore, one message board presented solely public transportation options while the other included additional multimodal options (such as ride-hail, and traffic conditions in the area).

- Overall, the dynamic message boards garnered the most positive reactions from the focus group participants. Neither of the dynamic message boards tested in the focus groups incited the ‘I would never use this’ reaction that was present for most of the other real-time technologies discussed. Instead, participants praised these board for the amount of information provided and suggested that information like this could be
helpful to them if presented in the correct time and place. Most feedback pertained to the design and user experience rather than the content.

- Crucial to the effectiveness of these boards is their readability and understandability. Participants noted that both boards require a learning curve as they are not instantly understandable.

- Specifically, these participants were pleased that the Redmon Screen board provided information about the maintenance schedule and the weather, but many felt that the board was overwhelming and ‘too busy’ overall. Suggestions include adding a route map, clarifying if the times provided are the arrival or departure time, and keeping the information consistent so that it always shows the minutes until arrival and not the actual arrival time.

- The vast majority of online respondents who have used a Redmon Screen to look for information are satisfied with their experience, with 90% indicating they are mostly or completely satisfied with their experience getting real-time information from this message board. Notably, this satisfaction is equally high among all ages and types of transportation users. The Redmon Screen is considered valuable by 96% of the online respondents. Again, there are no differences between those who typically use public transportation and those who do not – all find this type of technology valuable; nor are there differences between the generations, with those 38 and older assigning just as much value to this screen as Millennials. The one place a significant difference is visible is across racial lines. Caucasians (non-Hispanic) are significantly more likely than those of other races and ethnicities to consider this screen valuable (98% vs. 90%).

- Some focus group participants felt that the amount of information provided via the Transit Screen could be overwhelming, but they prefer to have that level and variety of information as it helps them to make travel decisions. Beyond the standard public transportation information, participants were pleased to see information about the current and projected traffic conditions as well as the current and future weather. Suggestions for improvement include making it easier to differentiate between bus and rail lines, adding Lyft information (in addition to the existing Uber information), including the next several buses or trains that are arriving, and incorporating information about the current cost of tolls and ride-hailing price surges.

- While use and awareness is relatively lower, the online respondents who have used the Transit Screen before are generally very satisfied with their experience. About nine in ten respondents (93%) report being mostly or completely satisfied with their experience getting real-time information from these message boards. Furthermore, all respondents report being at least somewhat satisfied, with no one indicating that they were not very
or not at all satisfied. The Transit Screen is considered valuable by 93% of online respondents. As with Redmon Screen, there are no differences between the generations, with those 38 and older assigning just as much value to this screen as Millennials. Also similar to the results for Redmon Screen, Caucasians are significantly more likely than those of other races and ethnicities to consider the Transit Screen valuable (95% vs. 88%).

- While pleased with the concept of these boards, a couple participants mentioned that this is something they would like, or even prefer, to have on their phone so that they could customize the information.

**Mobile Phone Applications**

- While the prevailing attitude seems to be that people would like to find real-time information through an app, experiences with using apps can be difficult as there are so many options available that each offer different information. **These participants do not want another app on their phone that only provides a piece of the puzzle, they would like one single app that works to combine all of the available information in one place.**

- There are several themes that arose across the focus groups that clarify exactly what people are looking for when they turn to apps for real-time information. This information is useful in identifying values that can be incorporated into other vehicles of real-time information, as many of the themes outlined below were also present during discussions about dynamic message screens and other types of real-time technology.

- The focus group participants like when an app provides the ‘big picture,’ presenting all possible options and providing information that can be used to compare various trip choices; information about cost is the first aspect of what is considered a critical part of the big picture, as is the overall length of the trip and the estimated time of arrival. The participants also responded positively to apps that included good maps that provide landmarks to help them navigate.

- Although it is the most widely used and recognized app among the online respondents, Google Maps receives one of the lower satisfaction scores. In fact, all three of the least used apps (Moovit, CityMapper, Transit) received higher satisfaction ratings from the online respondents than both Google Maps and Apple Maps. Furthermore, Google Maps received significantly lower ratings from those 38 and older than from those under 38.
Conclusions and Recommendations

Objective 1: To understand what information riders are looking for and expect from transit agencies when they seek out real-time information (including which mode of delivery, form and format transit customers prefer).

- Real-time information is not just about time – it is about all of the information that impacts a trip. Specifically, people want information that pertains to the three main factors: the cost of the trip, the length of the trip, and the convenience of the trip.

- The desire to use real-time information to plan trips creates the need to see not just the next arriving bus or train, but the following two after that. This would allow a rider to choose which train is most convenient for them based on the conditions of their day (for example, how much time they have to make the trip, the weather, if they will be making multiple stops, etc.).

- Several focus group participants mentioned that they would like the information to provide solutions or suggestions when delays occur. It is not enough just to know their bus has broken down; they would like to be given alternate routes. An action item the county could consider is providing recommendations with communications about major events and delays.

- Reactions from the focus group participants in response to the dynamic message boards reveal that the existing branding used by the various public transportation agencies in the area has been successful in creating quick associations between colors and lines of transportation. However, this creates confusion when certain colors are used in messaging. For example, a map with a blue route is instantly assumed to be Metrorail’s Blue Line. Because the colors used for the various lines are so ingrained in this community, choice of colors is critical in ensuring the information is easily recognizable and understandable.

Objective 2: To identify when in the travel process riders look for real-time information and where they look for this information.

- The results from the focus groups indicate that real-time information is most critical before someone starts a trip and at key decision-making junctures on the trip. People turn to real-time information to decide which mode to take and what time to leave the house, so they need access to this information before they can begin the trip. This information is also important during the trip, especially when making transfers between bus or rail lines, or switching modes of transportation entirely.
Objective 3: **To identify where the information made available to transit travelers should be made available.**

- This research suggests that people turn first and foremost to apps when looking for real-time information, but like having the message boards to supplement their travel experience. However, due to the nature of when people have access to these boards, they cannot replace the role that apps play in the travel process.

- A recurring theme for all technologies located at the physical stop or station is that this information is provided too late in the travel process. By the time a rider has access to that information, they’ve already committed to taking that mode of transportation, and are essentially ‘stuck.’

- The focus group participants suggested several locations where these dynamic message boards would be useful, including lobbies of office buildings and apartments, in elevators, hotels, shopping centers, schools, as well as outside of Metro stations and sporting venues. It was also mentioned that these boards would be useful inside of the office or apartment itself, and not just in the lobby. The online respondents provided similar suggestions, with malls and shopping centers (71%), lobbies of commercial buildings (67%), lobbies of apartment buildings (52%), and hospitals (40%) receiving the most mentions. Less than one in ten respondents (7%) reported that they would not find value in this type of message board at any location.

- While the prevailing attitude seems to be that people would like to find real-time information through an app, participants do not want another app on their phone that only provides a singular piece of the puzzle. Rather, they would like one app that works to combine all of the available information in one place. For this reason, an ART-specific app is not advisable. Instead, ART should work to make its information available and easily accessible to third-party app developers.

Objective 4: **To gauge satisfaction with the sources of information currently available.**

- Providing a phone number at the bus stop to call for real-time information received the most negative feedback from the focus group participants. Feedback often pertained to this service taking too long, or being ‘outdated,’ ‘cumbersome,’ and ‘a hassle.’ If ever, this is mostly used as a ‘last resort.’

- While focus group participants were attracted to the concept of text message updates, there was abundant concern that this option could result in too many unwanted and unnecessary text messages. To combat the possibility of receiving too many or unwanted text messages, the participants stated that this service must be highly customizable.
While some appreciated the BusFinder for its sheer simplicity, many felt that it was missing key functionality that would make it a useful delivery method for real-time information. One of the main complaints is that it cannot be used as a tool to help inform decisions. Updating this technology to include the bus route and/or schedule would give customers a better picture of what buses are available to choose from.

Overall, the dynamic message boards garnered the most positive reactions from the focus group participants. Neither of the dynamic message boards tested in the focus groups incited the ‘I would never use this’ reaction that was present for most of the other real-time technologies discussed. Instead, participants praised these board for the amount of information provided and suggested that information like this could be helpful to them if presented in the correct time and place. Most feedback pertained to the design and user experience rather than the content.

Among the focus group participants, a recurring theme when speaking about the accuracy and reliability of real-time information is that the information available surrounding major events and delays needs improvement. Participants mentioned either never receiving notifications about delays or closures, or if they do receive them, the information is too late to be helpful. One specific suggestion to improve communications about delays is to always provide the estimated length of the delay.

While most focus group participants are comfortable with the concept of real-time information, there does appear to be some confusion as to which information is real-time and which information is based on the schedule. This suggests that public outreach or education could be beneficial when implementing real-time technologies.

Overall, the online respondents are least satisfied with their experiences getting real-time information from the phone number installed at bus stops. BusFinder was the only technology that was not significantly more satisfactory than the phone number. The two dynamic message screens (Redmon Screen and Transit Screen) received significantly higher satisfaction ratings than the phone number, text message updates, Arlington Transit website, and BusFinder.

The comparative value of each technology is more difficult to assess than its satisfaction as seven of the eight real-time information delivery methods are considered valuable by at least nine in ten online respondents. The Arlington Transit website, BusFinder, LED Displays, and Redmon Screen are all seen as significantly more valuable than both the phone number and text message updates. However, text messages did receive statistically significant higher value ratings than the phone number.
The online respondents who did not have experience using the tested technology were instead asked why they have not used the particular source of information. For every technology tested, the number one reason cited for not using the technology was lack of awareness. This suggests that one way to increase the number of people who utilize the available resources is to make these offerings more widely known.
BACKGROUND AND OBJECTIVES

In the transportation industry, research has found that real-time information is critical to customer satisfaction and ridership. Real-time information refers to information about the current status of transit, such as the location or arrival time, through signage and/or technology. In an effort to understand the needs and expectations that surround real-time information in Arlington County, DS&MG contracted WBA Research (WBA) to conduct a mixed methods investigation of transit-riders’ experiences with real-time information in the Arlington County and Washington, DC metropolitan area.

Specifically, the objectives of this research were:

- To understand what information riders are looking for and expect from transit agencies when they seek out real-time information (including which mode of delivery, form and format transit customers prefer),
- To identify when in the travel process riders look for real-time information and where they look for this information,
- To identify where the information made available to transit travelers should be made available, and
- To gauge satisfaction with the sources of information currently available.
METHODOLOGY

To accomplish the aforementioned goals, WBA employed a mixed methods research approach. This allowed the opportunity to explore the experiences of Arlington transit users in-depth through focus groups, and the benefit of collecting opinions from the wider Arlington population through an online quantitative survey.

Focus Groups

A series of fourteen focus groups were held between July 11, 2018 and July 26, 2018, with each group containing seven to twelve participants. In total, 140 people participated in the focus groups – the English-speaking participants each received a $100 gratuity while the Spanish-speaking participants each received a $125 gratuity. Each group lasted approximately two hours and was overseen by a professional focus group moderator from WBA Research.

The groups were designed to be as homogenous as possible in their transit use. One segment of groups contained rail users that do not typically ride the bus, one segment contained frequent bus users, and another contained those who use a variety of travel modes including bus, rail, Uber, and bikes. Due to the nature of public transportation in Arlington County, there are very few people who ride the bus but do not use Metrorail. Therefore, the participants in the bus groups typically use Metrorail as well. However, to qualify for the bus groups, they had to ride the bus at least as often or more frequently than they ride the rail.

As technology is at the center of the real-time information discussion, these segments were further divided by age to assess whether a person’s age impacts their opinions of and experiences with real-time technology. Each travel segment listed above had two focus groups with those age under 38 and two groups with those 38 and older. This reflects the generational break between Millennials and Generation X.

The final two groups were comprised of Spanish-speakers who live, work, and/or go to school in Arlington County. A five-year estimate conducted by the Census Bureau from 2013 to 2017 found that 29.5% of residents in Arlington County speak a language other than English at home. Spanish accounts for the largest proportion of languages other than English spoken at home (13.7% of the total population). Given this statistic, it is critical to ensure that the information made available to the public is accessible to those with all levels of comfort with the English language.

Prior to the start of each focus group, a comprehensive background survey focusing on demographics, travel habits, and attitudes was administered via tablet as participants arrived.

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2 Source: U.S. Census Bureau, 2013–2017 American Community Survey 5-Year Estimates
https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_S1601&prodType=table
(results are available in the appendix). These results are used to provide context to the findings from the focus groups. In total, 156 focus group participants completed this background survey. Online Research

While the information gathered from the focus groups is valuable for its depth, clarity, and nuance, these findings are not necessarily projectable or generalizable to the population at large. To bridge this gap, a quantitative survey was created to collect the opinions of the wider Arlington population.

An online panel was utilized to reach respondents who live, work, and/or go to school in Arlington County. This portion of the research did not stipulate that respondents use any form of public transit, so the results from this survey include those who use public transportation in the Washington, DC metropolitan area and those who do not. Overall, 346 online panel surveys were completed between September 26, 2018 and October 12, 2018.

As this research was not designed to capture only the opinions of Arlington County residents, but also those who commute to the area, there is no defined population to compare this sample to in order to assess how representative the results are. However, because 93% of those surveyed live in Arlington County, the demographics of this sample can be loosely compared to those of Arlington County.

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3 To ensure a successful number of participants at each focus group, best practice is to recruit more participants than necessary to seat. If too many participants arrive for the focus group, best candidates are selected for participation. In total, 16 participants arrived at the focus group and took the background survey before being selected for non-participation. This results in 140 total participants and 156 background surveys.
### Table 1: Sample Data vs. Census Data

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Sample Data</th>
<th>Census Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race and Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian, alone</td>
<td>79%</td>
<td>71.5%</td>
</tr>
<tr>
<td>African-American, alone</td>
<td>10%</td>
<td>8.8%</td>
</tr>
<tr>
<td>Asian or Asian-American, alone</td>
<td>5%</td>
<td>10.3%</td>
</tr>
<tr>
<td>Native-American or Alaskan Native, alone</td>
<td>1%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Native Hawaiian or Other Pacific Islander, alone</td>
<td>1%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Multi-racial</td>
<td>3%</td>
<td>3.2%</td>
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<tr>
<td>Hispanic or Latino(^1)</td>
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<td>15.5%</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median age (years)</td>
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<td>34.4</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
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<td>Male</td>
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</tr>
<tr>
<td>Female</td>
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<tr>
<td><strong>Income</strong></td>
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<tr>
<td>Median income (dollars)</td>
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<td>$112,138</td>
</tr>
</tbody>
</table>

\(^1\)Hispanics can be of any race, and so are included in the appropriate racial categories.
Typically, qualitative research is used to provide answers to attitudinal questions, as well as to provide insight and in-depth understanding of consumer perceptions and opinions. By nature, this research method does not usually allow for statistical analysis and interpretation. Rather, it is a tool for decision-making purposes. The findings from this type of research should be used to provide insight and direction into decision-making rather than as a sole basis for decision-making.

Qualitative research tends to provide answers to questions like “Why?” and “How?”, whereas quantitative research tends to provide answers to questions such as “How many?” or “How much?” The findings from the focus group portions of this report are based on the attitudes and opinions of the participants and are not necessarily projectable or generalizable to the population at large.

When evaluating results from the focus group background survey (available in the appendix), it should be kept in mind that this sample was specifically selected for its high use of public transportation and is not representative of the population as a whole. These results cannot be generalized to the population at large. Instead, the results from the panel survey can be used to assess how the wider Arlington County population feels about the various items measured in this research. Furthermore, the quantitative results from the focus groups are not directly comparable to the results of the online research for the attitudinal questions as the two surveys used different scales. A four-point scale was chosen for the focus group background survey that did not allow participants to select neutral so that slight leanings in opinions could be captured. However, a neutral option was added to the online survey to allow for more precise analysis.

Quantitative Sampling Error

As a result of only a portion of the entire population completing a survey, the data are subject to sampling error. A total of 156 focus group background surveys results in a maximum standard error of ±7.8 percentage points at the 95% confidence level, while the 346 panel surveys results in a maximum standard error of ±5.3 percentage points. However, depending on the data being examined, the sampling error may vary. Sampling errors are shown below at the 95% confidence level for various percentages.

Caution should be taken when evaluating data with a small sample size or base (n<35) due to the high level of sampling error around the data, which can lead to results that do not accurately represent the population as a whole.
If the percentage found is around:

<table>
<thead>
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<th>Percentage</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>99%</th>
</tr>
</thead>
<tbody>
<tr>
<td>40% or</td>
<td>±5.3</td>
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<td>±4.8</td>
<td>±4.2</td>
<td>±3.2</td>
<td>±1.0</td>
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<tr>
<td>30% or</td>
<td></td>
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<td>20% or</td>
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<tr>
<td>99%</td>
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Online Panel Survey (n=346)

Statistical Significance

Statistical significance means that there is a 95% chance that a difference found in this research would also have been found if everyone who lives and/or works in Arlington County had been surveyed. Depending on the data being examined, t-tests and z-tests were utilized to determine if the differences observed between various groups were statistically significant.

Where appropriate, comparisons have been made between gender, age, transportation usage, race, and other descriptors. Due to the variability of the types of comparisons made, any chart that includes statistical testing includes a footnote to explain how to read that table.
PARTICIPANT AND RESPONDENT PROFILE

Focus Group Participants

Overall, the participants who attended the focus groups should be considered proponents of real-time information. Nearly all of the focus group participants agree with the statements, “Having real-time information is important to me when using public transportation” (99% agree) and “Having real-time arrival information when using public transportation helps me relax” (99% agree). However, these participants are not all equally likely to seek out this real-time information. Participants in the rail groups were the least likely to indicate that they check for real-time arrival information before leaving the house (54% - 55%). Conversely, bus and multimodal participants under 38 were the most likely to engage in this behavior (90% - 100%).

In general, these participants are also tech-savvy and inclined to use technology as a source of information. Almost all of the participants agree with the statements, “I am comfortable using high-tech devices” (94% agree) and “It is important for me to be able to use a smartphone to get public transportation information” (95% agree). In fact, most of these participants feel there is potential to use technology even more when looking for information about public transportation. About eight in ten of all participants agree with the statement, “I would use technology to look for travel information more if it were easier to get the information I need” (82% agree). The bus and multimodal participants under 38 demonstrated particular preference for technology with nearly all of these participants indicating they would rather use technology to look for information than ask a person (95% each).

Rail under 38 – 22 participants

The rail under 38 participants skew slightly younger and female. Most of these participants are employed full-time and identify as Caucasian. Most earn between $50,000 and $100,000 a year, with none earning less than $35,000. All of these participants use Metrorail in a typical week, and many drive alone, walk, and/or use a ride-hailing service (Uber/Lyft). Interestingly, these participants were the least likely to indicate that public transportation is convenient for most of their trips in the focus group background survey.

Rail 38 and older – 21 participants

The rail 38 and older participants are evenly split between males and females. Most of these participants are in their 40s, but there is representation from some in their 30s, 50s, and 60s. Almost all of these participants are employed full-time, with one indicating they are unemployed and another retired. They are mostly Caucasian and wealthy, with most participants earning more than $100,000 a year. All of these participants use Metrorail in a typical week, and almost all drive alone. Slightly less than one-half of this group uses a ride-hailing service in a typical week.
**Bus under 38 – 20 participants**

The bus under 38 participants are about evenly split between males and females, as well as ages, with about one-half in their 20s and one-half in their 30s. Most of these participants are employed full-time. This group was more racially and ethnically diverse, with about one-half identifying as Caucasian and a similar portion identifying as African American (respondents could identify as more than one race). The reported income levels in this group were also more evenly distributed, with representation from all income brackets (ranging from less than $35,000 a year to $150,000 or more). Almost all of these participants use Metrobus in a typical week, and most also take ART, Metrorail, and/or a ride-hailing service. Notably, these participants were the most likely to indicate that they cannot rely on public transportation to be on schedule or on time in the focus group background survey. They were also the least likely to agree that travel on public transportation is safer than other forms of travel in the area.

**Bus 38 and older – 21 participants**

This group skews slightly female and older, with equal representation from those in their 40s, 50s, and 60s, and only two respondents in their 30s. Most are employed full-time and identify as Caucasian and/or African American. The income levels in this group were evenly distributed between those who earn less than $75,000 a year and those who earn $75,000 or more. All of these participants use Metrobus in a typical week, and many also use ART and/or Metrorail. About one-fourth of these participants use a ride-hailing service in a typical week.

**Multimodal under 38 – 21 participants**

The distribution of ages and genders was about even in this group. Almost all of these participants are employed full-time. This group was more racially and ethnically diverse, with almost one-half of participants identifying as a race other than Caucasian. The income levels in this group were evenly distributed between those who earn less than $75,000 a year and those who earn $75,000 or more. All of these participants use Metrorail in a typical week, and many also use Metrobus, a ride-hailing service, and/or walk.

**Multimodal 38 and older – 20 participants**

The participants in this group skewed slightly male and middle-aged, with most respondents being in their 40s or 50s. While most are employed full-time, there is also more representation from those employed-part time than in other groups. Most of these participants earn $75,000 a year or more. About one-third of the participants in this group identify as a race other than Caucasian. All of these participants use Metrorail in a typical week, and many also use Metrobus, walk, and/or drive alone.
Spanish – 15 participants

The participants in the Spanish group are evenly split between males and females. These participants are mostly in their 30s and 40s, and they all identify as Hispanic or Latino. About three-fourths of the participants are employed full-time and about one-fourth are employed part-time. The incomes skew slightly lower, with most earning less than $75,000 a year, but some still earning more than $100,000 a year. All of these participants use Metrorail in a typical week, and many also use Metrobus.

Online Respondents

The final online sample is composed of ART riders (25%), public transit riders who do not ride ART (36%), and those who do not typically use any public transit (38%). Throughout the report, comparisons will be made between these three groups of respondents. For clarity, the definition for each group is outlined below:

- **ART riders** are those who indicate that they use the ART bus in a typical week.
- **Non-ART public transit riders** are those who do not take ART in a typical week. This group includes those who never take the ART bus as well as those who may take it occasionally.
- Those who **do not typically use public transit** are those who do not take any form of public transit in a typical week. This group includes both those who never use any form of public transit as well as those who may take a form of public transit occasionally.

*Figure 1: Respondent Classification*

Q1. What types of transportation do you use in a typical week?
Base = Total online sample (n=346)
ART Riders

The ART riders included in this study skew younger (61% under 38), male, and educated. Most of these respondents identify as Caucasian (73%), while 14% identify as African American and 14% identify as Hispanic or Latino. Compared to the other respondents, this group is earning slightly less. The median income in this group is $85,190, compared to more than $110,000 in both of the other groups. These respondents are tech savvy, with most owning at least three different types of technology (smartphone, tablet, wearable tech, etc.). In fact, these respondents are significantly more likely than other respondents to own five different types of technology. In addition to the ART bus, many of these respondents are also typically using Metrorail and/or driving alone. These respondents are very familiar with real-time information, with the majority (91%) indicating that they check for real-time information before arriving at the bus stop or station.

Non-ART Public Transit Riders

The non-ART public transit riders are a mix of ages, with roughly equal proportions under 38 and 38 and older. These respondents skew slightly female, high income (median income is $116,670), and highly educated (more than one-half have a graduate or professional degree). Most of these respondents (80%) identify as Caucasian, with 10% being of Hispanic or Latino decent. The majority of these respondents are using Metrorail in a typical week, and many are also walking and/or driving alone. These respondents are also very tech-savvy, but perhaps a bit less so than the ART riders. Most of these respondents own three devices, compared to the ART riders’ five devices. Most of these respondents have experience seeking out real-time information, with more than two-thirds (69%) indicating that they check for real-time information before arriving at the bus stop or station.

Non and Occasional Public Transit Users

The non and occasional public transit users skew female, highly educated, high income (median income of $113,240), and older than other respondents included in this research (57% 38 and older, and 41% over 45). Most of these respondents identify as Caucasian, while 10% identify as African American and 8% as Hispanic or Latino. These respondents do not typically use any form of public transportation. The vast majority typically drive their car alone, while about one-third also walk and fewer use a ride-hailing service. Non-public transit users have the least experience with real-time information, with roughly four in ten (42%) indicating that they check for real-time information before arriving at the bus stop or station. Throughout the remainder of this report, this population will be referred to as ‘Non-public transportation users.’
TRAVEL PATTERNS

Discretionary Travel

The focus group participants all reported being very mobile. Most of their typical trips appear to happen within Arlington County or Washington, DC. The list of activities, attractions, and events they attend in these areas is extensive: happy hours, sporting events, plays, restaurants, museums, shopping, concerts, church, and trips to see friends are just a few. Notably, this activity is present among all ages, with the older participants demonstrating just as much verve as the younger participants.

Interestingly, when asked where they travel in the area many focus group participants cited neighborhoods within Arlington County (e.g. Clarendon, Ballston, or Rosslyn), suggesting that they do not think of travel as simply from Arlington to someplace else, but within Arlington as well.

This high level of activity is reflected by the online respondents, with 70% agreeing with the statement, “I often go out for dining, or to social, entertainment or sporting events” (Figure 2). Here, there is an observable difference between the generations, with those under 38 significantly more likely to agree with this statement than those 38 and older (77% vs. 63%). It also appears that those who use public transit are a bit more active than those who do not. Almost eight in ten public transit users (78%) agree that they often go out for dining, or to social, entertainment or sporting events, compared to roughly six in ten non-public transit users (58%).

While most respondents report that they often go out, there is mixed agreement with the statement, “I often go to new and different places” (Figure 3). About one-half (56%) agree with the statement, with public transit users (61% agree) and those under 38 (62% agree) once again the most likely to agree.
Commute Travel

While discretionary travel often involves new destinations or situations that allow for alternate modes of transportation, trips taken to commute to and from work appear much more routine. The majority of focus group participants have a predictable work schedule that allows for this behavior to be routine. Across all focus groups, participants mentioned that they have one or two different ways they might get to work, depending on the day, but they are not deciding on new modes or routes unless necessary.

“I mean during the work week, of course going to work, I’ve already pretty much planned out whether I’m taking the train, I’m driving on particular days. It depends on which location I have to go to. Weekend is a little bit different. Again, it depends on how late I’m going to be out that night, whether it’s convenient or easiest to drive or are there other resources to use?” – Rail 38 and older

“I won’t really consider a new route for my commute unless it is an exceptional circumstance or a bike or something. But, if we’re meeting people at a bar or a baseball game, then I absolutely will.” – Rail under 38

The potential for routine is shared by many of the online respondents, with nearly one-half (48%) indicating that their work schedule is predictable (Figure 4). Interestingly, those who typically take public transportation are more likely than those who do not to indicate that their work schedule is predictable (53% indicating a predictable work schedule vs. 39%), suggesting a relationship between predictability and the ability to utilize public transportation.

Among the online respondents, the average commute length is 11.5 miles. Most commutes fall within 3 and 20 miles of the home, with 28% commuting 3-5 miles, 24% commuting 6-10 miles, and 23% commuting 11-20 miles (Figure 5). Most respondents are able to get to work in less than 30 minutes. Roughly two in ten (19%) travel for ten minutes or less, while about one-fourth travel between 11-20 minutes (25%) or 21-30 minutes (23%, Figure 6). On average, the online respondents travel 27.5 minutes to work or school.
Q4. How long is your typical daily commute to work or school one way?

1Base = Online respondents answering (n=279)
2Base = Online respondents answering (n=280)
Travel Wait Times

The online respondents who use public transportation were asked how long they are willing to wait for the next bus and train once they arrive at the stop or station. The length of time people are willing to wait for the bus and train are similar, with most willing to wait 10 minutes or less for either mode (Figures 7 and 8).

The length public transportation users are willing to wait does not vary significantly between those who check for real-time information before arriving at the stop/station and those who do not. ART riders are willing to wait significantly longer for a bus than users of other public transportation: ART riders are willing to wait an average of 14.9 minutes, compared to other public transit users at 9.6 minutes. This is consistent with wait times for the train as well, with ART riders willing to wait an average of 15.1 minutes, and other public transit users willing to wait 10.0 minutes. There are visible differences between males and females as well, with men willing to wait longer than females for both the bus (13.5 minutes vs. 10.0 minutes) and the train (14.2 minutes vs. 10.1 minutes).

**Figure 7: Wait Time for Bus**

<table>
<thead>
<tr>
<th>Time Interval</th>
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</tr>
</thead>
<tbody>
<tr>
<td>0-5 minutes</td>
<td>29%</td>
</tr>
<tr>
<td>6-10</td>
<td>34%</td>
</tr>
<tr>
<td>11-15</td>
<td>20%</td>
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<tr>
<td>More than 15</td>
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</tbody>
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**Figure 8: Wait Time for Train**

<table>
<thead>
<tr>
<th>Time Interval</th>
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</thead>
<tbody>
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</tr>
<tr>
<td>6-10</td>
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<td>11-15</td>
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</tr>
<tr>
<td>More than 15</td>
<td>17%</td>
</tr>
</tbody>
</table>

Q4A. How long are you willing to wait for your bus to arrive once you are at the stop/station?
Base = Online respondents who use public transportation (n=214)

Q4B. How long are you willing to wait for your train to arrive once you are at the stop/station?
Base = Online respondents who use public transportation (n=214)
MODES OF TRANSPORTATION
Online Respondents: Mode Use and Share of Trips

The table on the following page details the percentage of online respondents that use each mode of transportation, as well as the share of trips each mode holds among the total sample, public transit users, and non-public transit users. The share of trips value represents the percentage of trips that each mode holds out of the total number of trips taken each week. In other words, of the 6,266 trips taken in a typical week by these respondents, WMATA Metrorail accounts for 913 of those trips, or a 15% share of trips.

Among public transportation users, walking holds the largest percentage of trips (22%), followed closely by WMATA Metrorail (21%). While driving alone still holds a considerable portion of weekly trips for public transportation users, it is significantly lower than among those who do not typically use public transportation (18% vs. 59%).

It appears the two major bus lines in Arlington County are competing for a similar share of trips, with Metrobus earning 6% of weekly trips and ART earning 5%. Notably, both buses earn a larger portion of the weekly number of trips than ride-hailing apps like Uber or Lyft (4%). However, public transportation users are using Uber and/or Lyft with greater frequency than those who do not use public transportation (5% vs. 3%).
Table 3: Mode Use and Share of Trips

<table>
<thead>
<tr>
<th>Mode of Transportation</th>
<th>Respondents Using the Mode</th>
<th>Share of Trips (Among Public Transit Users)</th>
<th>Share of Trips (Among Non-Public Transit Users)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving a car alone</td>
<td>72%</td>
<td>30%</td>
<td>18%</td>
</tr>
<tr>
<td>WMATA Metrorail</td>
<td>47%</td>
<td>15%</td>
<td>21%</td>
</tr>
<tr>
<td>Walking</td>
<td>43%</td>
<td>20%</td>
<td>22%†</td>
</tr>
<tr>
<td>Driving a car with passengers</td>
<td>34%</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>Riding in a car as a passenger</td>
<td>28%</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Using a ride-hailing service (Uber or Lyft)</td>
<td>28%</td>
<td>4%</td>
<td>5%†</td>
</tr>
<tr>
<td>Arlington Transit (ART Bus)</td>
<td>25%</td>
<td>5%</td>
<td>7%</td>
</tr>
<tr>
<td>WMATA Metrobus</td>
<td>24%</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td>Riding a bicycle</td>
<td>12%</td>
<td>2%</td>
<td>2%†</td>
</tr>
<tr>
<td>Carpooling or vanpooling</td>
<td>7%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>DC Circulator</td>
<td>5%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Virginia Railway Express (VRE)</td>
<td>5%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Taking a taxi or limousine</td>
<td>5%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Fairfax Connector</td>
<td>5%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Bikeshare</td>
<td>4%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Riding a motorcycle</td>
<td>3%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>DASH</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Riding a scooter</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

An arrow (†) signifies that the percentage for that population is significantly higher than the percentage for the other.

Q1. What types of transportation do you use in a typical week?
1Base = Total online sample (n=346)
Q1A. In a typical week, how many one-way trips do you take by each mode listed below?
2Base = Total trips taken by those answering (n=1,933 - 6,266)
Public transportation users tend to agree that they “travel on the same routes or lines of transportation all the time” (81% agree, Figure 9). This suggests both a high level of familiarity with their chosen modes and consistency in their travel habits. This pattern is consistent regardless of age, gender, race/ethnicity, or income.

Availability of a Car

Living in a metropolitan area with access to comprehensive public transportation makes living without a personal vehicle possible for many. However, the majority of online respondents live in a household with at least one car (88%, Figure 10). Those who do not have a car in the household appear to have limited access to a personal vehicle, with almost one-half of these respondents (48%, Figure 11) saying they never have access to a vehicle and only 10% indicating that a vehicle is available to them all or most of the time.

Q2A. How often do you have a vehicle available to you?
Base = Online respondents without a vehicle in the household (n=40)
MODE CHOICE: DECIDING HOW TO TRAVEL

Factors that Influence Mode Choice

The factors that influence mode choice will appear consistently throughout the remainder of this report. Therefore, an analysis is included to frame subsequent discussion. There is no single factor that drives which mode of transportation a person chooses to use. People consider a plethora of conditions that impact how they decide to get somewhere: the time of day, day of the week, how many people they are traveling with, type of event they are attending, if alcohol is involved, events happening in the city that may disrupt traffic patterns, weather, availability of parking, reliability of the mode, how close the Metro stop is to their destination, length of the trip, whether or not transfers are involved, and if considering public transit, when the next bus or train is arriving. While all of these factors are considered, they appear to funnel to three main factors: cost, time, and convenience.

These three factors are where people make trade-offs based on the conditions of the trip. For example, if they do not have any time constraints, they may choose a less expensive trip with a longer travel time; or, if the cost is equal, they will pick the trip that is most convenient or comfortable. However, in a different scenario where they must be somewhere by a certain time, they may choose the more expensive option if that mode is more reliable or faster.

“So I have to walk to the Metro. I can walk, but it’s not super close. So that’s, I don’t know, say 5 or 10 minutes depending on how fast I’m moving. Then I have to take the Metro somewhere. I have to wait for the train. I have to do all that stuff. Half the time, it’s just going to be pretty much just cost-wise, it’s probably going to be almost about the same, maybe a little bit more. But an hour versus 10 minutes in an Uber or a car, especially if it’s not rush hour.” – Rail under 38

“I want to take whatever is cheapest, so I usually check Uber and Lyft, and then look at what the Metro options would be if there’s not a time pressure.” – Bus under 38

“I usually look at the cost to time ratio. Again, taking that “time is money” literally, because sometimes it’s just worth it to pay the extra 2.9 surcharge for an Uber versus waiting 15 minutes for a train, and then making that transfer.” – Bus under 38

“I also take into consideration like what the cost of it’s going to be and then how long it’s going to take using that method of transportation.” – Multimodal under 38

“I will take a bus that goes out of my way but goes through my neighborhood so I can get on the bus stop right across from my house instead of walking to Columbia Pike. But then I have to be on the bus longer.” – Multimodal under 38

Three Main Factors:

1. Cost
2. Time
3. Convenience
“In my experience, people primarily care about three things. Time, money and energy.” – Multimodal under 38

“... it depends on the time. It would be convenient if you could just drive, get out of the car and go in, but then [you have to] pay for parking. It’s just so convenient to ride Metro and I don’t have to worry about a car or even walking to your car.” – Bus 38 and older

Cost and Time

Cost and time were almost never mentioned independently of one another; focus group participants invariably balance the value of their time and the value of their dollar. However, which way the pendulum swings depends largely on the individual.

“Sometimes it takes me half as much time to take Uber, but if it’s 10 times less expensive just to take Metro and it’s twice the amount of time, then I’m just going to suck it up and do the 45-minute Metro ride.” – Multimodal under 38

“It was worth it to me to just pay the extra $2 to take the Uber into town instead of waiting on the Metro.” – Rail under 38

Among the online respondents, attitudes are split. While one-half (50%, Figure 12) agree that “saving time is often more important than saving money,” the rest feel neutral or disagree with the statement. Notably, this attitude does not appear to be driven by a person’s socioeconomic status. Those who make less than $50,000 a year are equally likely to agree with this statement as those who make more.

Those who do not use public transportation are more likely than those who do to indicate that saving time is more important than saving money (57% vs. 45%). Interestingly, men are more likely than woman to do the same (57% vs. 43%). Those under 38 are significantly more likely than their older counterparts to disagree with this statement (27% disagree vs. 18%).

Figure 12: For me, saving time is often more important than saving money

Agree Neutral Disagree

50% 22% 28%

Base = Total online sample (n=346)
Regardless of how an individual values their time in respect to their money, it is generally understood that public transportation is not a quick mode of transit. In fact, this appears to be a barrier to using public transportation, with six in ten online respondents (60%, Figure 13) indicating that they would “use public transportation more if it did not take so long.” Interestingly, the responses from those who use public transportation were similar to the responses from those who do not. It appears that most agree, that they would use public transportation more if it did not take so much time, regardless of current transportation habits.

**Convenience**

Convenience is the third main factor that people consider when deciding which mode of transportation to use. Beyond the specific conditions that make one mode more or less convenient on any given day, the online respondents were asked if public transportation was convenient for them in general. About one-half of online respondents (49%, Figure 14) agree that “public transportation is convenient for most of my trips.” However, this proportion increases to two-thirds when looking just at public transportation users, who are significantly more likely to agree than those who do not use public transportation (66% vs. 22%). Notably, ART riders are more likely to agree with this statement than users of other modes of public transit (75% vs. 60%), suggesting that ART is meeting the needs of its riders.

In a metropolitan area where so many residents have personal vehicles, it is important to not only understand the attitudes surrounding the convenience of public transportation, but also those surrounding driving a car. About three-fourths of the online respondents (76%, Figure 15) agree with the statement, “I like the convenience of driving a car.” Naturally, those who do not use public transportation are significantly more likely to agree with this statement than those who use public transportation.
transportation (89% vs. 67%). Interestingly, males were significantly more likely than females to indicate that they enjoy the convenience of driving a car (82% vs. 70%).

A car’s immediate availability is one aspect of its convenience that commuters are attracted to. Depending on a person’s work or personal life, that instant access and control can be necessary during the day. The need to have a car available during the workday is a reality for roughly one-half of the online respondents (54%, Figure 16). Unsurprisingly, those who do not typically take public transportation are significantly more likely than those who use public transportation to agree that they need to have a car available during the workday (63% vs. 49).

Mode Choice and Unreliability

A mode’s real or perceived reliability is another significant factor when it comes to mode choice. This sense of unreliability leads many focus group participants to either build a significant buffer into their travel time or choose not to take public transportation at all. In fact, the findings from the focus groups suggest that people favor ride-hailing services when looking for reliability.

“I was going to take Metro and I just kind of was wondering how long it might take and then walking here. And then, I thought what if there’s a Metro delay because it’s so unpredictable? So I thought it was just easier to take a Lyft.” – Rail 38 and older

“There really is a concern these days and that is planning to be someplace, I want to be there at a certain time. I find now that I leave so much earlier for Metro because of the delays. And that’s a real disadvantage. And that if anything, has shifted me from using Metro to more Uber if I have an appointment and have to be someplace at a certain time.” – Rail 38 and older

“The weekend service has become, it’s just so unreliable that my wife and I don’t even think about using Metro on a Saturday or a Sunday. We don’t even check if there’s construction. We just don’t because we’ve just had so many bad experiences.” – Rail under 38

“Metro’s a great option where it takes away the stress of having to worry about parking and paying tickets and all that stuff, but I often feel like I have to dedicate extra time for Metro because it’s always up in the air. You don’t know when you go to Metro if you’re going to get stuck underground, how much of a delay. I feel like every time, especially if I’m going somewhere for a meeting, I have to factor in an extra half hour because you just never know what’s going to happen. And so that unpredictability is what caused me I feel like to drive a lot more because driving, at least it’s more under my control versus public transportation you just never know how it’s going to go.”
“It also depends on whether I need to be some place at a certain time or not. If I’m crunched for time, I would rather get in an Uber or drive, but if I’m not in any rush and can get there anytime, I would be more inclined to take public transportation, because you can never really depend on it really.” – Bus under 38

“If I have an appointment where I absolutely cannot be late, I’ll Uber and I’ll pay that extra. Because I can’t rely on the transportation.” – Multimodal under 38

Perceptions of public transportation’s reliability were tested through the online research. When the online respondents were asked if they agree with the statement, “I cannot rely on public transportation to be on schedule or on time,” responses were mixed with slightly less than one-half (45%, Figure 17) agreeing and almost three in ten (27%) disagreeing. Notably, public transit users are significantly more likely to disagree with this statement than those who do not use public transportation (35% disagree vs. 19%), suggesting either a gap between public transit’s perceived and actual reliability or a completely different set of experiences and expectations between public transit users and non-public transit users. Either way, about four in ten public transit users (41%) agree that they cannot rely on public transit to be on schedule or on time, indicating room for performance improvement.

While opinions about public transportation’s reliability are mixed, attitudes about delays are not. Less than two in ten respondents (18%, Figure 18) agree with the statement, “I don’t mind if public transportation is delayed,” while the majority of respondents (67%) disagree. Notably, ART riders appear to be less bothered by delays than both riders of other types of public transportation and non-riders (28% agree vs. 14% each). Interestingly, those who check for real-time arrival information prior to arriving at the stop or station are also less bothered by delays (23% agree vs. 10%). Perhaps this is because they are seeking out information and can prepare and plan around the delay.
Unsurprisingly, the majority of online respondents (86%, Figure 19) indicate that they are annoyed when their travel is delayed. Consistent with the previous attitude about delays, ART riders are less likely to be annoyed by delays than riders of other forms of public transportation (78% vs. 89%).

Mode Choice and Real-time Information

One of the more tangible factors that influences mode choice is the status of the bus or train as relayed via real-time information. Several participants mentioned first looking to see how far away the bus or train was before deciding which mode to take that day. While a few participants demonstrate situations when this information encourages the use of public transportation, others present examples of how this information works to dissuade potential riders from using public transportation (e.g. when they see the Metro is 45 minutes away, they’ll choose Uber or Lyft). Notably, real-time information as a factor in mode choice was mentioned in the rail groups, multimodal groups, and the Spanish groups, but not in either of the bus groups.

“So my apartment complex has a thing where it tells you when the next Metro is and the next bus is and where the closest Uber is. It’s very helpful […] I use it when I go out, yes. I look at it first to see what I’m going to do.”
– Rail under 38

“… my main two options are ART bus, because it takes me directly from my place to where I want to go. But if I miss the bus, because I usually check on my phone the real-time of arrival. But if I miss it, the second option is that same bus stop, there is the Metro buses that goes to a Metro station. That’s the second option. I take that one. And I always get on-time.” – Multimodal under 38 and older

“I usually have a ritual, I’ll always check my Metro app first and see when is the next one coming. If it’s too long, then I’ll just do a rideshare with Uber or Lyft.” – Multimodal under 38

“If the app says there is a bus coming and it’s the fastest way, I do that.” – Multimodal under 38

“If I look at the app, there are two buses that usually go by, one is like 10 minutes away, I’m like, “All right, I can kind of wait for that and just take that where I need to go,” versus getting an Uber.” – Multimodal under 38

“If it is late at night, I first take my Google maps and it will tell me what time the bus will arrive and what time is the Metro arriving. If it tells me it will take approximately 45 minutes to arrive, if it is too long, I directly turn to Uber.”
– Spanish
While most of the examples above use modern technology to access this information, such as an app or dynamic screen, some participants in the 38 and older groups are also turning to more traditional sources of information. A handful of these participants mentioned checking the news to listen for traffic or travel related information, a resource that was never mentioned in the under 38 groups.

“But the morning traffic report can change your mind from if you want to drive in the morning. If you see in the news as far as your route is congested from a number of things, then you can just drive to one of the local subway lots and park and come in on the train.” – Rail 38 and older

“News and traffic, like my days depend, if I turn on the news and see the traffic report […] if there’s a delay in the Metro then I’ll be like okay maybe I’ll drive. Or if there is traffic and the Metro is delayed, then I’ll call an Uber to work.” – Rail 38 and older

“But the morning traffic report can change your mind from if you want to drive in the morning. If you see in the news as far as your route is congested from a number of things, then you can just drive to one of the local subway lots and park and come in on the train.” – Rail 38 and older

Mode Choice and Transportation Network Companies (TNCs)

When speaking about the decisions they make and the modes they have to choose from, the older participants were often choosing between public transportation and a personal vehicle. Conversely, the younger participants were more often referencing decisions between public transportation and Uber/Lyft. They frequently cited the more affordable UberPOOL as an attractive option as the prices are so comparable to public transit fares. As mentioned in the section “Mode Choice and Unreliability,” ride-hailing services are particularly attractive when riders are seeking reliability, as this mode of transportation is viewed as more reliable than the available public transit options.

“Sometimes, even if the Uber is the same time consumption and pricewise, it’s the same as taking the Metro, I’ll still choose Uber, just because I associate socializing and going out with just being there in a car.” – Bus under 38

“I would say I recently have started Ubering more, because they have that Express POOL option. I’m noticing, even for me to get from Arlington to Tacoma sometimes, costs me about $6, which is how much it would cost me to take the Metro, and it’s usually a little bit shorter, and a little bit more convenient […] I’ve noticed that the prices are almost comparable at that point. I’d rather just save the time and energy.” – Bus under 38

“Well oftentimes, you can UberPOOL or UberPOOL express, at least for me, for around the same cost that it would cost me to ride the Metro. And UberPOOL is much more comfortable. And, it’s unpredictable still, but I’d rather sit in a car than potentially be delayed at the Metro or in a hot car on a 100-degree day.” – Rail under 38

“I find somewhere in between because I like to take the bus in from work, but if I see that there is an UberPOOL that is $3.50, then I will take the UberPOOL rather than waiting for the bus that is $2. But when the UberPOOL is $9, I’m like, “The bus is the way to go.”” – Bus 38 and older
Attitudes Influencing Mode Choice

With all of these considerations, factors, conditions, and personal values that impact mode choice, people in this area have a lot to take into account when traveling. However, it does not appear that these decisions are considered stressful. In fact, those in the 38 and older groups felt very strongly that these decisions are intuitive and just a normal part of life.

“It’s a way of life.” – Rail 38 and older

“It’s just part of living in this city” – Rail 38 and older

“Me myself, I know the schedule by the hour, so I already know my time, what time the bus I catch tomorrow morning, what I take... I even know what I catch the bus when I leave out of here.” – Bus 38 and older

“My travel plans are instinctive. It’s just how I think about am I going to do, is this work, is this pleasure, is this business, is this leisure, whatever I think in my mind that comes to me, do I get on the computer and plan a trip [...]” – Bus 38 and older

“It’s not though. It’s an automatic so, if it’s Tuesday at 4:00 p.m., and I’m meeting you at 4:30 p.m. in DC, and I can just jump right on the Metro from work and meet you in DC, then my decision is automatically made, because I know 4:30 Tuesday, traffic is crazy. Get on the Metro.” – Multimodal 38 and older

“It’s intuitive.” – Multimodal 38 and older

Interestingly, while only two participants in the under 38 groups admitted that these decisions can be stressful, no one expressed the same level of acceptance and comfort that those in the 38 and older groups displayed.

“There are more stressful things but it’s just one more thing to have to worry about.” – Multimodal under 38

“It’s stressful.” – Rail under 38

While most of the online respondents (57%, Figure 20) indicate that it is not confusing to figure out how to use public transportation, close to one-fourth (23%) agree that “it is confusing to figure out how to use public transportation to get places.” This statistic increases to one-third (33%) among those who do not use public transportation.

For some, a factor that influences mode choice is whether or not a trip requires transfers. Attitudes were mixed among the focus group participants; while many
expressed that they do not mind if a trip requires transfers, others disagreed.

“[The best option has] the least amount of transfers.” – Multimodal 38 and older

“…like I’ll walk extra just to not transfer.” – Bus under 38

Attitudes among the online respondents are also mixed, with one-half (50%, Figure 21) agreeing with the statement, “I don’t mind that public transportation sometimes requires transfers,” and about one-third (31%) disagreeing. Unsurprisingly, those who take public transportation in a typical week are significantly more likely to agree with this statement than those who do not. However, among public transportation users, those who take ART appear to mind transferring less than riders of other modes of public transit (68% vs. 49%).

Safety is another factor that can influence mode choice, particularly for trips taken at night. Nearly four in ten online respondents (39%, Figure 22) agree that “travel on public transportation is safer than other forms of travel in this area,” while about one-third (36%) feel neutral and one-fourth (24%) disagree. Overall, those who use public transportation, especially ART riders, agree with this statement more than those who do not (61% ART riders, 38% non-ART public transit users, 26% non-public transit users). There is also a visible difference between how males and females feel about the safety of public transportation. While one-half of males (50%) agree that public transportation is safer, significantly fewer females (30%) feel the same.
GAP ANALYSIS: IMPORTANCE VS. ARLINGTON COUNTY PERFORMANCE

The online respondents were asked how important each of the following characteristics is when choosing which mode of public transportation to use. They were then asked how well each of these characteristics describes the public transportation in Arlington County. The following graphics present a visual of how the public transportation in Arlington County is performing in comparison to the needs of its population.

Ratings of Arlington County’s performance fell below each measure’s importance score, with the exception of “is familiar to me” and “is used by friends, family, and/or co-workers,” suggesting room for improvement in almost all areas. The two most important characteristics when choosing public transportation are: “provides transit stops close to your destination” (83% rating very important) and “goes to the places you need to go” (82% rating very important). Arlington County is performing below the importance benchmark on both of these measures, so these should be treated as primary considerations for improvement. There were two additional areas where the gap was particularly large: being “available when you need it” (28% gap) and “gets you to your destination on time” (26% gap).

Access to real-time information is an important factor when choosing which mode of public transportation to take for two-thirds of these online respondents (66%, shown on the following page). Arlington County’s performance on this measure was rated highly by roughly one-half of respondents (52%), suggesting that there is room for improvement in this area.

Figure 23: Online Respondent Gap Analysis

Q8. Please rate how important each of the following is when choosing which mode of public transportation to use.
Base = Total online sample (n=346)

Q9. Please think about specific aspects of public transportation in Arlington County. Please use a scale of 1 to 10 where 10 means you strongly agree and 1 means you strongly disagree. Public transportation in Arlington County is...
Base = Total online sample (n=346)
Q8. Please rate how important each of the following is when choosing which mode of public transportation to use. Base = Total online sample (n=346)

Q9. Please think about specific aspects of public transportation in Arlington County. Please use a scale of 1 to 10 where 10 means you strongly agree and 1 means you strongly disagree. Public transportation in Arlington County is...
Base = Total online sample (n=346)
TECHNOLOGY

Use and Comfort

Across all focus groups, most participants have a smartphone and those with a smartphone feel they use it for ‘everything.’ This was visible in both the 38 and older and under 38 groups.

“The smartphone is so accessible, it’s just always with you.” – Rail 38 and older

“I do everything on my phone.” – Rail 38 and older

The focus group participants expressed comfort with technology in general, with nobody expressing fear of or discomfort with new technology. These participants are tech savvy beyond the smartphone, with most owning several types of personal technology including laptops, desktops, home devices (such as Alexa or Google Home), and wearable tech. In fact, some show a preference for these other technologies over smartphones for certain activities, like shopping or reading. Even the under 38 groups express a preference for online shopping through a computer, but they do seem more comfortable with using a smartphone for this task than the older groups do.

This comfort with technology is reflected by the online respondents, with about eight in ten (83%, Figure 24) agreeing that they are “comfortable using new technology.” Here, there is a significant difference between generations, with those under 38 significantly more likely to agree with this statement than those 38 and older (88% vs. 77%). Interestingly, public transit users, and ART riders in particular, were more likely to agree that they are comfortable with new technology than those who do not use public transportation (86% all public transit, 91% ART, and 77% non-public transit users).
This general comfort with technology does not translate to early adoption. Nearly four in ten respondents (39%, Figure 25) agree that they are “often one of the first to get new technology or devices.” Those most likely to relate to this statement are males and those under the age of 38. Notably, ART riders do appear to be more technologically inclined than others in this population. About six in ten ART riders (62%) agree with this statement, which is a significantly higher proportion than users of other public transportation (29%) and non-public transportation users (34%).

Looking at the types of technology used by the online respondents, the smartphone is nearly ubiquitous with about nine in ten (93%, Figure 26) using this technology. This is followed closely by laptop computers (89%); tablets/iPads, wearable technology, and home devices are less universally used. The younger generation is more likely to use all types of these technologies, except for tablets/iPads, where use is relatively even across the generations.

An arrow (↑) signifies that the percentage for that population is significantly higher than the percentage for the other population.

Q5. Which of the following do you use?
Base = Total online sample (n=172-346)
Most online respondents use at least three different types of technology (Figure 27). However, there are some observable differences between demographic groups. Those under 38 tend to use more devices than those 38 and older. ART riders continue to demonstrate an inclination towards technology, using more types of technology than those who do not use public transportation. Interestingly, the total number of devices used does not vary significantly across income levels.

**Figure 27: Number of Device Types Used**

![Figure 27: Number of Device Types Used](image)

An arrow (↑) signifies that the percentage for that population is significantly higher than the percentage for the other population.

Q5. Which of the following do you use?

Base = Total online sample (n=172-346)

Technology and Travel

Real-time Information

The smartphone is an invaluable tool for many when it comes to finding real-time information, which will be discussed in greater detail later in this report. However, the smartphone is not the only technology that people are using to find real-time information. Some focus group participants mentioned using their home devices to help inform their travel decisions, such as when to leave the house or which route to take that day. This was not a common use of this technology, and these examples represent a behavior that is “ahead of the curve.”

“I mean Google Home [I have] my home address and my work address and where I’m going to already keyed in. So I can ask, “Okay Google, plan my route,” or, “How is my commute to work?” and it can actually tell me…” – Rail 38 and older

“I’m always doing something. I’m trying to get ready for work so I can just hear the Google Home tell me as far as my route and I can determine what way I want to travel in.” – Rail 38 and older

“…you can say, “Alexa, open Metrobus.” And she’ll say something like, “Hello, your saved stop ID is… [Street] and [Street]. The next bus is a 16C bus in five minutes. Then in eight minutes there will be a 16Y bus.”” – Multimodal 38 and older
Electronic Tickets

An increasing trend in the transportation industry is a move towards electronic ticketing. While this capability is not yet available in Arlington County, attitudes about this functionality were investigated in this research as a means of further understanding a person’s relationship with technology when they travel.

Many of the participants use their phone to display an electronic ticket when they travel, but confidence in this technology is mixed. While some participants almost never print a paper ticket, others like to keep a paper copy as a backup just in case their mobile ticket fails to work. Even those that trust the technology express concerns about what happens if their phone dies or gets lost. However, most of these concerns came from the 38 and older groups, with the under 38 groups displaying more comfort with this capability.

“I think it’s secure always with both. I always have these ideas if the phone falls in the toilet can’t fly now…” – Rail 38 and older

“I fly a lot, it’s easier just to have the paper folded up. Make two copies, keep one in a pocket, one in the thing and just update it, than having to deal finding the phone, digging it out. It’s easier, bam, done.” – Rail 38 and older

“I haven’t printed a ticket in years.” – Rail 38 and older

“The one time I did electronic boarding pass, I came this close to my phone running out of juice so you know, once your phone’s out of juice, you’re kind of stuck.” – Bus 38 and older

“I think it makes you feel safer. Sometimes I feel like if I have everything on my phone, I’m going to mess something up. If I have it printed, I feel like I know for a fact that when I get there, [...] I’ll be good.” – Bus under 38

“For an international flight, I print out the tickets but as like a backup. But for domestic, I don’t ever print anything.” – Multimodal under 38

“Definitely the app.” – Multimodal under 38

“I print it, but I also leave it on the phone as well.” – Spanish

Social Media

When it comes to social media as a resource for information about transportation, Twitter remains the most relevant platform. A few participants across all focus groups said they turn to Twitter as a source of information. However, this was only mentioned for Metrorail. Nobody cited an example of using Twitter to find information about the bus.

“On the Twitter front, one of the main reasons I still use it is I follow a lot of people that just complain about the Metro.” – Rail 38 and older

“Sometimes, it’s faster than the official Metro, too.” – Rail 38 and older
“I depend on Twitter, like Twitter is live people that are tweeting, “Hey, Orange Line sucks.” No AC on this train.” – Rail 38 and older

“If there’s something going on and I can tell there’s a delay, the place where I’m going to find out where it is, usually it’s on Twitter. The only time I ever go on Twitter is to figure out what’s going on with traffic and the Metro.” – Bus under 38

“I check Twitter in the morning too, just #WMATA to see if there’s any huge delay, or station overcrowding, or something like that.” – Bus under 38

“I don’t trust whatever like the actual service says. I go on Twitter, and I use a hashtag, or I, because there’s like all kinds of Metro commentaries. Like actual Twitter feeds where people will say like “Oh there’s some somewhere.” And so I’ll just be constantly checking Twitter to see what is happening exactly that and go from there.” – Bus under 38

“I will say that Metro and Metro information is easily had on twitter. Metro has a very active twitter account.” – Multimodal 38 and older

“I’ve actually found, there’s this Twitter handle called Unsuck DC Metro, and people post minute by minute updates on what’s happening.” – Rail under 38

Looking at the online respondents, almost all are using social media in some capacity (Figure 28). The majority of those under 38 are spending more than one hour per day on social media, with about four in ten (42%) spending more than two hours a day. Those 38 and older were almost equally as likely to spend 30 minutes or less as they are to spend more than an hour on social media (37% 30 minutes a day or less vs. 40% more than one hour a day).

**Figure 28: Time Spent on Social Media**

<table>
<thead>
<tr>
<th>Time</th>
<th>Total</th>
<th>Under 38</th>
<th>38 and older</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 15 minutes</td>
<td>13%</td>
<td>5%</td>
<td>18%</td>
</tr>
<tr>
<td>15 to 30 minutes</td>
<td>22%</td>
<td>6%</td>
<td>15%</td>
</tr>
<tr>
<td>30 minutes to 1 hour</td>
<td>22%</td>
<td>22%</td>
<td>23%</td>
</tr>
<tr>
<td>More than 1 hour to 2 hours</td>
<td>22%</td>
<td>25%</td>
<td>18%</td>
</tr>
<tr>
<td>More than 2 hours</td>
<td>33%</td>
<td>42%</td>
<td>22%</td>
</tr>
</tbody>
</table>

An arrow (↑) signifies that the percentage for that population is significantly higher than the percentage for the other population.

Q5A. How much time do you spend on social media in a typical day?

Base = Online respondents who use social media (n=148-318)
REAL-TIME INFORMATION

Engagement with Real-time Information

The advent of real-time information has impacted not just the transportation industry, but also retail and service operations. Beyond looking for arrival information for public transportation, people have the opportunity to utilize real-time information to track shipments of online purchases, air travel information, food deliveries, and Uber/Lyft orders. Experiences with these applications of real-time information were investigated to assess the level of exposure those in Arlington County have to this type of information in general.

About two-thirds of online respondents (64%, Figure 29) check the arrival time of their bus or train prior to arriving at the bus stop or station. Almost all of the ART riders surveyed (91%) indicate that they seek out real-time information before arriving at the bus stop or station, confirming that this is information ART riders need, want and use. In general, those who identify as a race other than Caucasian and those under 38 are most likely to check for real-time information. Interestingly, the more devices a person uses, the more likely they are to seek out this real-time information, suggesting a relationship between tech-savviness and utilization of real-time information.

Figure 29: Check the arrival time of the bus or train prior to arriving at the bus stop or station

Q5BB. Which of the following do you regularly do?
Base = Total online sample (n=346)
Statistical differences are shown through the use of letters. A letter next to a number signifies that it is significantly higher than the corresponding value.
Notably, those who regularly check for real-time information are significantly more likely to engage in all of the real-time applications shown below than those who do not look for this information. Overall, tracking shipments of online purchases and checking departure time and gate information for air travel are the most frequently used applications of real-time information, with at least eight in ten regularly utilizing this information (80% - 88%, Figure 30). There are no significant differences between the generations when it comes to this information; those 38 and older are just as likely as those under 38 to track shipments and check air travel information. About two-thirds of respondents are regularly tracking Uber and/or Lyft orders (66%) and one-half are regularly tracking food purchases that are made online (50%). Those under 38 are significantly more likely than those 38 and older to look for all three of these types of information.

**Figure 30: Regular Engagement with Real-time Information**

Q5B. Which of the following do you regularly do?
Base = Total online sample (n=346)

<table>
<thead>
<tr>
<th>Application</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Track shipments of purchases you make online</td>
<td>88%</td>
</tr>
<tr>
<td>Check departure time and gate information for air travel</td>
<td>80%</td>
</tr>
<tr>
<td>Track an Uber or Lyft car you ordered</td>
<td>66%</td>
</tr>
<tr>
<td>Check the arrival time of your bus or train prior to arriving at the bus stop or station</td>
<td>64%</td>
</tr>
<tr>
<td>Track food purchases that you made online</td>
<td>50%</td>
</tr>
</tbody>
</table>

**Importance of Real-time Information**

The majority of online respondents (81%, Figure 31) agree that “having real-time arrival information is important when using public transportation.” Unsurprisingly, those who use public transportation are more likely to agree with this statement than those who do not (86% vs. 73%). Those under 38, and those who are more tech-savvy (use 3-5 devices) are also most likely to agree.

While these demographic differences are visible among the total sample, they disappear when examining just public transportation users (Figure 32). Among public transportation users in Arlington County, there are no significant differences between ages, genders, types of
public transportation used, races, or income levels, indicating that this is information that is equally important to all different types of people who use public transportation in Arlington County. Interestingly, even those who do not regularly check for real-time information indicate that this information is important to them (66%).

Figure 32: Having real-time arrival information is important to me when using public transportation

This research suggests that one reason that having real-time information is important is that it helps riders to relax. Most of the online respondents (73%, Figure 33) agree that “having real-time information when using public transportation helps me relax.” However, it appears that different populations feel this effect to a varying extent. Millennials are more likely than older respondents to find real-time information relaxing (82% vs. 65%); ART riders are also more likely than those who take other forms of public transportation to indicate that real-time information helps them to relax (90% vs. 71%).
Interestingly, the differences that are observable among the total sample shift when looking just at public transportation users (Figure 34). Here, there are no significant differences between the generations, but there are differences between racial groups. Those who identify as Caucasian are significantly more likely than those who identify as another race or ethnicity to agree that real-time information helps them to relax.

Figure 34: Having real-time information when using public transportation helps me relax
(Among public transportation users)

- Total: 79%
- Caucasian (A): 83%
- Not Caucasian (B): 69%
- Female (C): 76%
- Male (D): 81%
- Under 38 (E): 79%
- 38 and older (F): 78%
- ART rider (G): 90%
- Non-ART public transit user (H): 71%
- 4-5 Devices (J): 80%
- 3 Devices (K): 78%
- 1-2 Devices (L): 77%
- Regularly checks for real-time information (M): 83%
- Does not regularly check for real-time information (N): 64%

Q6K. Having real-time information when using public transportation helps me relax.
Base = Online respondents who use public transportation (n=214)
What People Look for in Real-time Information

Cost, Time, and Convenience

Through discussions about when and why people seek out real-time information, it became clear that for most focus group participants, the ideal real-time information does not just provide the time the next bus arrives, but also how long the trip is expected to take, and how much the trip costs. In other words, they want a resource that will give them information that addresses all three of the main travel factors: time, cost, and convenience.

“But like a lot of times it tells you the duration of time so you can determine when you want leave from where you’re located to get where you’re going.” – Bus under 38

“I think the ideal app would have like all of the options and you would type in like where you’re going. And then, it would have like real-time updates for how long it’s going to take to get there, based on where you are now. And then also like the price that it’s going to cost. And like maybe every two minutes it updates. So, you’ve got real-time.” – Multimodal under 38

“Let me know [when] it’s coming here, but will it take me 40 minutes to get to the city or the normal 20, or whatever, because of construction or something?” – Multimodal 38 and older

As mentioned in several of the quotes above, cost is particularly important to these focus group participants. In almost every group, cost was cited as a crucial piece of information when making travel decisions, so they want a resource to provide that information. It is possible that offering this information could help make ART more competitive in a landscape where Uber and Lyft display the cost of the trip up-front.

“Real-time has to be the time that it takes as well as the money, the cost. The estimates of how much it’s going to cost.” – Rail under 38

“It would be to have all my options laid out and knew how much they were going to cost and when I would get there. Just everything had like this standardized.” – Rail under 38

Trip Comfort

For some, information about how comfortable the trip will be is also desirable. For example, details about how crowded the bus or train is, or whether or not it is a new vehicle. However, for some participants, access to this information is just the first step; ideally, they would like the information to provide a recommendation based on all of the available measures.

“How crowded the Metro is, or how long. Just giving us as much information as possible and sort of distilling it with some sort of recommendation almost. Based upon a lot of different factors beyond just the time and mode I guess.” – Rail 38 and older
“...it’s not enough for you to be able to weigh the value of things, I want it to spell out value. I want it to say it’s an unpleasant drive, there will be no seats on the Metro, or it’s going to cost you an arm and a leg to get there.” – Rail 38 and older

“If there was a way to do density of people. I don’t know if density’s the right word, but how popular it is right now.” – Rail under 38

“If it’s a new car or an old one, that makes a difference. If it’s a new train, I’m like, “I’m definitely getting on.”” – Rail under 38

Solutions and Suggestions

Essentially, people use real-time information as a decision-making tool, so they want the information they receive to be structured in a way that is suitable to that end. Taking this a step further, several participants mentioned that they would like the information to provide solutions or suggestions when delays occur. It is not enough just to know their bus has broken down; they would like to be given alternate routes.

“I just want to know if there’s a problem, but I also want a solution, because tell me what my other options are.” – Bus under 38

“When there is a snow day, the bus that I take, it’s a commuter bus, they just don’t run it. Now, what bus should I take instead to get into the office would be helpful?” – Bus under 38

“But the other problem is, there is no app that I have found that will tell me what the maintenance schedule is going to be in advance. This always is a problem like Friday night at 10:00 p.m. when the Metro maintenance starts. If I’m trying to go somewhere at 9:30 and then I get on the Metro, all of a sudden, I’m stuck on a train for one-half hour.” – Multimodal under 38

“I would say the biggest thing would need to be alternate routes including buses, alternate route options, not just the most common things, but alternates.” – Bus 38 and older

Information that is Immediate, Exact, and Precise

It is not enough to just have access to the information, they want it to be immediate, exact, and precise. They expect that the real-time information is taking into account the current traffic conditions and other events that will change either the arrival time of the bus or the length of the trip. As soon as the status changes, they are looking for immediate notification of the change.

“Meaning it’s updated in the last 30 seconds or so and you know in real time that you’re going to arrive at 6:31 instead of 6:32.” – Rail 38 and older

“Sometimes, Metro buses have like they all do now, you text a certain number or you put in a stop number and it tells you okay, it’s 2 minutes away. I think it’s using that real time technology based on traffic or other delays.” – Rail 38 and older

“I signed up for the text alerts. The problem is, is when they had a bus shortage, they would text you but they would text you an hour after the fact which was not entirely helpful.” – Bus 38 and older
“Everything would be current and up-to-date, so you knew what the traffic was like, you knew what the Metro schedule was.” – Rail 38 and older

Confusion about Real-time Information

While most are comfortable with the concept of real-time information, there does appear to be some confusion as to which information is real-time and which information is based on the schedule. This theme will appear throughout the next several sections, suggesting an area where public outreach or education could be beneficial when implementing real-time technologies.

“Some of the bus stops have electronic signs that, in theory, tell you when the next bus is supposed to be coming. And whether that works off a schedule or off the GPS, I don’t know. But I have found those to be consistently inaccurate.” – Multimodal 38 and older

“That phone number, is it based on, like when you call and get the time, is that based on the schedule, or is that based on the bus that is actually going to be there?” – Multimodal under 38
ACCURACY AND RELIABILITY OF REAL-TIME INFORMATION

Satisfaction with Available Information

Satisfactory Experiences

Across the focus groups, there were several participants who expressed satisfaction with the real-time information they consume, believing it to be accurate and comprehensive.

“The bus times when I use my phone, I’m able to pinpoint it to a minute so that’s, I haven’t had any complaints about that.” – Rail 38 and older

“I don’t really feel like I need it any more than what I have right now.” – Rail 38 and older

“Usually pretty accurate for me.” – Bus under 38

“I use the Metrorail and the ART buses, thankfully, and most of the time, when you get the real time online, those are pretty accurate, at least the route that I use for the ART bus. The real-time information is pretty accurate.” – Bus under 38

“Well I only see it on the phone so what I get it, I don’t know where it streams from, but it has been good for me. If it tells me the train is going to arrive at 6:47 at the Rosslyn Metro and well, you must walk 6 minutes from your house to get there. I get there, and well sometimes it varies from 1 to 5 minutes, but it is always on point.” – Spanish

Unsatisfactory Experiences

Others expressed less satisfactory opinions about the quantity, quality, or reliability of the information. The importance of having trustworthy real-time information is exemplified here when a couple participants mention abandoning the pursuit of real-time information after losing faith in its accuracy.

“There’s a nice quantity of it, but it’s, I usually just give myself a really long cushion, and I stopped checking that honestly.” – Bus under 38

“I have a job of, like when the bus is going to be arriving, and a lot of times, I know at the Pentagon Metro station, it tells you it’s going to be there like in five minutes, but it never shows up.” – Multimodal 38 and older

“If you’re not going to trust it why bother opening it, but if you start to realize it’s doing pretty well then you’ll use it more often.” – Bus under 38

“It’s not accurate at all for the buses. Like I was waiting for the 55, and it said it would come, and I was still waiting 30 minutes.” – Multimodal under 38

“And then the information they give people is almost always very poor. In other words, we are already on the transportation and you have very little alternatives usually, and you are left waiting, so I think the information is dreadful.” – Spanish
Results from Online Research

The online respondents express relatively low satisfaction with the information provided by public transportation agencies, with less than one-half of respondents (45%, Figure 35) demonstrating satisfaction. However, public transportation users are significantly more satisfied than non-users with the information provided (52% vs. 34%). Furthermore, those who ride ART appear even more satisfied than users of other public transportation (64% vs. 44%).

Notably, those that check for real-time information about their bus and/or train are also significantly more satisfied with the information provided than those who do not seek out this information (50% vs. 38%).

Simultaneously, a similar proportion of respondents also express frustration with the lack of information available when they are using public transportation; roughly four in ten (41%, Figure 36) agree that they are “often frustrated by the lack of information when they are using public transportation”. Interestingly, while this level of frustration is consistent among those who use public transportation and those who do not, ART riders were more likely to express frustration than riders of other forms of public transportation (51% vs. 33%). Those under 38 tend to agree with the statement more frequently than those 38 and older (49% vs. 34%).
How Inaccurate and Unreliable Information Impacts Travel Patterns and Choices

Experiences with Inaccurate or Unreliable Information

Since people use real-time information as a tool to plan trips, inaccurate or unreliable information can have deleterious effects on the decision-making process. When people choose to take public transportation because of the information provided via real-time information platforms, there seems to be increased frustration when events occur because they would have made a different choice had they been given correct and reliable information. The importance of supplying accurate information is demonstrated below by focus group participants who were negatively impacted by inaccurate information.

“I have the perfect example how it doesn’t work. Yesterday, I was waiting on the ART bus at the stop I always wait at. The bus did not show up. I called and told them, “Hey, the bus never came. This is unusual, blah, blah, blah.” So I went across the street so that I could take the next bus going the other direction because I was re-routing. That bus didn’t come either. Now, I’ve been here an hour. I called ART and I’m like, “This other bus didn’t come, blah, blah, blah,” and he was like, “Oh, it looks like the route’s been changed or cancelled because of mechanical issues.” I said, “Well, why didn’t the first lady tell me that?” And he’s like, “Why didn’t you push the button?” because there’s a button that tells you when your bus is coming. I said, “Because it doesn’t work.” So that’s really frustrating.” – Bus 38 and older

“Now, the bus drivers have said, they can come up to ten minutes before they’re supposed to come, before, and still be counted on time. So, I always try to be at least ten minutes early. But, when the bus says it’s coming in 20 minutes, and I’m out there in ten, so I make sure that I’m there early. And then you watch the thing come, and especially like it’s a cold day or it’s raining or whatever, and you’re watching, you’re counting down every minute. And it’s one minute and you want to see the bus come around the corner. And then it will go to zero, and then it will go 20 minutes again. And the bus just never [comes]. You’re trapped.” – Multimodal 38 and older

Leave a Buffer or Avoid Public Transit

Some participants choose to leave a significant buffer when they travel on public transportation so that if the information is incorrect, they still have time to spare.

“Due to unreliable information, some leave a significant buffer in their travel time while others choose not to take public transportation at all.

“There have been too many times when I have tried taking new bus lines, and I’m waiting there, and I’m using like a tracker, and it says it’s coming in 10 minutes, but it’s already been 20. I just give myself an hour no matter where I’m going.” – Multimodal under 38

“When I am using public transportation, in my schedule, I know that I need to have flexibility, and that’s why I’m paying less but then at the same time I receive that benefit, but it also comes with things not so pretty.” – Spanish
Others choose not to ride public transportation at all if they do not have access to reliable real-time information because they cannot run the risk of finding out the train is delayed once they are already at the station, or the bus never arriving when it says that it will.

“I know sometimes with my app, I don’t know if it happens with you guys, on the weekends, sometimes they don’t even have times, it’s just dashes. I’m like, “Oh. Okay. That’s cool.” I guess the train is never coming. That happens too. If it’s single tracking, there’s just no times, and I just don’t want to take the gamble of showing up at the station, and it’s 19 minutes.” – Bus under 38

“So, for me, like if I know that I have to be somewhere at a certain time, and I’m going to take Metro, I either will leave like really early, just because it’s, like even if you look on your phone, like I’ve done this before I left the house, I look on the Metro schedule and it will say on time. And then by the time you walk there, it’s not on time anymore. And so, it’s kind of unreliable. So, I’ll either leave really early and take Metro, or I’ll take another mode of transportation, like Uber, because I know the estimate is going to be more reliable.” – Multimodal under 38

“The ghost bus, is why I will never take the Circulator unless I have literally all the time in the world because the Circulator is the ultimate ghost bus. There is no reliable way to track it. The convenience factor sometimes works out really well, particularly where my office is, but you just can never predict how long it is going to take.” – Multimodal under 38

Information about Major Events and Delays

A recurring theme when speaking about the accuracy and reliability of real-time information is that the information available surrounding major events and delays needs improvement. Participants mentioned either never receiving notifications about delays or closures, or if they do receive them, the information is too late to be helpful. A specific suggestion to improve communications about delays is to provide an estimate of how long the delay is expected to be.

“At least in the last few months, there have been a couple of times when there was like a police incident or a medical emergency, and I had no idea until either I get to the Metro station and see a million cop cars or bunch of people streaming out of the Metro stop. And then, only then, I find out that I’m going to have to get an Uber or drive to work.” – Multimodal under 38

 “[The information is accurate] unless there’s something that happens, like a fire or something. I don’t think that really updates. That would be on Twitter. It’s more timely.” – Rail under 38

“I’m having issues with the Metro, because I’ve been on trains that have been broken down. After I wake up from an hour-long nap, and surface, and get signal. Oh. There’s a train broken down. I’m like, “Actually, well, now it’s fixed, because I was sitting on it for an hour.” I prefer it to be fixed, so I feel like what the protocol is for reporting repairs, but they tend to not report them until they’re fixed, that there is a problem. People are like, “A train broke down.” I’m like, “No, it’s actually fixed now.” It’s just such a delay, and I know if I were above ground, it would be too late for me. I would have to call an Uber. I wouldn’t be able to wait around to figure out what’s going on. I find it not very timely when breakdowns occur.” – Bus under 38

“One thing that I would love to have, even though I’m signed up for alerts for, if there is a station that is closed or whatnot, or there is major delays, especially for like during the workweek. I don’t
necessarily get those all the time. And I come to the station, and I see the little announcements of, “Oh, there was a fire in this station. So, major delays both ways.” I’m like, well my app should have told me that. And I look at the app like, I live a block away from the Metro, so I’m lucky in that sense, but I look at the app while I’m walking, and I don’t see any of that. So, I wish that, that would be conveyed.” – Multimodal under 38

“But sometimes, they have DLY, delay. That is not useful at all […] I don’t care if it’s delayed, when’s it going to be here?” – Rail 38 and older

“For Metro Bus and the Rail, I signed up for the text alerts. The problem is, is when they had a bus shortage, they would text you but they would text you an hour after the fact which was not entirely helpful.” – Bus 38 and older

“I actually [text messages] for the ART bus for the route that I take to the hospital, and they do text updates, but sometimes it’s a delayed text. I’ll already be there at the stop expecting the bus to arrive any minute now, and it’s like, “Oh. Well…” They’ll send the message maybe, five to 10 minutes after the bus was already supposed to be there, saying that this bus will be missed, or this bus is delayed.” – Bus under 38
WHEN PEOPLE LOOK FOR REAL-TIME INFORMATION

Before Starting a Trip

Since real-time information is utilized as a tool in the travel decision-making process, access to this information prior to the trip begins is crucial. People turn to real-time information to both choose which mode to use, and also to decide what time to leave the house. Several focus group participants know exactly how long it takes them to travel from their home or office to their stop/station, so they use the real-time information to time their departure exactly.

"The Red Line is pretty much always has a problem. So, before I leave the office, I always go onto the WMATA website and see if there is a problem." – Multimodal 38 and older

"My office building is right across the street from the Rosslyn Metro and if during my lunch hour, I have a doctor’s appointment or something and I’m trying to maximize my lunch hour, I will be on the WMATA website and when I see the train, it’s like 6 minutes away, then I’ll run. So that’s kind of the only time in addition to going on the bus in the morning that I’m using the real-time information is to try to pinpoint an exact boarding onto the train and stuff.” – Rail 38 and older

"When we leave our apartment to look and see when is the next train coming in and we know how long it takes to walk to the end of the station for departures.” – Rail 38 and older

"I do kind of, I do my homework before I go out. I like to know what time it is, how much time I have. If I’m walking, I’m going to be clocking it so I’m going to be making a schedule before I leave home about what I want to achieve. And then, taking public transportation, part of my goal is to make it work for me, not for having it work, not the other way around. Driving my car, I take control. I’ve got to be willing to give that up when I’m doing public transportation.” – Bus 38 and older

"Where I live and I think that a lot of buildings have this function, in the lobby they have televisions where they tell you, okay the next train, these are the different lines of trains that are closest to you and these are the schedules, and in the next 8 minutes the express will be here. The bus is coming, or x, y z. So sometimes before I leave, I look and say oh okay perfect. So, I literally have the information in front of me because I have to leave from the elevator and there it is on the screen.” – Spanish

While only mentioned by one participant, this piece of feedback provides a unique perspective on when real-time information is needed most. For this person, real-time information is critical for bus lines that run infrequently, because those are the buses it would be inconvenient to miss. There is less stress for the bus lines that run every 8 minutes because a trip is only delayed by a few minutes the bus is missed; however, if the bus only runs every 45 minutes, one needs to know exactly when that bus is arriving so as to be sure not to miss it.

"It depends on the bus route, like I live on Columbia Pike so there’s 30 buses that go down that street. So I usually won’t check because I can just, you know I just stand on the side of the street and a bus will come eventually. But then there’s this other bus by my school that runs like every 45
Almost six in ten online respondents (58%, Figure 37) check for real-time arrival information before leaving their home. Unsurprisingly, those who typically use public transportation are more likely to check for real-time information than those who do not (65% vs. 47%). However, it is notable that almost one-half of those who do not typically take public transit seek out this information, suggesting that it is not just frequent or regular riders who benefit from this information. Furthermore, ART riders are particularly likely to seek out this information, with about eight in ten riders (83%) looking for real-time arrival information before leaving the home. This is a significantly higher proportion than both non-public transit users and users of other forms of public transportation (53% non-ART public transit user, 47% non-public transit user).

Looking specifically at those who use public transportation (Figure 38), there are no significant differences between ages or tech-savviness when it comes to looking for real-time information before leaving the home. However, those who do not identify as Caucasian (non-Hispanic) are significantly more likely to seek out this information than those who identify as Caucasian (78% vs. 60%); and those who make less than $100,000 a year are more likely to seek out this information than the higher earners (73% - 79% vs. 56%).
During the Trip

While important during the trip planning phase, real-time information is also needed at key decision-making junctures on the trip. For example, when making transfers between bus or rail lines, or switching modes of transportation entirely. Participants express a desire for information during the trip to help them decide which line or mode to switch to based on their estimated time of arrival and conditions that may be impacting the various options.

“*My understanding is that maybe they’re working on this, but if the Metrorail would have either cell service or Wi-Fi that actually worked, because often times I’ve been connecting to the bus, and trying to figure out the schedule in the bus, and even which bus I should take, isn’t letting on my phone when I’m on the Metrorail, because there’s no service.*” – Bus under 38

Figure 38: I check for real-time arrival information about public transportation before I leave my home
(Among public transportation users)

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<tr>
<th>Category</th>
<th>Total</th>
<th>Caucasian (A)</th>
<th>Not Caucasian (B)</th>
<th>Female (C)</th>
<th>Male (D)</th>
<th>Under 38 (E)</th>
<th>38 and older (F)</th>
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Q6J. I check for real-time arrival information about public transportation before I leave my home.
Base = Online respondents who use public transportation (n=214)
“I take, coming home, two trains and then the bus. And so, I want to know when the bus is going to be at the Pentagon, so I know, do I need to hustle or take my time. I need to push people out of the way and get on the escalator.” – Multimodal 38 and older

“Because there are times I usually connect from Metro Center to the F, and I’m down in the Metro checking to make sure my bus, because sometimes I got two minutes to sprint upstairs and get there. If I go upstairs and push the button, I’ve already missed the bus. I need to know beforehand.” – Bus under 38

“I would also say the good thing about having an app, for example, you’re in a hurry, and you’re rushing to get somewhere, then you can check the app as you’re running there. That’s what I do a lot of times, so that I don’t have to wait until I get there to search for information. I do it while I’m running.” – Bus under 38

“[I would like an electronic board in the Metro so when] I’m coming to Metro Center and it would tell me when Blue Line, is the next Blue Line is going to be at Metro Center, and then it would also tell me when the next Yellow Line is going to be at Gallery Place so I can make my decision do I get off here or do I get off at the next one. So if that was in the train you know for those particular close, the next station I think that would be really, really helpful.” – Rail 38 and older

Dependent on the Type of Trip

While generally considered an important service offering in the transportation industry, there are times that real-time information is more valuable than others. Participants in the focus groups explained that this information is most important when they have commitments or appointments that require a specific time of arrival. If they are traveling for leisure, on-time arrival is less critical.

“I think the information is situational. I mean it really is because it’s like if you’ve got an appointment, if you’ve got to be at work at a certain time, then it’s important. But if I’m going off to dinner and meeting friends, if I’m 10 minutes late or 10 minutes early…” – Rail 38 and older

“It’s accurate probably 99% of the time. But that one time that it’s not, that’s then going to throw my whole commute off by an hour, and I’m going to miss a meeting, so.” – Multimodal 38 and older
WHERE PEOPLE LOOK FOR REAL-TIME INFORMATION

Websites

As mentioned in the section on social media (page 36), Twitter is the most popular ‘unofficial’ source of real-time information, but this does not compete with the juggernaut that is Google Maps, which appears to be used almost by nearly all of the focus group participants when looking for travel information.

“I do map trips on the phone through Google Maps because it connects to the ART and all the bus systems. You don’t have to go to The Bus Place. You can just put it in Google Maps and it shows you, so I do a lot of that.” – Bus 38 and older

“If you use public transit on Google Maps, you can, it gives you the Schedule Explorer. You can look at the chart by time of day. If I can save like 15 minutes of travel time by getting there 10 minutes early, then it can tell me to do that.” – Multimodal under 38

The WMATA Trip Planner website was also mentioned frequently, while the Arlington Transit website garnered fewer mentions across all groups.

“I go to the WMATA website and use the Trip Planner.” – Bus 38 and older

“I created shortcuts on my iPhone to the Arlington Bus website and I created a shortcut for the stops I use and there’s one that stops right outside my house and so if I’m in a rush in the morning trying to get to work... They don’t have a dedicated app, at least that I’m aware of so it’s just using their website which isn’t the best on a little iPhone. But just to get straight to the info, I created a shortcut so I don’t have to click on MyBusStop and all this kind of annoying stuff.” – Rail 38 and older

“I’ve used the Arlington Bus website and plugged in addresses just to see if there’s routes but that’s not my first, I mean that’s like if I’m planning something days in advance or something.” – Rail 38 and older

“You can go on ART RealTime and it’ll tell you when you’re getting picked up and when you get there.” – Bus 38 and older

“I went to the Metro [website] and I entered the number of the bus stop, and then I selected the bus that I need. And when I get it, the real time that arrival of the bus, what I did is I send the link to my home page on my phone, and then every day I just click there and then I know how many minutes I have to wait for the bus.” – Multimodal 38 and older

Mobile Phone Apps

Of all the resources available, it appears that people are turning primarily to mobile phone applications to look for the real-time information they need. These participants mentioned a plethora of different apps, including Apple Maps, Google Maps, CityMapper, Transit, and the WMATA App. Notably, participants from both of the Spanish groups mentioned using an app called DC Rider that was not mentioned in any of the English groups.
“I think the key thing to what he said is the app. Because what I use is an app, too, On-Time Arrivals. I could do something in the house or at work and know that I have eight minutes to pack everything up and be at the bus stop.” – Bus 38 and older

“The Apple Map is pretty good for transit, even if you’re in some place that you don’t know the best routes. You just plug in where you want to go, and it will tell you take the 43 bus or whatever. It’s pretty easy. It’s not accurate timewise.” – Bus under 38

“I’ve just been using CityMapper for so many years now, and it is so reliable. It gives you the time, and I haven’t really had any issues with it. It’s real-time, too. I don’t know how they track like when all the trains are going to be there, when the buses are going to be there, but it always knows when everything is going to be there.” – Multimodal under 38

“It’s glorious. I tell the app where I want to go, and then it gives me public transit directions, I can do rail only or bus only or bus and rail, how long it’s going to take to take Uber, and then it will estimate the price, how long it will take by my own bike, how long it will take by Bikeshare, and then it will combine... Metro and Uber or Metro and Bikeshare and tell me how long it thinks that will take. It gives me the price for any public transportation and the time for any way I want to go and how long it will take me to get there.” – Multimodal under 38

“I use the WMATA app. It tells you about the Metro time and where it’s going.” – Bus under 38

Interestingly, a handful of participants mentioned selecting which mobile app to use based on the type of transportation they planned to use. For example, if they were taking a familiar route and knew only Metro was required, they would pivot towards a Metro-specific app rather than Google Maps.

“Yes, if I’m going just Metro specific, I go to the app that I use for Metro.” – Multimodal 38 and older

Attitudes Surrounding Sources of Transportation Information

The utilization of smartphones is not unique to the focus group participants; three-fourths of the online respondents (75%, Figure 39) indicate that it is important to be able to use a smartphone to get public transportation information. Those who use public transportation are more likely to agree with this statement than those who do not (81% vs. 66%). ART riders continue to demonstrate a preference for technology, with 88% of these respondents indicating it is important to be able to use a smartphone. However, it is notable that two-thirds of those who do not typically use public transportation (66%) still indicate that it is important to be able to use a smartphone when they do seek out this information.
Looking specifically at public transportation users, those under 38 are significantly more likely than those 38 and older to indicate that it is important to be able to use a smartphone to get public transportation information (88% vs. 73%). Those who regularly seek out real-time information are also particularly likely to indicate that being able to use a smartphone is important (87%). Furthermore, those who use multiple types of technology are more likely than those do not to agree with the statement, indicating that this attitude may be related to a person’s level of tech-savviness (87% vs. 70%).

The majority of online respondents, regardless of public transportation use, agree that they would use technology to look for travel information more if it were easier to get the information they needed (72%, Figure 40). Here as well, those under 38 and ART riders show a particular inclination towards technology (77% under 38 agree and 82% ART riders agree).

Technology appears to not only be valued as a source of information, but also preferred over asking a person for that same information. About one-fourth of online respondents (23%, Figure 41) agree that “when I need information, I would rather ask a person than use technology,” meaning that most either feel neutral or actually prefer turning to technology over turning to a person. Interestingly, Millennials are more likely than their older counterparts to prefer asking a person (28% vs. 18%). Nonetheless, they still show a preference for technology.

While demonstrating low agreement, the responses from the online respondents suggest that there is still a need for paper schedules and flyers. About one-fourth of those surveyed (26%, Figure 42) agree that paper schedules and flyers are the best way for them to get public transit information. However, this increases to more than four in ten (44%) when looking just at those who ride ART. This is a significantly higher proportion indicating a preference for paper schedules and flyers than found among public transit users of other modes (14%), suggesting that the utility of this information varies depending upon the mode and population.
Most of the online respondents still like the schedules to be posted at the stop or station, even if it is not their preferred resource. Eight in ten respondents (80%, Figure 43) agree with the statement, “I like when the schedules are posted at the bus stop or rail station.” Those who use public transportation are significantly more likely than those who do not to agree with this statement (85% vs. 73%).

Figure 42: Paper schedules and flyers are the best way for me to get public transportation information

Figure 43: I like when the schedules are posted at the bus stop or rail station
REACTION TO AVAILABLE SOURCES OF REAL-TIME INFORMATION

One objective of this research was to gauge the level of satisfaction with the sources of real-time information that are currently available to those who travel around Arlington County. These concepts were presented in the focus groups and/or the online survey to gauge how satisfied riders are with these technologies and assess how these technologies could be enhanced or improved to better meet the needs of those who use them.

The following technologies and services are discussed in the following sections:

- Phone Number at the Bus Stops (page 56)
- Text Messages (page 62)
- Arlington Transit Website (page 67)
- BusFinder (page 69)
- LED Displays (page 76)
- Dynamic Message Boards (page 78)
  - Redmon Screen (page 82)
  - Transit Screen (page 87)
- Mobile Phone Applications (page 95)
PHOTO NUMBER AT THE ART BUS STOPS

Reaction to this Service

Across the focus groups, several participants have used the phone number at the bus stop to look for real-time information. A couple participants recalled having positive experiences with calling this number, but people were far more likely to offer complaints about the accuracy of the information and the quality of the customer service representative they spoke with. In fact, some participants said they were not able to get any information at all when they called.

“I mean I haven’t called all that much but out of curiosity, I called a few times and it’s pretty accurate.” – Rail under 38

“I was grateful that I was able to call and a person did answer. It wasn’t satisfying, of course, because she was like, “You know, you have to get there five or 10 minutes early” or whatever. “No, I don’t! That’s the whole point of the schedule. Don’t lie to me.”” – Bus 38 and older

“It never [works for me], it says it’s coming in five minutes and then I wait 10 minutes and the bus never shows. I called again and it’s like the bus has already showed up.” – Rail under 38

“I think they would be good if they knew what they were doing, the people, the employees.” – Bus 38 and older

“I’ve tried calling that number, and no one answered.” – Bus under 38

“Yeah you just had a lot of like options to go through. And then it usually, it kind of is hit or miss. Like sometimes it’s just the scheduled time, like the bus is scheduled to arrive at 12:15. It’s like well it’s 12:25 now so I don’t know...” – Bus under 38

One of the most frequent reactions to this service is that it takes too long to get the information. A few participants explained that by the time they get through to a person or reach the correct option on the menu, the bus may have already arrived. At the same time, those that have never used this service say that their willingness to try it depends on how long it would take to get the information they need (for example, how many automated lists they had to listen to).

“I mean I guess it depends on how long, like the worst is when you call Comcast with a simple question and you have to go through 15 automated messages until I finally get a person on the phone. So I guess it depends on how many things you have to get through until you get the information that you need.” – Rail under 38

“...the thing about it is when you call, you’ll never get the right person and you’ve got to hear that they’re saying, to give you the choices that you might miss. It’ll, by the time you get them, the bus is coming.” – Bus 38 and older
“It’s like have an option right away. I want to talk to an operator now. I don’t [want] to go through all the push 2, push 3, 4, 5, 6, 7. I want this route and this route.” – Bus 38 and older

“It was painful […] It was like, “Put in your bus number,” and then what I expected in return was, “Your bus will be here in five minutes,” or “Your bus will be here in two minutes,” whatever it is, but it just kept going on and on and on. It was like, “I wasted four minutes, and I don’t know where my bus is.”” – Bus 38 and older

“When I used to call, what, the guy on there was like the beginning of the call they tell you all the new details and stuff like that, so you have to wait to listen to all that type of stuff was going on.” – Bus under 38

“In my experience, the bus usually shows up before I can get anybody on the phone to, so.” – Multimodal 38 and older

Beyond the difficulties participants have had with this service, most feel that it is not the right vehicle for information in this century. Many called this method of delivery ‘outdated,’ ‘cumbersome,’ or ‘a hassle.’

“I think a phone number is so last century.” – Rail 38 and older

“I mean in this day and age why am I calling a phone number?” – Rail 38 and older

“What’s preventing them from taking the next step and just, if they’ve already gotten information, why isn’t it being automatically beamed up to people who want it?” – Rail under 38

“It’s cumbersome.” – Bus 38 and older

“I wouldn’t want to say to take it down, but there are better ways.” – Bus 38 and older

“It’s much easier to use your phone though, so why would you call?” – Bus under 38

“I think nowadays phone numbers are rarely a good option in terms of getting information, because they’re, most of the phone numbers are set up in such a way that deter people from calling. Just like they’re set, you have to go through all these menu options, you have the random announcements and stuff. They make it as difficult as possible for you to actually speak to a human being. So like I rarely, rarely call any sort of like help number because I just don’t think it’ll actually help.” – Bus under 38

“You have to get the number off the side and sometimes they’re five or six digits, and, it’s just a hassle.” – Multimodal 38 and older

“Involves the phone and calling a number. I’m sorry, I mean most people have, if you’re going to have a phone in your pocket, more than likely, unless you’re the one person in the county that has a flip phone, you’re going to have an app. You’re going to use an app because it’s just so much easier.” – Multimodal 38 and older

For some, the reason this service feels cumbersome or a hassle is because of the automation – they would prefer to speak with a live operator.
"I’d rather go through the app and push the buttons rather than hear this lady that’s not a real lady and to have to wait until she’s done to push a button.” – Rail under 38

“The only time I’ve used that number is when I know someone’s going to pick up and I know it’s going to be a live person there and it’s going to tell me something. Other than that, it’s no use in it. If it’s not live, I hate the recording.” – Bus 38 and older

These reactions leave many to feel that they would only use this service as a ‘last resort.’ They only see value in this if the screen at the bus stop is not working or the apps they use are down or unavailable.

“The only time I’ve ever used it is when the app isn’t working or it’s saying that it’s supposed to be there and you can call.” – Rail under 38

“I think it is helpful because if you’re at a bus stop and something is going wrong, you don’t know what the problem is anything, rather than try to dig through your phone to figure out what the number is to call, it’s right there, you can just call and figure out whatever the situation is, what is going on.” – Bus 38 and older

“I just wouldn’t call [...] Unless there is some real problem with my phone or the app or something.” – Multimodal 38 and older

“I think for true emergencies, yes. It would be great.” – Multimodal under 38

“Like for emergencies, let’s say you’re using a smartphone, and you don’t have unlimited data or something. Then, you could use that.” – Multimodal under 38

Some responded more vehemently, stating they would never use this service. This was particularly visible in the rail 38 and older groups.

“I would never [use this].” – Rail 38 and older

“Sorry, I just it’s a highly privilege problem to have I’m just super lazy, I don’t want to dial a number.” – Rail 38 and older

“I think it’s a pain in the neck.” – Rail 38 and older

“There’s no value in that for the customer.” – Bus under 38

Overall, the overwhelming attitude appears to be that this is a service ‘for people not like me.’ Almost all participants state that they do not want to make a phone call to access the information they need, but they are unwilling to explicitly state that this service should be removed entirely. Instead, they are more likely to suggest that there might be a person who needs this service so it should be maintained for them. Typically, they imagine this person as older without access to smartphones.

“Some of the older people who don’t have smartphones, they may use that phone number.” – Rail 38 and older
“Well actually, it’s probably a lot more, it’s probably more accessible for some people with disabilities, that can’t necessarily use a lot of apps. If they can tell their phone to call a number and hear it.” – Rail under 38

“The only benefit I can see if people are riding the bus that don’t have smartphones.” – Bus under 38

“I would think so it would be worth it just for you know like the older generation that not really caring about using smartphones, they just want to know what’s coming and what’s not. So I guess it’s still good for them to use...” – Bus under 38

“I agree with the options, because it may not be feasible for people in this room, but there may be people who really like that. They just want to call.” – Multimodal 38 and older

“I think it’s good to have. Just because some people don’t have an app for that, so, it’s there.” – Multimodal 38 and older

“Yes, I do think so. I think about my mom’s generation and perhaps for her it would be easier and well we must understand that in different generations they use information in different ways. So, I think that yes, we have to think about that and it would be a good option, but we have to also think that there are different ways that we receive information, like text for me would be the option that works for me.” – Spanish

Suggestions for Improvement from Focus Group Participants

Many participants offered suggestions for delivery methods they would prefer instead of calling the phone number. In a couple focus groups, participants recommended installing a barcode or QR code that someone could scan that would then tell them the information. In fact, this idea came up more frequently in the 38 and older groups than in the under 38 groups, so it is not just the Millennials who are looking for options other than making a phone call.

“A barcode would work better than that.” – Rail 38 and older

“That’s a lot of work for me, you know, when I, so used to just having it. You know I feel like either it should be on the sign, or there should be a QR code where I go beep, next bus, you know what I mean, it’s a lot easier.” – Rail 38 and older

“That would be cool if they just had a QR code that you could scan on your phone and it would automatically pop up with the buses that are coming.” – Rail under 38

Similar to the barcode concept, others suggested providing a code to text that would then send the status of their bus. The implications of text messages as a delivery method for real-time information are discussed in greater depth in the following section.

“Text the number and they’ll text you back.” – Rail 38 and older

“It would be cool if you could text the bus stop number.” – Rail under 38

“I think it’s more convenient to have to text this number, and get a response of when the next bus is coming. I like those.” – Bus under 38
“It would be nice for them to have it through text, no? Send a text to a certain place with your bus stop, and for them to tell you well it’s going to get there in five minutes, in eight minutes, and 20 minutes.” – Spanish

Results from Online Research

Use and Awareness

Of the online respondents, about one-third (32%, Figure 44) have ever called the phone number to get information. Those who typically ride the ART bus are significantly more likely to have called this number than those who do not. This number has also been used more frequently by those under 38, and those that identify as a race other than Caucasian (however, this may be due to the fact that the ART riders included in this research skew younger with larger representation from minorities).

Figure 44: Has Called the Phone Number to Get Information

The main reason given for not calling this phone number is that they are unaware of the service and/or have never seen the number before (44%, Table 4), suggesting that awareness is the biggest barrier to using this service. Those that cited specific barriers mentioned that they do not like to talk to operators (22%), do not think the phone number is reliable (16%), and/or that they believe it gives the scheduled time of arrival and not the real time of arrival (14%). Notably, those under 38 are significantly more likely than those 38 and older to say they do not like speaking with operators (40% vs. 9%).
Why not?

Table 4: Why Respondents Have Not Called this Number

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was not aware of this number/Have not seen it before</td>
<td>44%</td>
</tr>
<tr>
<td>Do not like to talk to operators</td>
<td>22%</td>
</tr>
<tr>
<td>Do not think they are reliable</td>
<td>16%</td>
</tr>
<tr>
<td>Gives scheduled time and not real time</td>
<td>14%</td>
</tr>
<tr>
<td>No need/interest (not specific)</td>
<td>9%*</td>
</tr>
<tr>
<td>Operators give me too many options</td>
<td>7%</td>
</tr>
<tr>
<td>Prefer to use the app</td>
<td>5%*</td>
</tr>
<tr>
<td>Gives information that does not apply to my stop or route</td>
<td>3%*</td>
</tr>
<tr>
<td>Takes too much time/Get put on hold</td>
<td>3%*</td>
</tr>
<tr>
<td>Use the website/Can find information online</td>
<td>2%*</td>
</tr>
<tr>
<td>Don’t carry/use a cellphone</td>
<td>2%*</td>
</tr>
<tr>
<td>Too much of a hassle</td>
<td>1%*</td>
</tr>
<tr>
<td>Prefer electronic signage</td>
<td>1%*</td>
</tr>
</tbody>
</table>

*This question provided respondents with a list of possible responses and an option to submit additional responses. These responses were submitted by respondents, unaided, which might account for their lower prevalence.

Satisfaction

Those who have called this number tend to be satisfied with their experience; about two-thirds (65%) report being mostly or completely satisfied with their experience calling to get real-time information about when the next bus would arrive. Interestingly, males, those under 38, and ART riders were the most likely to be satisfied with their experience.
Value

While the results from the focus groups suggest that this is not the ideal delivery method, the online respondents seem to have a more favorable opinion with about three-fourths of respondents (78%) indicating that they believe this service is valuable. There were no statistically significant differences among any of the demographics examined for this measure – all of those surveyed had similar assessments of the value of providing a phone number at the bus stop.

**Figure 46: Value of Providing the Phone Number**

Q12. How valuable would you say it is for Arlington County to provide a phone number or other kind of contact information at the bus stop for riders to get real-time bus arrival information?
Base = Total online sample (n=346)
REAL-TIME TEXT MESSAGES

Reaction to this Service

In general, the focus group participants responded more positively to the concept of text message updates than the phone number service. Many participants were open to this idea with the caveat that the information must be accurate.

“I’d like that better than calling.” – Rail under 38

“It’s probably quicker too, because it just immediately pushes it to you. It’s probably quicker than trying to dial it on the phone.” – Rail under 38

“It’s good, because you don’t have to make the effort to check anything. You just look at your phone, and it’s right there, so it’s convenient.” – Bus under 38

“I would text if it’s accurate information, then it’s convenient, because I don’t like talking on the phone. I’d rather text. That’s a good option.” – Bus under 38

The most attractive feature to these focus group participants is that a text message could help them plan their travel and decide when to leave for the stop or station, allowing them to use their time most productively. Or, if they are already en route, a text could let them know if they need to run to catch the next bus or if they have time to stay for one more cup of coffee.

“Well, you can make the decision beforehand if you’re going to get a text or a notification from it. You don’t have to waste your time walking if you know it’s going to be an hour late or something.” – Rail under 38

“Because at home I’m sitting there, having my coffee, I’m not checking my phone any more. I’m waiting for that text to come. It will come five minutes before the bus arrives, and like my walk is exactly four minutes. I’ll get there when the bus is getting there.” – Rail 38 and older

“It would be nice if I was three blocks away and I needed to know if I needed to run.” – Rail under 38

“Yes, they can just as easily give you the approximate time for the next three buses. It could give you the next one, why shouldn’t it?” – Rail under 38

“For me, texting, like if I’m at work or in a meeting or something, and I needed to know like I’m getting off in 30 minutes or an hour, and I needed to know some information. It would be easier to kind of just see the text come across instead of actually having to interrupt the meeting or look like I’m doing something else and checking an app or something, so. Texting would be better.” – Multimodal 38 and older

“So, if I got a text early in the morning, Central Metro sign, the Orange line was delayed, or there are problems on it, that would be good for me to know. Because then I can go to the app and see what the play is, have to change things up a little bit, so.” – Multimodal 38 and older
While the reaction was generally positive in all groups, the same concern appeared in each group: the potential for too many unwanted text messages. It appears that people are comfortable with the idea of receiving text messages, but only when appropriate and applicable. This concern was particularly evident among the 38 and older groups.

“That’s a fine line between the messages being spam and helpful, so that’s just kind of a balancing act.” – Rail 38 and older

“I would be okay with messages if I’m specifically looking for information. If it’s just going off on my phone, it’ll probably drive me crazy.” – Rail 38 and older

“But it needs to be customizable. It needs to, if it needs to be Blue Line only, you can choose which lines you want notifications for. Because if I only travel on the Blue Line, I don’t want all of the notifications for the Red Line that’s always screwed up. Because then if something for the Blue Line does come up, I’m going to miss it because of all the Red Line stuff. So it has to be completely customizable.” – Rail under 38

“Because sometimes, you sign up and then they inundate you with so much crap you’re like, “I don’t need this.”” – Bus 38 and older

“I had signed up for it, and then I deleted it because it was, like you said, it was too many messages.” – Bus 38 and older

“I feel like it could get overloaded very quickly.” – Bus under 38

“So, I used to sign up for that, the Metro one, that they would send you the alert. But I got to be honest with you, it’s so annoying because it’s constant.” – Multimodal 38 and older

Suggestions for Improvement from Focus Group Participants

To combat the possibility of receiving too many or unwanted text messages, the participants stated that this service must be highly customizable. They should be able to select not only the routes they would like text message updates for, but also the days of the week and times of day that they typically travel on those routes. For example, if they take the 45 bus every day at 9 a.m., they only want alerts about that route between 8 a.m. and 10 a.m.

“Text message I think would be good if it’s properly customized. For instance, they ask me how long does it, is my walk. Let’s say it’s four minutes, so they always text me five minutes before the bus arrives.” – Rail 38 and older

“Only for delays. I don’t need, I know the bus schedule so I don’t need that.” – Bus 38 and older

“No. Because I would be getting them all the time. If I could put in a span of 10 minutes, then that’s fine.” – Bus 38 and older

“But if the bus runs from 6 a.m. to 9:15 a.m. and there is a delay starting at 7 a.m. and I’m not getting on until 8 a.m., I don’t want to get those text messages before, and once I’m on the bus, I don’t really care because I’m stuck.” – Bus 38 and older
“I would do it if it was only during like designated times, times that I could designate. I wouldn’t want to know if there was a delay like in the middle of the day or really early in the morning.” – Multimodal under 38

As mentioned during discussions about calling a number to receive information, participants mentioned here as well that they would prefer text messages as a delivery method if they could initiate the interaction by texting a code. The current alert system sends unprompted updates whenever there is a notification about service. This suggestion would reduce the possibility of being inundated with text messages and would guarantee that they are only getting information that is relevant to them in that moment.

“I think it’s more convenient to have to text this number, and get a response of when the next bus is coming. I like those.” – Bus under 38

“I just want that one-time text. I text a number and you talk to me. I don’t want ping, ping, ping, ping. “It’s on time. It’s late.”” – Bus under 38

“If you could like send the text that says the bus or the train you’re taking, like 16G and then it texts you “Oh there is a delay” or it’s running on time or something.” – Bus under 38

However, not all were equally interested in having to initiate a text as they felt this was too much work to get access to the information they need. They would prefer to have a screen at the stop or station that told them what they need to know so they do not have to seek it out at all.

“Still too much work.” – Rail 38 and older

“If it’s raining and you’re carrying stuff, and you have to pull out your phone, and you got your glasses on...” – Rail 38 and older

“I don’t want to have to text anybody to see if there is a problem with my bus. I want them to tell me there is a problem with my bus.” – Multimodal 38 and older

The younger participants commonly suggested that the delivery method could be improved by switching from a text message to a push notification, as that is their preferred way to be notified through their smartphone. This came up in each segment of Millennial focus groups but was never mentioned by the older participants.

“Just like a push notification would be nice. I don’t want to read text messages from other entities.” – Rail under 38

“I think if it was going to be something that provided a solution, I’d prefer it instead of a text, to be an app notification, so that way when I click on the solution, it will take me to the map and show me what I can do. If it’s just a text, then it will literally just say, “You should do this,” and I’m a visual person, so then after I see the text, I’d be like, “Okay. Can I see what the route looks like?” instead of having to go search for it on my own on Google Maps.” – Rail under 38

“There’s like signs up on the train that say like visit this website and you can sign up. But I just spent, like I think the texts are more annoying for whatever reason than like just regular
notifications. Does that make sense? You know like app notifications, or kind of different...” – Bus under 38

“I would prefer a push notification to a text.” – Multimodal under 38

Results from Online Research

Use and Awareness

Three in ten online respondents (30%, Figure 47) have signed up for and used text message updates to get information (from any line of public transportation). Those who ride ART are more likely to have used this service than users of other public transportation. Notably, there are no significant differences in text message usage between the generations; those 38 and older are just as likely to have used this service as those under 38. However, there are visible differences across genders: males are significantly more likely to have signed up for this type of service than females (41% vs. 20%).

Figure 47: Has Used Text Messages to Get Information

The main reason given for not utilizing text messages is that they were unaware of the service (53%, Table 5). Those who cited specific barriers mentioned text messages are not beneficial to them (23%), they do not like to receive text messages (18%), and/or they do not think they are reliable (10%). Notably, there were no statistically significant differences between the generations when it comes to disliking text messages – those under 38 were equally likely as those 38 and older to cite this as a reason.
Table 5: Why Respondents Have Not Used Text Messages

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not know about this service</td>
<td>53%</td>
</tr>
<tr>
<td>They are not beneficial to me</td>
<td>23%</td>
</tr>
<tr>
<td>Do not like to receive text messages</td>
<td>18%</td>
</tr>
<tr>
<td>Do not think they are reliable</td>
<td>10%</td>
</tr>
<tr>
<td>System I use does not offer text messages</td>
<td>5%</td>
</tr>
<tr>
<td>No need/interest (not specific)</td>
<td>4%*</td>
</tr>
<tr>
<td>Prefer to use the app</td>
<td>1%*</td>
</tr>
</tbody>
</table>

Q13A. Why not?

Base = Online respondents who have not used text messages to get information (n=220)

*This question provided respondents with a list of possible responses and an option to submit additional responses. These responses were submitted by respondents, unaided, which might account for their lower prevalence.

Satisfaction

Those who have used this service are generally satisfied, with 78% indicating that they were mostly or completely satisfied with their experience getting real-time information from text messages. Notably, almost all of the ART riders report being satisfied with their experience, with 95% indicating that they were mostly or completely satisfied. This is significantly higher than the satisfaction ratings from the non-ART public transit users (72%) and the non-public transit users (61%). Interestingly, there were no statistically significant differences between generations for this measure.

Figure 48: Satisfaction with Text Message Updates

Q14. How satisfied were you with your experience getting real-time information from text messages about when the next bus or train would arrive when there was a delay?

Base = Online respondents who have used text messages to get information (n=103)
Value

In line with the results from the focus groups, the majority of online respondents (90%) view text messages as a valuable delivery method for real-time arrival information. ART riders in particular are significantly more likely to find this valuable than users of other types of public transportation (94% vs. 84%). Interestingly, there were no statistically significant differences among the generations for this measure. Notably, those who agree that having real-time information is important when using public transportation were significantly more likely than those who do not agree that real-time information is important to indicate that these text message updates are very or somewhat valuable (92% vs. 78%)

Figure 49: Value of Providing Text Message Updates

Q15. How valuable would you say it is for Arlington County to provide riders with the option of text message updates for real-time bus or train arrival information?
Base = Total online sample (n=346)
ARLINGTON TRANSIT WEBSITE

Results from Online Research

Use and Awareness

Arlington County does not provide an app that offers real-time information, but it does have a website that people can use to find information about the bus routes in the area as well as real-time arrival information. Almost four in ten respondents (38%, Figure 50) have used this website before to search for real-time information. The fact that three-quarters of all ART riders surveyed (75%) use this website speaks to its prevalence among its customer base.

Figure 50: Has Used the Arlington Transit Website

The main reason given for not utilizing the Arlington Transit website is that they were unaware of the website (72%, Table 6). Those who cited specific barriers mentioned that they do not think the website is reliable (11%), they do not have a need or interest (9%), and/or the website does not offer the information they need/useful information (7%).
Table 6: Why Respondents Have Not Used the Arlington Transit Website

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not know about this website</td>
<td>72%</td>
</tr>
<tr>
<td>Do not think the website is reliable</td>
<td>11%</td>
</tr>
<tr>
<td>No need/interest (not specific)</td>
<td>9%*</td>
</tr>
<tr>
<td>Website does not offer the information I need/useful</td>
<td>7%</td>
</tr>
<tr>
<td>Website is difficult to use/too much work</td>
<td>5%</td>
</tr>
<tr>
<td>Prefer to use the app</td>
<td>2%*</td>
</tr>
<tr>
<td>Do not use a smartphone</td>
<td>2%*</td>
</tr>
<tr>
<td>Prefer to call</td>
<td>1%*</td>
</tr>
</tbody>
</table>

Q17A. Why not?
Base = Online respondents who have not used the Arlington Transit website to get information (n=82)
*This question provided respondents with a list of possible responses and an option to submit additional responses. These responses were submitted by respondents, unaided, which might account for their lower prevalence.

Satisfaction

Those who have used the Arlington Transit website to find real-time information are generally satisfied with the experience, with 80% indicating that they are mostly or completely satisfied.

Figure 51: Satisfaction with the Arlington Transit Website

Q17. How satisfied were you with your experience getting real-time information from the Arlington Transit website?
Base = Online respondents who have used the Arlington Transit website to get information (n=131)
Value

The online respondents see value in providing this website, with more than nine in ten (94%) indicating that this website is very or somewhat valuable. Notably, nearly all ART riders (99%) find this website valuable. Interestingly, there are no significant differences among any of the demographics examined for this measure.

Figure 52: Value of Providing the Arlington Transit Website

Q18. How valuable would you say it is for Arlington County to provide riders with real-time information through the www.ArlingtonTransit.com website?
Base = Total online sample (n=346)
BUSFINDER

Reaction to this Technology

Reactions to the BusFinder are mixed among focus group participants; while some participants respond positively and seem to prefer this idea to texting or calling, others are underwhelmed by the technology. On first impression, this technology is seen as simple, easy to use, and accessible to all different kinds of people.

“I like it better, it’s better than a phone-in option that you mentioned previously.” – Rail 38 and older

“This is really nice, I think something like this is quick, easy to use as long as the type font is large enough.” – Rail 38 and older

“I would probably use the bus more if I saw this.” – Rail 38 and older

“That’s cool because especially if you have five bus routes. Usually on the screens, you only get maybe three at a time.” – Rail under 38

“It is kind of like endearingly simple […] I’m being 100% serious. I like that it’s, when I first saw it, I was like, “Wow, this looks like 1980,” but I like that it’s simple.” – Rail under 38

“It’s nice and simple. It’s easy.” – Rail under 38

“I think this is very people-friendly.” – Bus 38 and older

“They don’t have these at every stop on the route, so you’re lucky if you get to a stop where you have this, and for somebody like me, this is actually convenient, because if I’m running out of my job trying to catch the bus, and I don’t really want to whip out my phone and get on Safari, because ART bus doesn’t have an app, and go through the trouble of having to look all this information up, I could just hit this button and it will tell me, “Your bus will be here in 10 minutes.”” – Bus under 38

“I mean the positive of that is like it’s really clear. If you push 41, the 41 bus is six minutes away, like in a perfect world. It’s just so straightforward, like when is the next 62 bus coming? It’s 15 minutes away.” – Bus under 38

“[It’s good for] A lot of different types of customers, older, younger, you know. People with phones, people without phones.” – Multimodal 38 and older

“Yes, I was going to say, I like the idea of, if it was like laid out a little better. Other than opening your phone. For me, like, out of laziness. It would be nice to just like press a button.” – Multimodal under 38

“I generally like it, and it might be useful for people, again, who don’t have smartphones. That way they don’t have to call, either. They can just press the button, so it would take less time.” – Multimodal under 38
“You know why that’s good because we rely on cellphones and what if it drops, whether it is cheap or expensive or smart or not smart, they get ruined, discharged, and this is good.” – Spanish

“I think there should be something like this for people that do not have a phone or have forgotten it. For me it should be mandatory.” – Spanish

This is also seen as a good offering for those who do not have smartphones or for when a smartphone is not available.

“I think this is fabulous because you don’t have to go through all your junk, and grab something else, worry about the Internet, and do all that stuff. You know right away what to do here.” – Rail 38 and older

“Yes, especially if my phone was dead. That way, you don’t have to use your phone.” – Rail under 38

“This is a great idea except I have only ever used it when I was having trouble with the real-time information that was coming through my phone.” – Bus 38 and older

“I think having it at every stop, for me, especially in the wintertime and stuff like that, or raining or anything like that, when I get to the bus stop, the last thing I want to do is fumble around, get my phone out, look up the app, open it up, try to look up at the thing, get the number, type it in, when here you can just push the button, and Voila!” – Bus 38 and older

“I’m not going to lie, there have been times where my phone has died. So, I’m not able to call an Uber. So, times like that, this is helpful. Like out of desperation.” – Multimodal under 38

“I think if I’m going to use this, it’s because my phone died. It’s nice to have something that doesn’t rely on my phone.” – Multimodal under 38

Once again, how attractive this technology is to users is largely dependent on its reliability and accuracy. Most are open to using this technology ‘if it works.’

“When they’re working, they’re good.” – Bus 38 and older

“This is neat, but I don’t know if I’d trust it. I feel like everything’s half broken at these things.” – Rail under 38

“I like it when it’s working.” – Bus 38 and older

“Somebody needs to go redesign the technology in it to make it reliable.” – Bus 38 and older

“I’m already skeptical at how accurate that is.” – Bus under 38

“I think if it works it’s a great idea...” – Bus under 38

“Oh, it’s accurate. I use it all the time. But, the thing about it is, if the weather is bad or something, it just stops working.” – Multimodal 38 and older

“As long as they’re working, I think it’s great.” – Multimodal 38 and older
This caveat was particularly relevant during discussions about the BusFinder when several participants shared experiences about times they were unable to or had difficulty making the technology work.

“I have probably used this maybe, tried to use it 10 times. And of those 10 times, it has worked twice.” – Bus 38 and older

“I didn’t think it was like sort of pressure sensitive because it’s just like a slab of plastic, but I tried pushing it harder, I tried leaving my thumb on it. It eventually worked sort of like the third time I tried it. I’m not sure what it was that made it finally light up.” – Bus 38 and older

“I think they could make it a little bit easier to use. I know with this one, you just have to use your thumb. If you try and use another finger, it won’t work. So, you can only use your thumb for some reason.” – Multimodal 38 and older

“I used it a couple times, it didn’t work. The light didn’t turn on.” – Bus under 38

“They just don’t work, like not in the sense that they’re inaccurate, but in the sense that like you’ll push it and nothing will happen.” – Bus under 38

“Sometimes it’s hard to read the dots in the sun. I think the last time I used it, I couldn’t quite tell that it was illuminated or not.” – Multimodal under 38

However, even assuming the technology does work, there were still some who saw the value of this technology as limited. One of the main complaints is that it cannot be used as a tool to help inform decisions. At the bus stop is seen as too late in the trip to receive critical information.

“I’m just trying to get feedback, like it’s helpful once you’re at the bus stop so it’s like again, I’m trying to think of just what the constructive feedback would just be. But like if you show up and it’s 30 minutes until your next bus, I guess you’re getting the information, which is helpful, but it’s like you’re still kind of stuck.” – Rail 38 and older

“So it’s just helpful information but it’s not really guiding your plan, exactly.” – Rail 38 and older

“Before heading to the bus stop, I’ve probably already tried to look up the time, so I’d probably just have it up and pay attention. I probably wouldn’t even bother to use this.” – Rail under 38

“I think this is good for a time when I happened to be by that bus stop. But it’s very like last-minute kind of thing. Obviously, because it’s at the stop. It’s not something that I would plan on.” – Rail under 38

“I might be out of turn here, but it seems kind of like the door close button on an elevator. I think it’s just there to ease your anxiety about when the next bus is coming. It’s not really like, you can’t use it to plan your day.” – Rail under 38

The perceived utility of this device is limited as it cannot be used to inform decisions.
“Sure, I guess it’s not value less, it’s just this doesn’t help you determine when to leave your house. It just tells you stop fretting, it’ll be here in three minutes.” – Rail under 38

“I much prefer [using my phone to look for real-time information] because I can get that at my house or I can get that on the way, whereas this I have to already be there. It kind of takes away one-half of the purpose of having it because the point for me is, that’s great if I can show up exactly right when the bus is arriving. That feels very efficient to me. The idea of sitting waiting at a bus stop for 15 minutes is like, that’s the thing that would make me never ride a bus. I want to get there right on time, maybe running a little bit, so then I feel efficient.” – Bus 38 and older

“It’s good if you’re already at the bus stop, but if I’m deciding whether I want to leave somewhere, if I should leave or not, it’s better to check on the phone or the computer, because I don’t want to get there, and hit the button, and it says 30 minutes.” – Bus under 38

Furthermore, when they are already at the bus stop, they would like more information than the BusFinder is designed to provide. Many participants feel that it is missing key functionality, like the bus route and/or schedule, which would give customers a better picture of what is available to them. This enhanced functionality would also help those who are not familiar with the system and/or do not know the number of their bus route.

“If you’re not a frequent bus rider and you don’t really know what the actual route is, to be able to see it would be nice.” – Rail under 38

“Just by the numbers, you have to kind of already know what the route is. Like someone just said, I wouldn’t know what 41 versus 45 was. I’d have to go somewhere on my phone to figure out what the routes even are, then figure out which one I care about. And at that point, I would just see it on my phone anyway.” – Rail under 38

“I want to know what the route is.” – Bus 38 and older

“I know but there was a time when I was trying to figure out, I knew my bus was not going to be coming for a while and I was trying to figure out if a different ART bus was going to take me at least part way through my journey. And there was no way to find that out.” – Bus 38 and older

“It doesn’t hurt, but I feel like you need something and not just this. This wouldn’t be enough to stand alone. Again, you need some sort of app.” – Bus under 38

“I would use it as long as there was a map. Or like even if they had it as the map of all the stops, like that would be helpful. I got to see what all is kind of going on.” – Bus under 38

“What it doesn’t show, and I don’t do it now, I take the same bus. But it doesn’t show, you can have a couple of different buses and you may have to walk an extra three or four blocks. But if you don’t know that route, you’re not going to be able to figure that out. This doesn’t really give you that information.” – Multimodal 38 and older

“I want options for another bus that I can walk to.” – Multimodal 38 and older

“I mean, it’s obviously meant for someone who is familiar with the bus system, I guess sort of, like what [she] alluded to. Because it’s not explaining routes or anything like that.” – Multimodal under 38
“I’m just trying to envision myself, “This is my first time at this bus station, and I’m not sure should I take this bus or that.” This is mostly for people that are experienced.” – Multimodal under 38

Beyond the information it provides, participants were also critical of the technology itself, feeling it is ‘antiquated,’ ‘juvenile,’ and ‘outdated.’

“This kind of just looks outdated. If this is brand new, that they just came out with, you would think that this is something that they presented 15 years ago.” – Rail 38 and older

“It just doesn’t seem modern at all.” – Rail 38 and older

“It’s kind of kiddish. It looks like a toy.” – Rail 38 and older

“Yes, make it look like a tablet, not like a half-hearted attempt to make it look like a bus or something.” – Rail 38 and older

“It’s antiquated.” – Rail 38 and older

“It looks like this is from 10 years ago.” – Rail under 38

“I think it would have been a great idea like 20 years ago, but I think there’s better ways of displaying that information nowadays.” – Bus under 38

“I mean I like the idea but like [he] said I think there are better ways of displaying the information.” – Bus under 38

“It has that look of something that was at one point very high tech.” – Multimodal under 38

“It just looks messy and like I don’t want to use it.” – Multimodal under 38

“It looks like it’s meant for a preschooler.” – Multimodal under 38

Some participants expressed discomfort with having to touch the BusFinder to use it, citing concerns about the cleanliness of the device. Interestingly, this concern was only shared by the older focus group participants.

“I wouldn’t want to have to touch the thing.” – Rail 38 and older

“If this is at an actual bus stop, this is who I am, so many thumbs touch that thing, maybe there could be a Handi Wipe next to it.” – Bus 38 and older

“I still don’t know why you need to touch things when you have, we know the technology exists, just to have a small digital board that shows you. You don’t have to have 25 different people touching something. They could have colds or whatever.” – Multimodal 38 and older

“I wouldn’t want to touch it. But I like the idea of being able to see how far away the bus is. But I won’t touch it.” – Multimodal 38 and older

This technology also spurred concerns about its general accessibility, particularly for those who have difficulty seeing.

“I mean you have the accessibility concern, for sure.” – Rail 38 and older
“Would this have sound to it? Because again, people have disabilities in some way, I don’t know.” – Rail under 38

“I’m not 100% sure about this particular one, but I’ve noticed with some of these things, they’re too high up. So, if you’re short like I am, or let’s say you’re in a wheelchair, you’re not going to be able to see it.” – Bus and older

“Is this adapted for people who are visually impaired, because it all looks like smooth buttons to me?” – Bus under 38

“If you’re blind, how are you going to know where to touch?” – Multimodal under 38

Suggestions for Improvement from Focus Group Participants

While some praised the technology for being user-friendly, others found it less intuitive and suggested adding instructions to assist those unfamiliar with the device.

“I think for some who may not be tech savvy, there should be some set of instructions.” – Rail 38 and older

“I know it’s self-explanatory for the most part, but when I first looked at it, it took me a minute to figure out what all those things around the side were. It might be, for some people, they may not get it. So, you might want to put some sort of an explanation on there.” – Bus 38 and older

“I’ve seen these things, but I had no idea what it was, because I think there should be some kind of instruction panel on how to use this.” – Bus under 38

“Maybe have a help button or something, with the instructions to guide you through on what to do.” – Multimodal 38 and older

“I would say for some people, they would need the instruction to touch it, to use it.” – Multimodal under 38

“Are there instructions? Because I know I’ve seen these before, but I never knew that you pushed it.” – Multimodal under 38

Adding instructions may also work to clear up some of the confusion about the type of information being provided as some participants were unsure if the BusFinder provides real-time information or the scheduled time of arrival.

“It would be kind of cool if there was, like I would have had no clue that this is based on GPS, like a device on the bus, right? It would be cool if I knew that, because I would have had… I would have never guessed that in a million years.” – Rail under 38

“How do we know if this is more reliable…? What if it was just on a timer or something, and it’s the same thing? What if there’s traffic and a bus gets delayed, would that information be relayed to this?” – Bus under 38

“But is this using some sort of ping off the bus, or is it just going off its normal schedule…” – Bus under 38
Participants also had more significant suggestions for improvement, including a feature that would allow customers to track the bus en route like an Uber or Lyft, while others suggested implementing another type of technology altogether, such as a scannable QR code or LED display.

“Seeing the [bus on the] route would be better because if you know the area, then you pretty much can figure out [when it will arrive].” – Rail under 38

“I guess it’s basically the same just in another way, but I don’t know why you can have the, like on the map trail, I did actually know it was coming in four minutes.” – Rail under 38

“I think if it was a little bit more, I was going to say sophisticated but just to kind of jump on [her] comment about the QR and being able to scan it, if it was kind of set up similar to this, but have the scanning capability and of course, a protected surface around it. But, you could hold your phone up to that right there at the bus stop, scan.” – Rail under 38

“The thing this makes me think of is how the Metro has, it just says what the next one or two or three are, when I’m on the Metro Rail. Does it really use that much more power to do that than this? That would be way better. Then there wouldn’t be the problem with like pressing it. Just when I walk up, I could just see it on there.” – Bus 38 and older

“I guess, is this cheaper or hardier than a tablet? Some of these, not necessarily this one, but some tablets cost $50, and I think people are maybe more comfortable with them, and there would be a lot more room for personalization in showing a map and such. I’m just wondering why that? Unless it’s cheaper, or hardier, or less of a stealing risk.” – Bus under 38

“So, yes, I would probably find more use if this itself was an app, and maybe there was like a code or a barcode that you can scan on your app, and then take you to a platform that is much more easily readable and have more up-to-date.” – Multimodal under 38

Results from Online Research

Use and Awareness

Exposure and usage of the BusFinder is largely dependent upon the type of transportation used during the typical week. Roughly one-half of those who take ART during a typical week (53%, Figure 53) have used a BusFinder before, compared to 11% of those who take other types of public transportation and 8% of those who do not typically take public transportation. In general, ART riders are aware of this technology with only 10% never having seen or used one before.
Most of those who have used a BusFinder are satisfied, with almost eight in ten (78%) indicating they are mostly or completely satisfied with their experience using BusFinder to get real-time information.

Figure 53: BusFinder Use

Figure 54: Satisfaction with BusFinder

Q19. Have you ever used or seen a BusFinder in Arlington?
Base = Total online sample (n=88-346)
A = significantly higher than ART riders; P = significantly higher than Non-ART public transit rider; N = significantly higher than No public transit

Satisfaction

Most of those who have used a BusFinder are satisfied, with almost eight in ten (78%) indicating they are mostly or completely satisfied with their experience using BusFinder to get real-time information.

Figure 54: Satisfaction with BusFinder

Q20. How satisfied were you with your experience using BusFinder to get real-time information about when the next bus would arrive?
Base = Online respondents who have used BusFinder (n=72)
Value

The majority of the online respondents view this technology as a valuable resource, with more than nine in ten (95%) indicating that the BusFinder is very or somewhat valuable. Interestingly, those who do not use public transportation are significantly more likely than those who do to find this device valuable (99% vs. 93%).

**Figure 55: Value of Providing BusFinder**

Q21. How valuable would you say it is for Arlington County to provide BusFinder at the bus stop for riders to get real-time bus arrival information?
LED DISPLAYS

Results from Online Research

Use and Awareness

The online respondents were shown the picture of a LED screen included here, and then asked if they had ever seen or used one before. While not defined for users, LED displays provide next bus real-time arrival information. Exposure and experience with LED Displays at bus stops is mixed among the online respondents. One-third of these respondents (33%, Figure 56) have used an LED Display at a bus stop before, while another one-third (34%) have seen but never used this display, and the final one-third (33%) have never seen or used one of these displays. Once again, those who ride the ART bus during a typical week are significantly more likely than other public transportation users to have used one of these displays before (58% vs. 32%).

Figure 56: LED Display Use

Q28. Have you ever seen or used these message boards?
Base = Total online sample (n=88-346)
A = significantly higher than ART riders; P = significantly higher than Non-ART public transit rider; N = significantly higher than No public transit
Satisfaction

Those who have used an LED Display before tend to be very satisfied with their experience, with almost nine in ten (87%) indicating that they are mostly or completely satisfied with their experience getting real-time information from these message boards. Those who ride ART are significantly more likely to be mostly or completely satisfied with their experience than those who ride other modes of public transportation (94% vs. 80%).

Figure 57: Satisfaction with LED Displays

Value

These displays are seen as very valuable resources for riders to get real-time information with 96% of the online respondents indicating that it is somewhat or very valuable for Arlington County to provide this signage at bus stops. Those 38 and older find this type of display particularly valuable, with nearly all of those respondents (99%) indicating that this is a valuable resource.

Figure 58: Value of Providing LED Displays
DYNAMIC MESSAGE BOARDS

Dynamic message boards are electronic screens installed in public locations to disseminate multimodal transit real-time information. Two different dynamic message boards were tested in this portion of the research to ensure that the opinions collected were not specific to one design. Furthermore, one message board presented solely public transportation options while the other included additional multimodal options (such as ride-hail, and traffic conditions in the area). Specifically, both Redmon Screen and Transit Screen were tested in both the focus groups and the online research.

While there are differences in design and content, much of the feedback overlaps when speaking more generally about the pros and cons of these dynamic message boards. This first subsection will address the reactions to these devices overall. Feedback specific to each board will then be covered separately.

Reaction to Dynamic Message Boards

A recurring theme in this research is that people want real-time information before they begin their trip to help them plan. Information that is made available in public spaces or at the stop or station is often viewed as accessory because it is not serving the purpose of helping them plan. To that end, one of the main pieces of feedback about these message boards is that they are not useful for people who are already on the go – by the time a person has access to this screen, they do not need the information because they have already decided how they are going to travel.

“I think the modus operandi for people who run to the platform as fast as possible. Do I care to look at information about when the train’s arriving? No, because I’m there at the station. I’m just going to go as fast as I can to the platform.” – Rail 38 and older

“I mean my building has something like this displayed downstairs and I never, I pass by it every day, I never look at it […] I notice it, I don’t pay attention to it because I’m going to go to the Metro regardless, the worst I’ll be 30 minutes late to work.” – Rail 38 and older

“Can I get this pumped into my house direct? Is there a channel that I can put it on that’ll give me this for Mac?” – Rail under 38

“I think if this were in the lobby I would, I mean I’d have to go down to look at it where I could, especially if I was taking the Metro I would just check my phone before I left my…” – Rail 38 and older

“Well it’s by the elevators, when you get off the lobby it’s right there, but 99% of the people as soon as they get off the elevators they walk away.” – Rail 38 and older

“I think this is really great. I mean what would be nice if, you know, even to have something like this available at home where you could just look at that really quickly if you have these kinds of options. Like well gee, should we drive out there, or should we take this, or should we take? I think this is fabulous.” – Rail 38 and older
“I would love this in my apartment itself.” – Bus 38 and older

“It’s almost like if I’m going to take public transportation, it’s so much, I think, more useful to look at it on my phone because I’m probably going to be like, by the time I have left whatever area I just saw this, the information has already changed, and I would like to see it updated in real-time.” – Multimodal under 38

“It’s nice, but I think you have also kind of made your decision before you walked out the door. Before I walk out the door, I’m tracking my apps to see how fast I have to walk, can I make this bus, do I have to wait for the next one.” – Multimodal under 38

“For real life living, a board is invariably going to be in a lobby, in a, someplace where I can’t plan. Where I’ve already started a trip. So, it’s not, it wouldn’t fit into my life.” – Multimodal 38 and older

The desire to use these dynamic message boards as a planning tool also leads many to suggest that the boards always show the next three trains and buses arriving so they can decide whether they need to catch the next bus or train or if the second or third arriving is more convenient.

“I like options because you could be like alright I’ll have another beer.” – Rail 38 and older

“The two minutes may require a run, and sweaty, and 14 minutes yeah okay I will just take my time or...” – Rail 38 and older

“If it had not just the next one but the one after that, like it does for Huntington, how it shows that.” – Rail under 38

“This is an example for me, when I used to work right here at this restaurant and I got in real late. I’d walk up to Rosslyn and update and say, “Okay, Silver Line train I just missed. The Orange Line train is another 25 minutes. Oh, the 38 bus is on its way. I missed the 45.” It will tell me what options I have.” – Bus 38 and older

“Yeah I’d prefer more information than less [...] I would say I don’t, if some of the stuff I don’t need I don’t have to look at, but it’s nice to have these options on here. I don’t have a Bikeshare account but if I did it would be interesting to see oh there’s none here, so now I got to come up with another different plan.” – Bus under 38

“They all either need to say the next one, or the next and the next, next.” – Multimodal under 38

“If the next one is coming in 10 minutes, I’m going to make that one, but if it’s two minutes, I might miss it. I want to know when the next one is.” – Multimodal under 38

“The trains only show you one again, so the Largo is in one minute, and it’s like, “Uh. So, should I run for it? Is the next one in 20 minutes? Is the next one in five minutes?” It only shows one train coming.” – Bus under 38

Crucial to the effectiveness of these boards is their readability and understandability. Participants noted that both boards require a learning curve as they are not instantly understandable. However, once they spent some time looking at the examples they were able to find the information they needed.
“I just want it to look the same so that every time I look at it I know what I’m looking for and can see it quickly.” – Rail 38 and older

“It’s confusing, because it says arriving next is the bus to Ballston, but that’s not for 30 minutes, and all the other buses are coming before it, but show afterwards.” – Bus under 38

“You don’t think of it. If you get used to it, you just know where the information is. You have to kind of figure out what, and once you do that it’s okay.” – Multimodal 38 and older

“Wait, but when it says, this red, the 23D, it says it’s arriving next. But then 30 minutes. I don’t know how to read that. It says, arriving next. What’s the 30 minutes?” – Multimodal under 38

“I feel like with any of these things, there’s going to be that visual learning curve, and then you’re like, “Oh. Okay.” It took us two seconds what was going on with the bike situation, and then like, “Oh. Okay. Boom.” Now we all know how to read bikes. I think with anything that gets put up, there’s going to be that initial learning curve, but as soon as you know how to use the system, you’re good.” – Bus under 38

“The first time I saw it, it was yes, but seeing it every day I was like I know exactly where the Ubers are, blah, blah, blah.” – Rail 38 and older

“I think the first time I look at this, it comes across as like a lot, but if it were in my apartment building and I saw it, like the third time I saw it, I think it would be just fine because I would be used to what I was looking for and know where it was, and it would be, I would want a lot of information on it.” – Bus 38 and older

“I like all the information, but at the same time, at first glance at it, it could be too much. Your eyes are kind of wandering.” – Bus under 38

“I think that to be able to provide exact information regarding transportation, it has to be much simpler to understand. It doesn’t need to have a lot of information. Because people, when they see it for the first time, they don’t even pay attention to it because they see it as too complicated.” – Spanish

The participants in the Spanish-speaking focus groups had a separate concern about the readability of these dynamic message boards. Some feel that these boards may be difficult to understand for those who do not read English well, while others feel the use of icons and numbers made it accessible for people of all languages and reading levels.

“For a group like this that is technologically advanced this is perfect. But not for everybody... The ones he mentioned that have a language barrier, the ones that don’t understand English, and don’t have these types of devices, with the elderly, or disabled.” – Spanish

“I would say it’s a good thing, with all due respect, but I suggest that it also be bilingual, there is a lot of text here if someone reads it carefully, which has important information but it’s only in English like there are no departures at this moment at these bus stops, what is not functioning or if there are delays. There is a lot of information here to manage in Spanish.” – Spanish

“I am going to reference people who don’t understand English well or about elderly. If we focus a little more on the screen we can see that there is a good amount of images. So, the screen is communicating by itself, its saying looks it has the bus images, the images of the bike, 395, and the
time. So, I think that even for the people who don’t speak good English, you see the bus image, you see the time that says min, which in Spanish it also means minutes, although not everything in life is perfect, but this is something that this would be an advancement and will help a lot more.” – Spanish

Results from Online Research

Ratings of Possible Features

The dynamic message board features tested in the online research were selected based on the discussions from the focus groups, so these concepts will be visible in the feedback from participants in the Redmon and Transit specific sections.

The most important features for these message boards to contain are route maps (75% rating very important, Figure 59), a familiar map interface (73%), and information that allows the board to act as a one-stop tool for all transportation information needs (71%). Those who use public transportation rated each of these features significantly higher than those who do not use public transportation, suggesting that these are needs at the forefront of transit users’ minds.

While respondents are interested in these message boards presenting all possible transportation modes (62% rating very important), they are less interested in the inclusion of the newest transportation options, like ride-hail, bikeshare, and electric scooters (47%). However, those under 38 find both of these features more important than do those 38 and older.

Figure 59: Importance of Possible Message Board Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Rating</th>
<th>8-10</th>
<th>4-7</th>
<th>1-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide route maps</td>
<td>75%</td>
<td>22%</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Provide a map interface that you are familiar with</td>
<td>73%</td>
<td>24%</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Be a one-stop tool for all your transportation-information needs</td>
<td>71%</td>
<td>26%</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>Allow you to adjust your departure time</td>
<td>69%</td>
<td>27%</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Present all possible options and combinations</td>
<td>66%</td>
<td>30%</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Offer all possible transportation modes including walking, driving, biking, ride-hailing, and others</td>
<td>62%</td>
<td>32%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Include the newest transportation options like ride-hail, bikeshare, electric scooters, and others</td>
<td>47%</td>
<td>40%</td>
<td>12%</td>
<td></td>
</tr>
</tbody>
</table>
Redmon Screen

Reaction to the Redmon Screen

The dynamic message boards typically garnered positive reactions, with a noticeable absence of the strong, ‘I would never use this,’ verdicts present for the other types of technology discussed. Overall, the participants like the concept of this technology and what it could provide.

“If you need to know the information, this is helpful.” – Rail 38 and older

“You know, running errands, like there’s a delay or something, you’re like, “Oh, I have time to go to Starbucks” or whatever.” – Rail 38 and older

“And it’s not overwhelming. It’s precise information for what you’re looking for for traveling.” – Rail 38 and older

“I’m just saying I think this is fabulous, I mean these are great.” – Rail 38 and older

“At least if the bus is up there, for me, it’s going to make me start thinking about, “Okay, maybe I should start taking the bus.”” – Rail under 38

“It tells you everything you need.” – Bus 38 and older

“I love this.” – Bus 38 and older

“I would like this at every bus stop tomorrow.” – Bus 38 and older

“It has all the information we need.” – Bus under 38

“I now understand the ART [BusFinder] thing, but this was immediately understandable. I wouldn’t have to learn the secret code.” – Bus under 38

“I feel like with this right here, you could still list the phone numbers somewhere on this page, but the actual people actually needing to use the number to call and get this information, real-time information, they wouldn’t have to do it as much with all of this right here versus the other, with the ART buses, their real-time information.” – Bus under 38

“You don’t have to do anything. It’s just right there.” – Bus under 38

“There is a lot to look at here. If I had to wait 10 minutes for a bus, I could be looking at the screen.” – Multimodal under 38

Specifically, these participants were pleased that this board provided information about the maintenance schedule and the weather.
“I like the thing saying about the maintenance schedule so you’re aware of it and know.” – Rail 38 and older

“I like that they have the weather on it.” – Rail under 38

While pleased with the concept of this board, a couple participants mentioned that this is something they would like, or even prefer, to have on their phone so that they could customize the information.

“That is an app I would use...” – Rail 38 and older

“But the nice thing is you can customize. Like you can get rid of the, like for me I’m not going to use the bike dock, I’m not going to use the bus. Like you can customize it so it’s not so cluttered. Like if this is kind of busy, for me this is kind of busy, but if you were able to customize it as a widget, or an app, or whatever, you can just take out and add what you’re actually going to use, like that’s feasible...” – Rail 38 and older

Suggestions for Improvement from Focus Group Participants

While impressed overall with this message board, the participants did have a few points of contention that they would like to see ironed out. Across all groups, the participants were a bit overwhelmed with the design. Most often, they commented that the board felt ‘too busy’ and that the information for Metrorail was too small.

“I feel like it’s good, great information, but in terms of the design, I feel like it’s a little bit busy.” – Rail under 38

“Why is the Metro by the buses, why are icons so big? That part doesn’t matter to me as much as what the route is and where it is and what time it’s coming. So I just feel like your eyes are drawn to things that don’t matter and the things that do matter, are really small. Like the Metro times, the text is tiny.” – Rail under 38

“I need it like when I’m going to work and I’m going to the station, I don’t care about the ads, I don’t care about this, that and the other. I just can quickly my eyes immediately go to, “That’s the train I need. That’s what time it is. Crap, I have one minute. I’m going to run down to the platform.” You know, your eyes want to zoom into the most important stuff.” – Rail under 38

“I’ll know if I’m going to take the Metro, because most of the time I do. I know where to look to see how many minutes away it is. But if it’s somewhere else where I’m deciding where I want, what I want to take, then it should be a cleaner layout.” – Rail under 38

“There is a lot going on and I’m kind of confused on why the bus section is a lot bigger than the Metro and the... But I guess it’s just because there are a lot of options for this.” – Rail under 38

“I think it’s good, I just think it tries to put too much information in it. It’s a lot to process when you’re standing out in the rain, like there’s stuff together people waiting for the same bus. You know like you’re not wanting to do that much. Like individual interpretation, you just want to be able to look at something and be like okay, that’s what I’m getting. And that’s not as clear as I would like it to be.” – Bus under 38
“As an example of like similar information displayed slightly differently, the screens on like the new Metro trains are... They’re fantastic at displaying all the information that you need, like how many stops as until you... Yeah like what sort of amenities are at each station. Like that’s really well laid out, and very, very clear even to someone that’s never used it before.” – Bus under 38

“If I saw this message board, it would look a little busy to me. It’s a lot of stuff on here.” – Multimodal 38 and older

“I think like the Metro numbers and information is like too small.” – Multimodal under 38

“If I may, I love this information. It pretty much has everything. I just think it is maybe a little bit too crowded. I would like it more simple. Like too many colors or whatever. I get it, of course, it’s a sign, but if it’s just kind of more clear.” – Multimodal under 38

“You just can’t see those graphics in the back there. I would have just made it plain blue.” – Multimodal under 38

The importance of clear branding was also visible in participant feedback on the design. A few participants mentioned that the blue map instantly led them to assume that this board was specifically for Metrorail’s Blue Line; others saw the red ‘M’ logo for Metrobus and assumed it was for Metrorail’s Red Line. With the colors used for the various Metro lines being so ingrained in this community, choice of colors is critical in ensuring the information is easily recognizable and understandable.

“When I saw the Metro logo, I instantly assumed train.” – Rail under 38

“When I first looked at it, I was like, “Oh, Red Metro.” And then I realized that it says bus arrivals and it didn’t make sense to me.” – Rail under 38

“This little map at the top, I don’t think that’s the Blue Line, but it’s blue.” – Bus under 38

Other miscellaneous suggestions include adding a route map, clarifying if the times provided are the arrival or departure time, and keeping the information consistent so that it always shows the minutes until arrival and not the actual arrival time.

“This last word here, see how it has the time instead of the next minutes. That is far less desirable than having the minutes like the other three.” – Bus 38 and older

“Metro map would be nice. Maybe one of the screens it scrolls through gives a Metro map.” – Bus 38 and older

“The metro map would be good.” – Bus under 38

“This all sounds silly, but you know, one thing that I would really think would be necessary would be a real map. I mean, I’m not sure that little blue thing is the greatest map in the world.” – Multimodal 38 and older

“I mean Rosslyn is the end of the line for the 45, but it says arrives in ten minutes. But, then it doesn’t tell you that you’re going to wait 20 minutes for them to leave. Unless you ask them. So,
Redmon Screen: Results from Online Research

Use and Awareness

Overall, about one-third of online respondents (33%, Figure 60) have used a Redmon Screen to look for information. Use of the Redmon Screen is significantly higher among those who ride ART bus than those who do not, regardless of public transportation use. Those under 38 are also more likely than those 38 and older to have used one of these screens (40% vs. 26%).

Figure 60: Redmon Screen Use

Q22. Have you ever seen or used one of these message boards?
Base = Total online sample (n=88-346)
A = significantly higher than ART riders; P = significantly higher than Non-ART public transit rider; N = significantly higher than No public transit
Satisfaction

The vast majority of those who have used a Redmon Screen to look for information are satisfied with their experience, with 90% indicating they are mostly or completely satisfied with their experience getting real-time information from this message board. Notably, this satisfaction is equally high among all ages and types of transportation users.

Figure 61: Satisfaction with Redmon Screen

Value

The Redmon Screen is considered valuable by 96% of the online respondents. Again, there are no differences between those who typically use public transportation and those who do not – all find this type of technology valuable; nor are there differences between the generations, with those 38 and older assigning just as much value to this screen as Millennials. The one place a significant difference is visible is across racial lines. Caucasians are significantly more likely than those of other races and ethnicities to consider this screen valuable (98% vs. 90%).

Figure 62: Value of Providing Redmon Screens
Transit Screen

Reaction to the Transit Screen

As with the Redmon Screen, the Transit Screen inspired none of the negative declarations heard for other types of technology. The participants are generally far more open to the concept of this technology and the information it provides. Transit Screen in particular received praise for the variety of information it provided, giving users a full picture of the transportation options available.

“It’s nice because it’s one-stop shopping.” – Rail 38 and older

“It’s organized in a way that makes more sense to me.” – Rail under 38

“This gives you all your transportation options.” – Bus 38 and older

“I wish I had this back when I took the Metro every day in my office building because it would have made things a lot better than having to walk down to the Metro, figure out, it’s like 20 minutes behind. And then go up, then everyone is trying to take the same bus or Uber. So this would be nice to kind of cut out of that...” – Bus under 38

“I just think it’s a nice little heads up if you’re going to take like the Metro and a bus. Like, “Can I walk slowly, or should I pick up the pace to get that train?”” – Multimodal under 38

While some admit that the amount of information provided can feel a bit overwhelming, they prefer to see everything because it is all helpful. The amount and variety of information is seen as especially useful because it helps them make travel decisions.

“This one is more available information. And not only is it telling you the trains, it’s telling you the bus. It’s also telling you whatever bus that you’re trying to do, giving you information on Uber, the Bikeshare, the traveling.” – Bus 38 and older

“You know why, because if you find out that there’s a lot of traffic, then you’ve got an option to go get on the Metro, then you’re going to go get on the Metro. But if you find out that traffic’s moving really good, then you’re going to get in your car and if you have that.” – Bus 38 and older

“I think the more [information] the better, people can decide.” – Rail under 38

“If I had something like this, it would be really helpful because that way, you could find out the easiest and quickest way to get where you’re going.” – Rail under 38
“But if I do see, if I do happen to notice that all the trains are running 30 plus minutes behind schedule, maybe I’ll look at Uber.” – Rail 38 and older

“And this is fabulous. If you have, let’s say you have a meeting, and you were going to planning on driving, and you see this. And you say, “Oh wait a minute, it’s going to take me, look at the traffic, it’s going to take me 40 minutes to get, I may as well just get on the Metro.” I think this is fabulous. I think, you know, see because this is so easy.” – Rail 38 and older

“I think you need it all so yes, it’s too much [information] but you kind of need it all there.” – Rail under 38

“You can look at it and see, “Traffic is bad. I’m going to take the bus.”” – Bus 38 and older

“I go back to the more the better, if you don’t need it you don’t have to look at it.” – Bus under 38

“Or you can stay at work and lay later, or whatever. So it just gives you an option to kind of change your plans as opposed to just walking up.” – Bus under 38

“...It’s nice to see like how many Ubers are around. Like if there are a lot, we’ll just grab that, or grab the Metro or something.” – Multimodal under 38

Beyond the standard public transportation information, participants were pleased to see information about the current and projected traffic conditions as well as the current and future weather.

“I like that they have the weather on it.” – Rail under 38

“I like that they gave you the temperatures and the weather, the forecast throughout the day.” – Rail under 38

“I do like the traffic time.” – Rail under 38

“I would love to have the traffic one. We only have the white one, so we don’t have traffic, but I would love it for traffic.” – Bus 38 and older

“I really like the weather. I wouldn’t think “Oh I need the weather” but sometimes like an hour, if you stay an hour later you’ll miss the rain.” – Bus under 38

“Actually, what is great, the great piece of information here, is the traffic travel times now, and then estimated in 30 minutes, is really brilliant.” – Multimodal 38 and older

“I like that it has the traffic especially, with the minutes and the miles. That’s important. This way you can avoid going to a road if there is too much traffic, you can see that. Gives you another option.” – Multimodal 38 and older

“Traffic, not only the bus and the train but also the traffic, you see the surrounding. Very good.” – Spanish
The focus group participants were shown two different Transit Screens, a blue one and a white one. The blue screen included some additional information that the white one did not, like the traffic conditions. These participants found the design of the white screen easier to read but they preferred the additional information provided by the blue screen.

“The blue one, I would use more so than the white one.” – Rail 38 and older

“I feel like it’s hard to figure out where to look on the white one.” – Rail under 38

“I like the white one better.” – Rail under 38

“Well, I’m just talking about what a lot of people would be able to, like an older person, the contrast of black and white is easier for say somebody who’s steadily trying to read the information.” – Bus 38 and older

“[I prefer] the white one but with the information of the other one.” – Spanish

As with the Redmon Screen, this technology inspired a desire to possess and customize this information through an app on their smartphone.

“If you can do, like somebody said, if you can pick and choose what you want this thing to populate with, the most popular things.” – Rail 38 and older

“If you see what you want to take and then you click on it, and then it starts navigating you or shows you a map or something, I think that would be like, that would bring it to love for me.” – Rail 38 and older

“I still want it on my phone.” – Rail under 38

“If I want only Uber, can I just have Uber and not Uber and Lyft? Or, if I want the Bird Scooters, can I have that on there?” – Rail under 38

“If an app used location, your GPS location on your phone, and it knew where you were at, and you could get this, that would be fantastic.” – Bus 38 and older

“Maybe you can customize it, and choose what you want, maybe only Uber, or whatever it is. You can filter it, and it just gives you that.” – Bus under 38
“What would be nice, if this were an app, is if you could customize it, so if it gives you the base and you could like drop and add certain variables that are tailored to what you like, or your commute.”

– Multimodal under 38

Suggestions for Improvement from Focus Group Participants

Overall, these participants were less overwhelmed by the design of the Transit Screen than the Redmon Screen, but there are still some enhancements that could be made to improve the readability of this message board. The most frequently made comment is that it is difficult to differentiate between icons used for the bus and rail lines. Rather, participants would prefer to see the mode’s actual logo.

“I guess I would see the other information more clearly if there weren’t 50 things on here.” – Rail 38 and older

“I’m being nit-picky but it’s hard for me to kind of differentiate [between bus and rail].” – Rail 38 and older

“If you’re just looking at it, both have the Metro symbol and the train little car and the bus look very similar.” – Rail under 38

“With the white one, I think it makes it a lot easier to see what the sections are. I think my main problem with the blue one though is they’re obviously using color to mean different things in terms of lines and buses and logos and so with the blue background, it’s just too much going on with the color. If you’re trying to use color to differentiate between the text and it’s also the blue background, it just, it’s a little bit lost. It’s a little bit busy.” – Rail under 38

“The train car and the bus could use some differentiation.” – Rail under 38

“I would say really use the county art. I would just use the ART logo instead of the thing you put there.” – Multimodal 38 and older

“The logos help a lot, I think. It really catches your eye and what you’re looking for.” – Rail under 38

“I think that logos or the icons are really helpful. I zoomed in just on the right, just what I wanted, in the order that I would find it.” – Bus 38 and older

“I like that it has it organized in three separate columns, because it doesn’t seem like as much information as it actually is.” – Bus under 38

Other miscellaneous suggestions include adding Lyft information, including the next several buses or trains arriving, and incorporating information about the current cost of tolls and ride-hailing pricing.

“I think it would be nice if it included other, instead of Uber, you could have Uber and Lyft or you could customize it to just do one or the other.” – Rail 38 and older

“It should have the next one [to arrive].” – Rail under 38
“With the travel time on here, it should also add what tolls are, because those can vary so much in the morning too.” – Bus under 38

“I would like to see, too, if we’re going to all of this combined, if there’s a toll on 66 right now, or...” – Bus under 38

“Why does it have Uber and not Lyft?” – Multimodal 38 and older

“I think it would be more helpful if they had some way of saying like, “Here is generally what prices are running on Uber.” Instead of the fact that there is a car a certain number of minutes away. Because unless it’s like the middle of the night, there is always going to be an Uber like five minutes or less away. It’s not the distance. You could be dealing with like time surge, and then you’re like, “Okay, I’m not going to take Uber right now.”” – Multimodal under 38

Transit Screen: Results from Online Research

Use and Awareness

About one-fourth of respondents (26%, Figure 63) have used a Transit Screen. Those who ride the ART bus are significantly more likely to have used this screen before. However, use and awareness of this screen in general is low, with one-half of the online respondents (50%) never having seen this screen before.

Figure 63: Transit Screen Use

Q25. Have you ever seen or used one of these message boards?
Base = Total online sample (n=88-346)
A = significantly higher than ART riders; P = significantly higher than Non-ART public transit rider; N = significantly higher than No public transit
Satisfaction

While use and awareness is relatively lower, those who have used the Transit Screen before are generally very satisfied with their experience. About nine in ten respondents (93%) report being mostly or completely satisfied with their experience getting real-time information from these message boards. Furthermore, all respondents report being at least somewhat satisfied, with no one indicating that they were not very or not at all satisfied.

Figure 64: Satisfaction with Transit Screen

Value

The Transit Screen is considered valuable by 93% of online respondents. As with Redmon Screen, there are no differences between the generations, with those 38 and older assigning just as much value to this screen as Millennials. Also similar to the results for Redmon Screen, Caucasians are significantly more likely than those of other races and ethnicities to consider the Transit Screen valuable (95% vs. 88%).

Figure 65: Value of Providing Transit Screens
Locations for Implementation

The focus group participants suggested several locations where these dynamic message boards would be useful, including lobbies of office buildings and apartments, in elevators, hotels, shopping centers, schools, as well as outside of Metro stations and sporting venues. It was also mentioned that these boards would be useful inside of the office or apartment itself, and not just in the lobby.

“I want them to put this in my lobby at work.” – Rail under 38

“Well, if this is outside the station, it’s good, because it tells you everything. Like you said, if you want to go to the bank. The cellphone platform, because it just tells you.” – Multimodal 38 and older

“I would love if a lot of the office buildings would have something like this that you can just kind of just walk out and have it.” – Rail 38 and older

“It should be in the elevator.” – Rail 38 and older

“This would be perfect for a hotel.” – Rail under 38

“Grocery stores. Shopping centers.” – Bus 38 and older

“Schools, colleges.” – Bus 38 and older

“I think this would be perfect in bigger landmarks, like Metro stations, for example, hospitals, places of business, things like that, but just at every bus stop, I don’t feel like it would be...” – Bus under 38

“Especially, at Metro stops that are connecting to different lines. It would be nice to have these.” – Multimodal under 38

“Also, it would be good for like coming out of any of the sports stadiums.” – Multimodal under 38

“I don’t know if you were able to fit this somewhere in Chinatown, for example, that’s the closest to the Capital One Arena, closer to a lot of restaurants. Close to the theater.” – Multimodal under 38

“Yes however, the location of where they are displayed must be considered. If they are placed in private apartments, they are going to serve the residents of those apartments but for people who don’t live in those apartments, they will not have access to the lobby and see it. So, if they could put it in a public area it would be even more useful.” – Spanish

“I mean having that screen in your apartment, or office would be great because then you could just glance at it.” – Bus under 38
The online respondents provided similar suggestions, with malls and shopping centers (71%, Table 7), lobbies of commercial buildings (67%), lobbies of apartment buildings (52%), and hospitals (40%) receiving the most mentions. Less than one in ten respondents (7%) reported that they would not find value in this type of message board at any location.

**Table 7: Recommended Locations for Implementation**

<table>
<thead>
<tr>
<th>Location</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>In malls/shopping centers</td>
<td>71%</td>
</tr>
<tr>
<td>In lobbies of commercial buildings/commercial areas</td>
<td>67%</td>
</tr>
<tr>
<td>In lobbies of apartment buildings</td>
<td>52%</td>
</tr>
<tr>
<td>In hospitals</td>
<td>40%</td>
</tr>
<tr>
<td>At/outside Metro stations</td>
<td>2%*</td>
</tr>
<tr>
<td>At/Near bus stops/bus lots</td>
<td>2%*</td>
</tr>
<tr>
<td>At/Near transportation sites/transit centers</td>
<td>2%*</td>
</tr>
<tr>
<td>Near routes/At stations/stops</td>
<td>1%*</td>
</tr>
<tr>
<td>On the street/sidewalks</td>
<td>1%*</td>
</tr>
<tr>
<td>At all major transit stops</td>
<td>1%*</td>
</tr>
<tr>
<td>Tourist destinations/High traffic areas</td>
<td>1%*</td>
</tr>
<tr>
<td>Main locations/Key street intersections</td>
<td>1%*</td>
</tr>
<tr>
<td>I would not find value in a message board like this in any location</td>
<td>7%</td>
</tr>
</tbody>
</table>

Q31. Where would you find value in a message board like this?

Base = Total online sample (n=346)
Multiple responses accepted

*This question provided respondents with a list of possible responses and an option to submit additional responses. These responses were submitted by respondents, unaided, which might account for their lower prevalence.
COMPARATIVE ANALYSIS OF EXISTING REAL-TIME TECHNOLOGIES

Satisfaction

Overall, respondents are least satisfied with their experience getting real-time information from the phone number installed at bus stops. BusFinder was the only technology that was not significantly more satisfactory than the phone number. The two dynamic message screens received significantly higher satisfaction ratings than the phone number, text message updates, Arlington Transit website, and BusFinder.

Among those who typically ride ART, differences in levels of satisfaction with text message updates over the phone number and BusFinder become more pronounced. These respondents are also significantly more satisfied with the LED and dynamic screen experiences than experiences with calling the phone number and/or BusFinder.

**Figure 66:** Percentage Mostly or Completely Satisfied with Experience

<table>
<thead>
<tr>
<th>Technology</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone Number (P)</td>
<td>65%</td>
</tr>
<tr>
<td>Text Message (T)</td>
<td>78%</td>
</tr>
<tr>
<td>Arlington Transit Website (W)</td>
<td>80%</td>
</tr>
<tr>
<td>BusFinder (B)</td>
<td>78%</td>
</tr>
<tr>
<td>LED Displays (L)</td>
<td>87%</td>
</tr>
<tr>
<td>Redmon Screen (R)</td>
<td>90%PTWB</td>
</tr>
<tr>
<td>Transit Screen (S)</td>
<td>93%PTWB</td>
</tr>
</tbody>
</table>

How satisfied were you with your experience getting real-time information from [technology] about when the next bus or train would arrive?

Base = Online respondents who have used [technology] (n=72-131)

Significant differences are shown through the use of letters. A letter next to a percentage means that the number is statistically significant compared to the corresponding technology. For example, a ‘P’ means the finding is significantly higher than the finding for Phone Number.
### Figure 67: Percentage Mostly or Completely Satisfied with Experience

(Among ART Riders)

<table>
<thead>
<tr>
<th>Technology</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone Number (P)</td>
<td>78%</td>
</tr>
<tr>
<td>Text Message (T)</td>
<td>95%PB</td>
</tr>
<tr>
<td>Arlington Transit Website (W)</td>
<td>85%</td>
</tr>
<tr>
<td>BusFinder (B)</td>
<td>79%</td>
</tr>
<tr>
<td>LED Displays (L)</td>
<td>94%PB</td>
</tr>
<tr>
<td>Redmon Screen (R)</td>
<td>93%PB</td>
</tr>
<tr>
<td>Transit Screen (S)</td>
<td>95%PB</td>
</tr>
</tbody>
</table>

How satisfied were you with your experience getting real-time information from [technology] about when the next bus or train would arrive? Base = ART Riders who have used [technology] (n=40-66)

Significant differences are shown through the use of letters. A letter next to a percentage means that the number is statistically significant compared to the corresponding technology. For example, a ‘P’ means the finding is significantly higher than the finding for Phone Number.

### Value

The comparative value of each technology is more difficult to assess than its satisfaction as seven of the eight real-time information delivery methods are considered valuable by at least nine in ten respondents.

The Arlington Transit website, BusFinder, LED displays, and Redmon Screen are all seen as significantly more valuable than both the phone number and text message updates. However, text messages did receive statistically significant higher value ratings than the phone number.

### Figure 68: Value of Each Technology

How valuable would you say it is for Arlington County to provide [technology] at bus stops for riders to get real-time bus arrival information? Base = Total online sample (n=346)

Significant differences are shown through the use of letters. A letter next to a percentage means that the number is statistically significant compared to the corresponding technology. For example, a ‘P’ means the finding is significantly higher than the finding for Phone Number.
Among ART riders surveyed, all of the tested technologies are seen as more valuable than providing a phone number to call. However, there are no other statistically significant differences present for these technologies. Other than the phone number, they are all seen as valuable by at least nine in ten ART riders surveyed.

![Figure 69: Value of Each Technology](image)

How valuable would you say it is for Arlington County to provide [technology] at bus stops for riders to get real-time bus arrival information?

Base = ART riders (n=88)

Significant differences are shown through the use of letters. A letter next to a percentage means that the number is statistically significant compared to the corresponding technology. For example, a "P" means the finding is significantly higher than the finding for Phone Number.
REAL-TIME INFORMATION AND MOBILE APPS

The discussions about when, where, and why people look for real-time information, paired with the commentary about which aspects of the presented real-time technologies they do and do not like, results in the impression that people are turning to and relying on apps first and foremost, but like having the message boards to supplement their travel experience. Apps are less necessary for routine and standard trips, so those are the times people travel without them and rely more so on the information provided through message boards.

“I noticed right away, there’s a huge discrepancy between what’s great for someone from out of town and what’s great for someone who knows, who’s from here. I don’t need to be told to walk South from Foggy Bottom to get to the Lincoln Memorial. I’ve lived here for eight years. If I didn’t know that, that would be a bigger problem. So some of that information, so on that vein, I don’t know, something that just tells a little more basic information, just like when your next train is or what actual physical exit to use. Not necessarily like the compass and all that stuff. So I think there’s two different audiences here that is worth at least being aware of.” – Rail under 38

“Then this, even for a ballgame for example, I know where Nats Park is, and so maybe it’s more like a commute if we’re making that, but I still think something like this would be useful for that because something like Citymapper or Moovit or whatever these are called, because then, you get a more holistic look at what your options are when you’re going somewhere that’s not your commute.” – Rail under 38

“The message boards are going to tell you when the next train is coming, what your options are, but it’s not going to tell you how to get there. You need this to figure out how to get where you’re going. The message boards are great when you’re standing there, looking up and going, “Oh, that’s how long,” or whatever.” – Bus 38 and older

“If I already know where I’m going, I don’t get out an app. I just walk to the stop, and it’s nice for the board to tell me how long the wait is.” – Bus 38 and older

“...it’s useful like if I’ve never been there before, and I even know how long it’s going to take me to get there on like the general route. But other than that, like if you tell me what train to get on, where to get off, then I’m fine. I don’t really need all the like step by step directions.” – Bus under 38

“And the other benefit of the WMATA app is that it’s not, I already know I want to take the Metro, so I don’t have to deal with all these other options.” – Multimodal 38 and older

“...if I’m going just Metro specific, I go to the app that I use for Metro. But if I’m looking for directions somewhere, I got Google Maps.” – Multimodal 38 and older

However, while the prevailing attitude seems to be that people would like to find real-time information through an app, experiences with using apps can be difficult as there are so many options available that each offer different information. These participants do not want another app on their phone that only provides a piece of the puzzle, they would like one single app that works to combine all of the available information in one place.
“Just kind of knowing which app is the best for Metro because there’s different ones and they each have different information, but they’re not all synchronized. So it’s difficult.” – Rail 38 and older

“I want to also say that my problem is that I don’t like to download a bunch of different apps, because I usually don’t have space on my phone, so if I’m a person that takes the D.C. Circulator, and I also take WMATA, and then it’s like I don’t download the apps, because I don’t have space to have all these different apps.” – Bus under 38

“Something that has everything in one place, then I would download it, but usually, I tell myself not to download the app, because it’s a waste of space.” – Bus under 38

“I don’t know. I end up using a couple of different apps. I have downloaded, maybe this is really inefficient, but I have downloaded the pages or saved the pages on my phone for the ART buses... so that I can click on the next bus, go right to that page, and see when the next bus is coming. Metro has its own app. And sometimes I have to use Google Maps. I have to coordinate with a couple of different apps sometimes.” – Multimodal under 38

“I don’t want more. I have one that gives me everything, but I don’t always know how accurate and updated it is.” – Bus under 38

“Some type of centralized map. Google Maps, they do have most information, but she mentioned, she probably doesn’t want to use three or four apps, she wants to use one to have all kinds of information.” – Multimodal under 38

“It would be great if there were one app or maybe streamline and aggregated every single transportation service together. I see things like Google Maps is really close to that. They’ll incorporate Uber and Lyft and walking and driving. But they might leave something out. So, it would be nice if I didn’t have to collect data from different sources just to go somewhere.” – Multimodal under 38

“I just don’t think it’s very productive for like Arlington Transit System to create their own app, but it sounds like a lot of us use different transit apps, and it would be like more helpful for them to like work with developers of all these different apps to make their systems work better. Does that make sense? Like if Google Maps had moment to moment transit information for the buses, that would be more helpful than like Arlington making a really great app.” – Multimodal under 38

Reaction to Various Apps

With the above in mind, there are several themes that arose across the focus groups that clarify exactly what people are looking for when they turn to apps for real-time information. This information is useful in identifying values that can be incorporated into other vehicles of real-time information, as many of the themes outlined below were also present during discussions about dynamic message screens and other types of real-time technology.
Participants like when an app provides the ‘big picture,’ presenting all possible options and providing information that can be used to compare the various trip choices.

“I like that it tells you every eight minutes there’s a train coming.” – Rail 38 and older

“I like the other [app] better. It showed you all the different options on the phone. Because this way, you’ve got to push each one [to find more information].” – Bus 38 and older

“I like that Google Maps will compare all of them into one screen as opposed to me, “Oh. Let me check what the Metro. Okay. I saw the Metro. Let me now go check on the bus. Okay. Let me now check with the bike.” It will put it all into one screen.” – Bus under 38

“It certainly lets you know what your options are, that you might not have considered otherwise.” – Multimodal 38 and older

“So, it’s telling me, immediately it’s telling me how long the entire route will take. How often the trains are running. How long I have to walk. And not just that it’s Metro, but the color of the Metro. And then like a really clear go button. Seems pretty easy to me.” – Multimodal under 38

“It’s also set up so that really at a glance you get, I mean, you don’t have to spend a whole lot of time looking at it. But, probably within the first three or four seconds you can really...” – Multimodal under 38

“We were talking about earlier with the texting, we’d want to have multiple times of when the thing arrives because I’m still at home or something.” – Rail under 38

“And I like when you click on the more details and schedules, it tells you when the next trains are coming, too, and it tells you exactly when you have to leave your place.” – Bus 38 and older

“The other thing with Google Maps is if you press on the part where it says, ‘one stop three minutes’, it will also show you the list of other trains that are coming afterwards.” – Bus under 38

Information about cost is the first aspect of what is considered a critical piece of the big picture. People like to see the cost of each possible trip so they can weigh that factor against other competing values.

“I mean you could just at the top where it says “Trip Details” have the price. I mean it knows how much it costs to get from Rosslyn to Foggy Bottom, and then the bus to the, because if I’m doing all of this and it costs me $7.50, and it cost me $10 to get in a cab and go, or to get an Uber, then I’m just going to...” – Rail 38 and older

“What’s missing is the cost. So yes, maybe something to get you there 20 minutes faster, but if it’s double the price, maybe you wouldn’t want to take it.” – Rail under 38

“If it had like maybe prices on it, that would be helpful.” – Multimodal under 38

“I like the price. Most of them tell you like price of Uber or Lyft, but none of them tell you how much it would cost on the Metro.” – Multimodal under 38

“I have a question, why is that in general in these applications they give an estimate of the cost of how much it would be for Uber but, for example, it doesn’t give you an estimate of how much it
would be on the train. Because I’ve gone into many of these methods of transportation, if I get on the train it’ll cost me something, on the bus it’ll cost me something, if I want to grab a scooter it’ll cost me something. So is it that initially one can see, let’s say the Uber will cost $10 but if you have to get on five different things it can cost about the same. And because the Metro fees change depending on the time.” – Spanish

Information about the overall length of the trip and the estimated time of arrival is the second piece of the puzzle.

“It tells you the actual travel time of all three options...” – Rail 38 and older

“I don’t like the fact that it doesn’t immediately tell you how much, what the fastest option is going to be. You have to choose the different options and it’s not giving you that information of how much time driving versus the Metro versus...” – Rail 38 and older

“I like seeing the difference in times based on mode. You know 30-minute walk versus a 40-minute drive.” – Rail 38 and older

“Because if it’s going to be there in two minutes, but it normally takes 10 minutes and for some reason today, it’s going to take 25, that’s very relevant. Because if I’m working or something and I need to be there in 20 minutes, it usually takes 15 but now it’s going to take 25, then I’ll start to look at other options.” – Rail under 38

“...it’s giving me the time of how long it’ll take me with each method of transportation which I find very interesting.” – Spanish

Information about delays and major events is also seen as crucial to let them know if any of their possible routes should be avoided.

“If you want information about what’s going on that could possibly delay your trip or whatever, then this is obviously not going to help you.” – Rail under 38

“I like that it has the exclamation point, which I’m guessing means that there’s a delay or a single tracking or something.” – Rail under 38

“I like that it actually shows you alerts, what’s going on.” – Bus under 38

The participants responded positively to apps that included good maps that provide landmarks to help them navigate. In general, the visuals are very important to these participants when considering which app is best.

“One nice feature on this is you can zoom in. It will show, I mean just the detail gets to be unbelievable. I mean the building names. It’ll show you the restaurants in the bottom of the building.” – Rail 38 and older

“I like this one because it’s, it shows more pictures of the actual landscape, what I’m going to see out of the window, buildings, etc. So it can help get you as you’re walking with landmarks along the way.” – Rail 38 and older
“It should have icons, though, it would be super simple to add icons for a bus and a walking stick person, and the rail could be a little bit clearer because it looks like a train but could be, I guess it’s a train but.” – Rail 38 and older

“I’d love to see a map, I’m a map guy, so I’d like to see a map.” – Rail 38 and older

“Yeah and it’s an overview map instead of like the location map where I am right now. Like I want to see more Rosslyn, this I’m seeing a lot of the Mother Earth...” – Rail 38 and older

“I like how Google Maps has my landmarks. So you can zoom in and say, “Oh, this is the Kennedy Center,” and so that when you’re on your route, you know you’re going the right way.” – Rail under 38

[after expressing confusion about how to read the information] “If this was the first time I opened this up, I would never open it again.” – Rail under 38

“If I knew what the symbols were, like where it has the symbol for Metro, I would rather... I understand what it is now because we’re talking about it, but coming up at first glance, it’s going to confuse me. They need to do something with the symbols. If they could make the symbols more clear and the bus more clear that it’s a bus or it’s a train, then I would be okay with it.” – Bus 38 and older

“Just be able to do a city view, so you can get your perspective of where you are, and the landmarks are very nice when I’m looking at maps, so you can confirm like, “Okay. I am here.”” – Bus under 38

“If it’s showing me Metro I want to see the Metro and if it’s showing like an ART bus, I want to see the ART icon. Like I want the icons to be the real icons.” – Bus under 38

More nuanced features that are attractive to these participants are the ability to see where the transit options are located in relation to them, and information about which exit and entrance to use at the Metro station.

“I like how the map on the first screen shows you where all the different options are actually located, like you’re seeing Arlington, WMATA Bus, Metro Bus. I just think that’s just helpful to know where the other options are.” – Rail 38 and older

“It shows different bus ones. In Rosslyn, it’s kind of confusing where to catch a bus, because there’s so many bus stops, and it shows actually where they each are on the street.” – Bus under 38

“I like the station entrance and exit. I think it’s really nice.” – Rail 38 and older

“It says which entrance to go in which is nice.” – Rail 38 and older

“The which exit to take thing, at the Metrorail station, is really helpful.” – Bus under 38

The desire for customization is what lead several participants to express that they would like the dynamic message boards to be made available on their smartphones. This same desire is expressed for the apps, with some stating that they would only like to see their preferred modes
of transportation, and others wanting to save repeated trips so they do not have to plug that information in each time.

“I don’t need to see all of them because some of them are just not, like if it’s raining outside, I’m not going to take a bike. It just makes more sense to be able to customize and choose our options.” – Rail under 38

“I think another cool feature on some apps is that you can choose what’s on your home screen, so if you don’t want to see all these options, you can customize your home screen to only show, I don’t know, Uber or Lyft.” – Bus under 38

“Here in CityMapper, it’s nice being able to set a specific address for home and work, so you can just do that day after day, not have to plug in the address over and over.” – Bus under 38

“The thing I like about CityMapper as well is that you can select your, you can select what your actual routes are. You can say like I normally take the Yellow Line, I normally use these stations. You can select favorites, and select what lines and stuff.” – Bus under 38

Results from Online Research

Use and Awareness

Google Maps is the most widely used app, with no close second. This app is used regularly by almost two-thirds of respondents (62%, Figure 70) and occasionally by about one-fourth (24%). While use of Apple Maps does not compare, most respondents have at least heard of it with less than two in ten (18%) reporting that they are unfamiliar with the app. Transit, CityMapper, and Moovit are neither widely used nor widely recognized with between five and seven in ten respondents (52% - 71%) indicating that they have never heard of the app. Interestingly, ART riders are significantly more likely to use these less prominent apps than both users of other forms of public transportation and non-users. Millennials are more likely to use all of these apps except for Google Maps, which is used by a similar proportion of those 38 and older. It is also notable that those who identify as a race other than Caucasian are significantly more likely to use the Transit App than those who identify as Caucasian (36% vs. 19%).
Satisfaction

Although it is the most widely used and recognized app, Google Maps receives one of the lower satisfaction scores. In fact, all three of the least used apps received higher satisfaction ratings than both Google Maps and Apple Maps. Furthermore, Google Maps received significantly lower ratings from those over 38 than from those under 37. This is the only app where there is a gap in satisfaction between the generations.

Q33. For each of the following apps, please indicate if you have never heard of it, heard of it but never downloaded, downloaded but never used, downloaded and use occasionally or downloaded and use regularly.
Base = Total online sample (n=346)

<table>
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<tr>
<th>App</th>
<th>Never heard of</th>
<th>Heard of but never downloaded</th>
<th>Downloaded but never use</th>
<th>Use occasionally</th>
<th>Use regularly</th>
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<tbody>
<tr>
<td>Google Maps</td>
<td>3%</td>
<td>10%</td>
<td>24%</td>
<td>62%</td>
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<tr>
<td>Apple Maps</td>
<td>18%</td>
<td>18%</td>
<td>13%</td>
<td>33%</td>
<td>18%</td>
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<tr>
<td>Transit</td>
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<td>12%</td>
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<td>52%</td>
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<tr>
<td>CityMapper</td>
<td>6%</td>
<td>9%</td>
<td>4%</td>
<td>15%</td>
<td>66%</td>
</tr>
<tr>
<td>Moovit</td>
<td>4%</td>
<td>8%</td>
<td>2%</td>
<td>15%</td>
<td>71%</td>
</tr>
</tbody>
</table>

Q34. How satisfied were you with your experience getting real-time information from these apps about when the next bus or train would arrive?
Base = Online respondents who have used [app] (n=40-297)
Value

Interestingly, apps did not receive higher value ratings than the dynamic message boards with 93% of respondents indicating that these apps are somewhat or very valuable. Notably, those who look for real-time information prior to arriving at the stop or station were significantly more likely than those who do not to indicate that these apps are valuable (96% vs. 87%).

Figure 72: Value of Apps

<table>
<thead>
<tr>
<th>Value</th>
<th>Percentage</th>
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<tr>
<td>Very valuable</td>
<td>62%</td>
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<tr>
<td>Somewhat valuable</td>
<td>31%</td>
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<tr>
<td>Not very valuable</td>
<td>6%</td>
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<tr>
<td>Not at all valuable</td>
<td>1%</td>
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</tbody>
</table>

Q35. How valuable would you say it is to have an app like these (Apple Maps, Google Maps, CityMapper, Moovit, Transit, etc.) to get real-time information about when the next bus or train will arrive?
Base = Total online sample (n=346)

Likelihood to Use Apps

The majority of respondents (84%) see themselves as very or somewhat likely to use apps like these to get real-time information. Millennials are significantly more likely than their older counterparts to say they would use these apps to find real-time information (91% vs. 78%).

Figure 73: Likelihood to Use Apps

<table>
<thead>
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<th>Likely to Use</th>
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<td>Not at all likely</td>
<td>5%</td>
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</table>

Q36. How likely would you be to use an app like this to get real-time information about when the next bus or train would arrive?
Base = Total online sample (n=346)
Ratings of Possible Features

The top three most important app features to the online respondents are a map interface that is familiar (77%, Figure 74), an adjustable departure time (76%), and customizable modes of transportation (76%). As seen in the responses for possible message board features, there is interest in showing all possible modes of transportation (61%) in these apps, but less interest in the newer modes of transportation such as ride-hail, bikeshare, and electric scooters (49%). Once again, however, these newer modes of transportation are significantly more attractive to Millennials than the older generations (54% vs. 43%).

![Figure 74: Importance of Possible App Features](image)

Q37. On a scale of 1 to 10, in which 10 means it is extremely important to you and 1 means it is not at all important to you, please rate how important it is for apps such as these to have the following.

Base = Total online sample (n=346)
4 CONCLUSION

To summarize, this research proceeded in four steps and used a mixed approach to examine the needs and perceptions of Arlington travelers when it comes to real-time transit information. Four main categories of findings are important to highlight in conclusion. The first supports findings in the literature about the importance of real-time transit information and its impact on perception and mode choice. The second presents original results on how travelers are using real-time transit information. The third gives insights into what travelers think of available real-time transit information. The fourth category presents what users would like in real-time transit information.

The importance of real-time transit information (RTTI)

- RTTI is an important part of the travel experience (81% agree or strongly agree that “having real-time information is important to me when using public transportation”).
- RTTI impacts the user’s experience (73% agree that “having real-time information when using public transportation helps me relax”). Findings from the online research reveal that those who check real-time information before arriving at the stop or station are less bothered by delays than those who do not (23% vs. 10%).
- RTTI mode choice. The focus-group findings reveal that people look up the status of the bus or train to see when the next one is arriving, helping them choose which mode of transportation to use for a trip.

How travelers use real-time transit information (RTTI)

- People are overwhelmingly turning to personal technology as a source of real-time information to access mobile apps and useful websites such as Google Maps, WMATA Trip Planner, and Twitter.
- Almost two-thirds of online respondents (64%) check the arrival time of their bus or train prior to arriving at the bus stop or station. About nine in ten ART riders surveyed (91%) indicate that they seek out real-time information before arriving at the bus stop or station, confirming that this is information ART riders need, want, and use.

Satisfaction with available real-time transit information (RTTI)

- Phone numbers at bus stops received the most negative feedback from the focus-group participants, which was described as “outdated,” “a hassle,” and a “last resort.” Although 65% of online respondents who have used the phone number were satisfied with their experience, and 78% of all surveyed described the phone number as valuable, these figures represent the lowest ratings for value and satisfaction compared to all technologies rated in this research.
• **Text messages**: Focus-group participants think that text messages could help them plan their travel. They stated that this service must be highly customizable, so that they would not get too many unwanted text messages.

• **Website**: Ratings for satisfaction and value are high for this service, with 80% of those who have used the website indicating that they were mostly or completely satisfied, and 94% of all online respondents indicating that it is valuable for Arlington County to provide this website. Notably, **nearly all of the ART riders surveyed (99%) find this website valuable**.

• **BusFinder**: While some like the simplicity of the BusFinder, many felt that it was not useful. To some focus-group participants, it was unclear whether the BusFinder provided real-time or scheduled time-of-arrival information. The technology is seen as “antiquated,” “juvenile,” and “outdated.” Online respondents had a more positive view. Of those who have used a BusFinder, 78% were mostly or completely satisfied with their experience. Ninety-five percent of online respondents consider this a valuable device for Arlington County bus stops.

• **LED Displays**: Those who have previously used an LED Display tend to be very satisfied with their experience, with almost nine in ten (87%) indicating that they are mostly or completely satisfied. LED displays are seen as very valuable resources for real-time information, with 96% of the online respondents indicating that it is somewhat or very valuable for Arlington County to provide this at bus stops. Those 38 years-old and older find LED displays particularly valuable, with nearly all of those respondents (99%) indicating that this is a valuable resource.

• **Dynamic Message Boards**: Overall, the dynamic message boards garnered the most positive reactions from the focus group participants because of the boards’ readability and understandability. However, participants noted that these are not instantly understandable.

• **Mobile Phone applications**: The participants would like one app that integrates all available transit information, instead of having to download and use another new app that provides only one piece of the puzzle.

**Travelers’ RTTI wants and needs**

• **What they want**: Travelers want reliable information on three main dimensions of travel (1) cost, (2) time, and (3) convenience (e.g. distance to the nearest stop). From the general focus group findings, time was most important, followed by cost and then convenience, but this was not supported by quantitative evidence. Results from the focus groups indicate that people stop seeking real-time transit information when they’ve had bad experiences with it (i.e. when it’s been inaccurate). When planning trips, travelers want real-time information on the next arriving bus or train, as well as the upcoming two thereafter. Knowing the three upcoming bus or train arrivals would allow riders to choose which of them fits better in their schedule. They also want customizable text messages.
• **When they want it:** The results from the focus groups indicate that real-time information is most critical before someone starts a trip and at key decision-making junctures on the trip. Technologies stationed at the physical stop or station provided information too late in the travel process. By the time a rider has access to that information, they’ve already committed to taking that mode. Several focus-group participants mentioned that information on closures due to major events and delays should include solutions or suggestions on alternate routes.

• **How they want it:** Many participants offered suggestions for delivery methods they prefer instead of calling the phone number. In a couple of focus groups, participants recommended installing a barcode or QR code to scan to get information.

The results of this study reflect an important effort at gauging the opinion of a sample of the Arlington population in terms of what type of technology it needs and prefers and its overall satisfaction with available technology as it pertains to transit. This on its own is important for the county to conduct informed, data-driven decisions, in providing real-time transit information close to residents’ needs and ensure its optimal use by riders. This is an important step towards making transit more attractive in Arlington – and beyond – and boosting ridership.
REFERENCES


ART RealTime Arrivals https://www.arlingtontransit.com/pages/rider-tools/realtime/


Metro 2016. CHK America’s solar-powered digital display elevates bus stop info.


NextBus https://www.nextbus.com


6 APPENDIX

Detailed Focus Group Participant Profile

**Table 8: Detailed Focus Group Participant Profile**

<table>
<thead>
<tr>
<th></th>
<th>Rail</th>
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<th>Multimodal</th>
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<td>------</td>
<td>-----</td>
<td>-----------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Under 38</td>
<td>38 and older</td>
<td>Under 38</td>
<td>38 and older</td>
<td>Under 38</td>
<td>38 and older</td>
<td></td>
</tr>
<tr>
<td>Divorced or Separated</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than $35K</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>$35K to less than $50K</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$50K to less than $75K</td>
<td>6</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>$75K to less than $100K</td>
<td>6</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>$100K to less than $150K</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>7</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>$150K or more</td>
<td>4</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>22</td>
<td>21</td>
<td>20</td>
<td>21</td>
<td>21</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>
The focus group participants generally expressed satisfaction with the variety of modes of transportation they have available to choose from. The table below details the percentage of participants that use each mode of transportation, as well as the share of trips each mode holds. The share of trips value represents the percentage of trips that each mode holds of the total number of trips taken each week. In other words, of the 5,379 trips taken in a typical week by all of the focus group participants combined, WMATA Metrorail accounts for 1,036 of those trips, or 19% of the trips taken.

### Table 9: Focus Group Mode Use and Share of Trips

<table>
<thead>
<tr>
<th>Mode of Transportation</th>
<th>Percentage of Participants Using the Mode</th>
<th>Share of Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMATA Metrorail</td>
<td>90%</td>
<td>19%</td>
</tr>
<tr>
<td>Walking</td>
<td>73%</td>
<td>19%</td>
</tr>
<tr>
<td>Driving a car alone</td>
<td>67%</td>
<td>16%</td>
</tr>
<tr>
<td>WMATA Metrobus</td>
<td>63%</td>
<td>10%</td>
</tr>
<tr>
<td>Using a ride-hailing service (Uber or Lyft)</td>
<td>57%</td>
<td>6%</td>
</tr>
<tr>
<td>Riding in a car as a passenger</td>
<td>55%</td>
<td>6%</td>
</tr>
<tr>
<td>Arlington Transit (ART Bus)</td>
<td>49%</td>
<td>7%</td>
</tr>
<tr>
<td>Driving a car with passengers</td>
<td>49%</td>
<td>7%</td>
</tr>
<tr>
<td>DC Circulator</td>
<td>22%</td>
<td>2%</td>
</tr>
<tr>
<td>Riding a bicycle</td>
<td>21%</td>
<td>3%</td>
</tr>
<tr>
<td>Taking a taxi or limousine</td>
<td>18%</td>
<td>1%</td>
</tr>
<tr>
<td>Carpooling or vanpooling</td>
<td>13%</td>
<td>1%</td>
</tr>
<tr>
<td>Fairfax Connector</td>
<td>10%</td>
<td>1%</td>
</tr>
<tr>
<td>Virginia Railway Express (VRE)</td>
<td>3%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Riding a motorcycle</td>
<td>1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Other bus</td>
<td>2%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

Q1. What types of transportation do you use in a typical week?

1Base = Total focus group sample (n=156)

Q1A. In a typical week, how many one-way trips do you take by each mode listed below?

2Base = Total trips taken by those answering (n=5,379)
Focus Group Gap Analysis

The focus group participants were asked how important each of the following characteristics is when choosing which mode of public transportation to use. They were then asked how well each of these characteristics describes the public transportation in Arlington County. The following graphics present a visual of how the public transportation in Arlington County is performing in comparison to the needs of the focus group participants.

Ratings of Arlington County’s performance fell below each measure’s importance score, suggesting room for improvement in all areas. The most important area when choosing which mode of transportation to use is: “provides transit stops close to your destinations.” Arlington County’s public transportation is performing below the benchmark here, so this could be considered a priority for improvement. There were four additional areas where the gap was particularly large. These areas are: being “available when you need it” (41% gap), “gets you to your destination on time” (35% gap), being a “fast way to travel” (34% gap, shown on following page), and “provides real-time arrival information” (33% gap, shown on following page).

While public transportation’s performance did not exceed importance for any of these descriptors, there are two places where Arlington County is coming closest to being on par with these participants’ needs. Specifically, these areas are: being “safe from crime” (10% gap) and being a “smart way to commute for people who can use it” (7% gap, shown on following page).

Figure 75: Focus Group Gap Analysis

Q8. Please rate how important each of the following is when choosing which mode of public transportation you will use. Base = Total focus group sample (n=156)

Q9. Please think about specific aspects of public transportation in Arlington County. Please use a scale of 1 to 10 where 10 means you strongly agree and 1 means you strongly disagree. Public transportation in Arlington County is... Base = Total focus group sample (n=156)
Q8. Please rate how important each of the following is when choosing which mode of public transportation you will use.
Base = Total focus group sample (n=156)

Q9. Please think about specific aspects of public transportation in Arlington County. Please use a scale of 1 to 10 where 10 means you strongly agree and 1 means you strongly disagree. Public transportation in Arlington County is...
Base = Total focus group sample (n=156)
Additional Focus Group Measures

**Figure 76: Commute in Miles**

Average: 8.9 Miles

<table>
<thead>
<tr>
<th>Distance (Miles)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>10%</td>
</tr>
<tr>
<td>3-5</td>
<td>35%</td>
</tr>
<tr>
<td>6-10</td>
<td>34%</td>
</tr>
<tr>
<td>11-20</td>
<td>12%</td>
</tr>
<tr>
<td>More than</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Figure 77: Commute in Minutes**

Average: 34.1 Minutes

<table>
<thead>
<tr>
<th>Distance (Minutes)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>7%</td>
</tr>
<tr>
<td>11-20</td>
<td>25%</td>
</tr>
<tr>
<td>21-30</td>
<td>21%</td>
</tr>
<tr>
<td>31-45</td>
<td>29%</td>
</tr>
<tr>
<td>More than</td>
<td>17%</td>
</tr>
</tbody>
</table>

**Q4. How long is your typical daily commute to work or school one way?**

1. Base = Focus group participants answering (n=125)
2. Base = Focus group participants answering (n=150)

**Figure 78: In what county or jurisdiction do you work or go to school? (Q10)**

Base = Total focus group sample (n=156)

**Figure 79: In what county or jurisdiction do you live? (Q11)**

Base = Total focus group sample (n=156)
Figure 80: How many years have you lived in the [insert] area? (Q22)

- Less than one year: 8%
- One year: 8%
- 2 to 4 years: 22%
- 5 to 9 years: 22%
- 10 to 19 years: 18%
- 20 years or more: 21%

Base = Total focus group sample (n=156)

Figure 81: Education (Q20)

- Grade school or less: 1%
- Some high school: 0%
- High school graduate: 4%
- Technical training beyond high school: 2%
- Some college: 9%
- College graduate: 38%
- Graduate school or professional degree: 46%

Base = Total focus group sample (n=156)

Figure 82: Number of People in Household (Q21)

- 1: 34%
- 2: 39%
- 3: 13%
- 4: 10%
- 5: 1%
- 6: 3%

Base = Focus group sample and answering (n=154)
Figure 83: I often go out for dining, or to social, entertainment or sporting events

- Agree: 90%
- Disagree: 10%

Figure 84: My work schedule is unpredictable

- Agree: 31%
- Disagree: 69%

Figure 85: I travel on the same routes or lines of public transportation all the time

- Agree: 94%
- Disagree: 6%

Figure 86: Vehicles in Household

- Car in household: 83%
- Disagree: 17%

Figure 87: For me, saving time is often more important than saving money

- Agree: 63%
- Disagree: 37%

Figure 88: I would use public transportation more if it did not take so long

- Agree: 76%
- Disagree: 24%

Figure 89: Public transportation is convenient for most of my trips

- Agree: 81%
- Disagree: 19%

Figure 90: I like the convenience of driving a car

- Agree: 72%
- Disagree: 28%

Figure 91: I need to have a car available during the workday in case of emergencies

- Agree: 47%
- Disagree: 53%

Base = Total focus group sample (n=156)
Figure 92: I cannot rely on public transportation to be on schedule or on time

- Agree: 91%
- Disagree: 9%

Figure 93: I get annoyed when my travel is delayed

- Agree: 86%
- Disagree: 14%

Figure 94: It is confusing to figure out how to use public transportation to get places

- Agree: 9%
- Disagree: 91%

Figure 95: I don't mind transferring between modes of public transportation to get where I need to go

- Agree: 60%
- Disagree: 40%

Figure 96: I feel that travel on public transportation is safer than other forms of travel in this area

- Agree: 93%
- Disagree: 7%

Figure 97: Driving during rush hour is very stressful

- Agree: 94%
- Disagree: 6%

Figure 98: I am comfortable using high-tech devices

- Agree: 94%
- Disagree: 6%

Figure 99: I am often one of the first to get new technology or devices

- Agree: 55%
- Disagree: 45%

Figure 100: Having real-time arrival information is important to me when using public transportation

- Agree: 99%
- Disagree: 1%

Base = Total focus group sample (n=156)
Figure 101: Having real-time information when using public transportation helps me relax

- Agree: 99%
- Disagree: 1%

Figure 102: I check for real-time arrival information about public transportation before I leave my home

- Agree: 77%
- Disagree: 23%

Figure 103: It is important for me to be able to use a smartphone to get public transportation information

- Agree: 95%
- Disagree: 5%

Figure 104: I would use technology to look for travel information more if it were easier to get the information I need

- Agree: 82%
- Disagree: 18%

Figure 105: When I need information, I would rather ask a person than use technology

- Agree: 82%
- Disagree: 18%

Figure 106: Paper schedules and flyers are the best way for me to get public transit information

- Agree: 81%
- Disagree: 19%

Figure 107: I like when the schedules are posted at the bus stop or rail station

- Agree: 95%
- Disagree: 5%

Base = Total focus group sample (n=156)
Additional Online Respondent Measures

**Figure 108:** In which county or jurisdiction do you work or go to school? (S1)

<table>
<thead>
<tr>
<th>County/Jurisdiction</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arlington County</td>
<td>71%</td>
</tr>
<tr>
<td>Fairfax County</td>
<td>21%</td>
</tr>
<tr>
<td>City of Alexandria</td>
<td>9%</td>
</tr>
<tr>
<td>City of Falls Church</td>
<td>5%</td>
</tr>
<tr>
<td>Montgomery County</td>
<td>3%</td>
</tr>
<tr>
<td>Fairfax City</td>
<td>3%</td>
</tr>
<tr>
<td>Prince George’s County</td>
<td>2%</td>
</tr>
<tr>
<td>Loudoun County</td>
<td>1%</td>
</tr>
<tr>
<td>Richmond, VA</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

Base = Online respondents who work and/or go to school (n=319)

**Figure 109:** In which county or jurisdiction do you live? (S2)

<table>
<thead>
<tr>
<th>County/Jurisdiction</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arlington County</td>
<td>93%</td>
</tr>
<tr>
<td>Fairfax County</td>
<td>5%</td>
</tr>
<tr>
<td>City of Alexandria</td>
<td>1%</td>
</tr>
<tr>
<td>Montgomery County</td>
<td>1%</td>
</tr>
</tbody>
</table>

Base = Total online sample (n=346)

**Figure 110:** Age (D1)

- Under 38: 50%
- 38 and older: 50%

Base = Total online sample (n=346)

**Figure 111:** Gender (D3)

- Male: 47%
- Female: 53%

Base = Total online sample (n=346)
**Figure 112: Employment Status (D2)**

- Employed full-time: 73%
- Retired: 12%
- Employed part-time: 8%
- A student: 4%
- A Homemaker: 1%
- Not currently employed: 1%

Base = Total online sample (n=346)

**Figure 113: Marital Status (D6)**

- Married or partnered: 49%
- Single: 45%
- Divorced or separated: 3%
- Widowed: 2%

Base = Total online sample (n=346)

**Figure 114: Income (D8)**

- Less than $35K: 5%
- $35K to less than $50K: 7%
- $50K to less than $75K: 18%
- $75K to less than $100K: 18%
- $100K to less than $150K: 27%
- $150K or more: 25%

Base = Total online sample (n=346)
Table 10: **D7. Primary Language Spoken at Home**

<table>
<thead>
<tr>
<th>Language</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>93%</td>
</tr>
<tr>
<td>Spanish</td>
<td>3%</td>
</tr>
<tr>
<td>Chinese/Mandarin/Cantonese</td>
<td>1%</td>
</tr>
<tr>
<td>French</td>
<td>1%</td>
</tr>
<tr>
<td>Amharic</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Finnish</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Italian</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Kiswahili</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Latvian</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Portuguese</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Other</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

Base = Total online sample (n=346)

**Figure 115: Education (D9)**

<table>
<thead>
<tr>
<th>Educational Level</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade school or less</td>
<td>1%</td>
</tr>
<tr>
<td>Some high school</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>High school graduate</td>
<td>4%</td>
</tr>
<tr>
<td>Technical training beyond high school</td>
<td>2%</td>
</tr>
<tr>
<td>Some college</td>
<td>8%</td>
</tr>
<tr>
<td>College graduate</td>
<td>41%</td>
</tr>
<tr>
<td>Graduate school or professional degree</td>
<td>45%</td>
</tr>
</tbody>
</table>

Base = Total online sample (n=346)
**Figure 116: Number of People in Household (D10)**

<table>
<thead>
<tr>
<th>Number of People</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36%</td>
</tr>
<tr>
<td>2</td>
<td>37%</td>
</tr>
<tr>
<td>3</td>
<td>11%</td>
</tr>
<tr>
<td>4</td>
<td>10%</td>
</tr>
<tr>
<td>5</td>
<td>3%</td>
</tr>
<tr>
<td>6</td>
<td>2%</td>
</tr>
<tr>
<td>7</td>
<td>1%</td>
</tr>
</tbody>
</table>

Base = Total online sample (n=346)

**Figure 117: Number of Children Under 18 in Household (D10A)**

<table>
<thead>
<tr>
<th>Number of Children</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>67%</td>
</tr>
<tr>
<td>1</td>
<td>16%</td>
</tr>
<tr>
<td>2</td>
<td>13%</td>
</tr>
<tr>
<td>3</td>
<td>3%</td>
</tr>
<tr>
<td>4</td>
<td>2%</td>
</tr>
</tbody>
</table>

Base = Online respondents who live in a multi-person household (n=223)

**Figure 118: How many years have you lived in the Washington, DC metropolitan area? (D11)**

<table>
<thead>
<tr>
<th>Years Lived</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than one year</td>
<td>6%</td>
</tr>
<tr>
<td>One year</td>
<td>7%</td>
</tr>
<tr>
<td>2 to 4 years</td>
<td>11%</td>
</tr>
<tr>
<td>5 to 9 years</td>
<td>20%</td>
</tr>
<tr>
<td>10 to 19 years</td>
<td>16%</td>
</tr>
<tr>
<td>20 years or more</td>
<td>40%</td>
</tr>
</tbody>
</table>

Base = Total online sample (n=346)

**Figure 119: Do any of the following apply to you? (D13)**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious difficulty walking or climbing</td>
<td>5%</td>
</tr>
<tr>
<td>Deaf or have serious difficulty hearing</td>
<td>4%</td>
</tr>
<tr>
<td>Blind or serious difficulty seeing even when wearing glasses</td>
<td>3%</td>
</tr>
<tr>
<td>Serious difficulty concentrating, remembering or making decisions</td>
<td>3%</td>
</tr>
<tr>
<td>Physical, mental or emotional condition making it difficult to do errands</td>
<td>3%</td>
</tr>
<tr>
<td>Difficulty dressing or bathing</td>
<td>2%</td>
</tr>
</tbody>
</table>

Base = Total online sample (n=346)
Figure 120: I often feel concerned about my personal safety in public places

- Agree: 33%
- Neutral: 23%
- Disagree: 45%

Base = Total online sample (n=346)

Figure 121: I prefer to find my own way rather than ask for directions

- Agree: 59%
- Neutral: 24%
- Disagree: 17%

Base = Total online sample (n=346)

Figure 122: On-time arrival is important when I commute

- Agree: 86%
- Neutral: 5%
- Disagree: 8%

Base = Total online sample (n=346)

Figure 123: On-time arrival is important when I travel for leisure

- Agree: 84%
- Neutral: 7%
- Disagree: 9%

Base = Total online sample (n=346)
Focus Group Screener

Job No. 18-456
May 2018

DS&G ARLINGTON REAL-TIME TRANSIT INFORMATION FOCUS GROUPS
RECRUITMENT QUESTIONNAIRE

NAME: ____________________________________________

ADDRESS: ____________________________________________

CITY: __________________________ STATE: __________ ZIP: ______________

EMAIL ADDRESS: ______________________________

TELEPHONE NUMBER: ( ) __________________________

DATE/LOCATION OF GROUP: __________________________ TIME: __________

INTERVIEWER: __________________________ DATE RECRUITED: __________

________________________

LEAVE MESSAGE: Hello, my name is ______________________ from __________ . We're inviting people to participate in several group discussions among transit users in the Arlington area to get their opinions of transportation services in Arlington County. Please be assured that this will not be a sales meeting. It is a part of a market research study. We think that you will find the discussion very interesting and we’d very much like to include your opinions. If you qualify and are interested in participating you will be compensated $100 for your time and opinions. Please call __________ if you are interested in joining a group discussion in June or July. Thank you and have a nice evening.

[ASK TO SPEAK TO THE HEAD OF HOUSEHOLD.]

(READ:) Hello, my name is ______________________ from __________ . We’re inviting people to participate in several group discussions among transit users in the Arlington area to get their opinions of transportation services in Arlington County. Please be assured that this will not be a sales meeting. It is a part of a market research study. If you qualify and attend the discussion you will be compensated $100 for your time and opinions.
Q1. Do you live, work, or attend college in Arlington County? (SELECT ALL THAT APPLY)

01 Live
02 Work
03 Attend college
98 DO NOT READ: Refused → THANK & TERMINATE
99 DO NOT READ: Don’t know → THANK & TERMINATE

Q2. How old are you?

Age: ________

IF UNDER 18 OR OVER 65, THANK & TERMINATE.
98 DO NOT READ: Refused → THANK & TERMINATE
99 DO NOT READ: Don’t know → THANK & TERMINATE

Q3. Do you or does anyone in your immediate family work for...? (SELECT ONE ANSWER PER ROW. RANDOMIZE KEEPING A & B TOGETHER.)

<table>
<thead>
<tr>
<th>Yes (TERMINATE IF ANY SELECTED)</th>
<th>No</th>
<th>DO NOT READ: Don’t know/Refused (TERMINATE IF ANY SELECTED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. A local transit agency including WMATA, Arlington Transit, or Fairfax Connector</td>
<td>01</td>
<td>02</td>
</tr>
<tr>
<td>b. Arlington County government</td>
<td>01</td>
<td>02</td>
</tr>
<tr>
<td>c. A market research or advertising company</td>
<td>01</td>
<td>02</td>
</tr>
</tbody>
</table>
Q4. What types of transportation do you use in a typical week? Please think about all trips you take for all purposes. (IF ONLY ONE MODE MENTIONED, PROBE: Any others? READ LIST IF NECESSARY. ACCEPT ALL THAT APPLY.)

FOR EACH MODE USED IN Q4, ASK:

Q4A. In a typical week, how many one-way trips do you take [INSERT MODE]? Please count each round trip as two one-way trips. If you are unsure, please use your best guess. (READ LIST. INSERT BASED UPON RESPONSE TO Q4. RANGE=01-97. USE 0 FOR LESS THAN 1. USE 98 FOR 98 OR MORE.)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Q4</th>
<th>Q4A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving your car alone</td>
<td>01</td>
<td>99</td>
</tr>
<tr>
<td>Driving your car with passengers</td>
<td>02</td>
<td>99</td>
</tr>
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<td>Riding a bicycle</td>
<td>15</td>
<td>99</td>
</tr>
<tr>
<td>Walking</td>
<td>16</td>
<td>99</td>
</tr>
<tr>
<td>Other (specify)</td>
<td>95</td>
<td>99</td>
</tr>
</tbody>
</table>

DO NOT READ: None, have not traveled 96
DO NOT READ: Refused 98
DO NOT READ: Don’t know 99

IF Q4(01,96,98-99) AND ONLY ONE MODE GIVEN IN Q4, THANK & TERMINATE.
IF MULTIPLE MODES GIVEN AND ALL # OF TRIPS/WEEK=1, THANK & TERMINATE.
ASK EVERYONE.

Q5. What is your employment status? Are you...? (READ LIST. ACCEPT ONE RESPONSE ONLY.)

01 Employed full-time,
02 Employed part-time,
03 A student,
04 Retired,
05 A homemaker, or
06 Not currently employed?
98 DO NOT READ: Refused

THOSE WHO ARE EMPLOYED FULL-TIME OR PART-TIME [Q5(01-02)], ASK Q6.

Q6. What is your occupation and where do you work?

THOSE WHO REFUSE COMPANY: In what type of industry do you work?

(SPECIFY BOTH ANSWERS BELOW.)

<table>
<thead>
<tr>
<th>OCCUPATION</th>
<th>COMPANY/INDUSTRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>98 DO NOT READ:</td>
<td>Refused</td>
</tr>
</tbody>
</table>

THANK AND TERMINATE

ASK EVERYONE:

Q7. RECORD/DON'T ASK: Gender [GET A MIX]

01 Male
02 Female

These next few questions are for background purposes only, and to ensure that we include a mix of different types of people in the discussions.

Q8. Are you of Hispanic or Latino descent? [GET A MIX]

01 Yes
02 No
98 DO NOT READ: Refused
Q9. What is your race? Are you... [READ LIST. ACCEPT ONE RESPONSE ONLY.] [GET A MIX]

01 Caucasian,
02 African-American,
03 Native-American or Alaskan native,
04 Asian or Asian-American,
05 Native Hawaiian or Pacific Islander,
06 Multi-racial, or
95 Something else (specify)______________
98 DO NOT READ: Refused

Q10. What is your marital status? Are you... (READ LIST.)

01 Married or Partnered,
02 Single,
03 Divorced, Separated, or
04 Widowed?
98 DO NOT READ: Refused

Q11. What is the primary language spoken at your home? (DO NOT READ LIST.)

01 English
02 Spanish
03 Chinese/Mandarin/Cantonese
04 French
05 Arabic
07 Vietnamese
08 Tagalog
09 Korean
95 Other (specify)______________
99 DO NOT READ: Don’t know/Refused

Q12. How well do you speak English?

04 Very well
03 Well
02 Not very well  \rightarrow  IF Q11(01,03-99) THANK & TERMINATE
01 Not well  \rightarrow  IF Q11(01,03-99) THANK & TERMINATE

Q13. Please stop me when I reach the category which includes your total annual taxable household income. (READ LIST.)

01 Less than $35,000
03 $35,000 to less than $50,000
04 $50,000 to less than $75,000
05 $75,000 to less than $100,000,
06 $100,000 to less than $150,000
07 $150,000 or more

Page 5 of 7
<table>
<thead>
<tr>
<th>#</th>
<th>Type</th>
<th>Qualification</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rail/Multimodal over age 37</td>
<td>Q2(38-65) AND [Q4(05,10) AND NOT Q4(06-09)] AND Q4A(05,10)=2 MULTIPLE MODES ALLOWED</td>
<td>7/11</td>
<td>6pm</td>
</tr>
<tr>
<td>2</td>
<td>Rail/Multimodal over age 37</td>
<td>Q2(38-65) AND [Q4(05,10) AND NOT Q4(06-09)] AND Q4A(05,10)=2 MULTIPLE MODES ALLOWED</td>
<td>7/18</td>
<td>8pm</td>
</tr>
<tr>
<td>3</td>
<td>Bus/Multimodal over age 37</td>
<td>Q2(38-65) AND [Q4(05-09) AND NOT Q4(05,10)] AND Q4A(06-09)=2 MULTIPLE MODES ALLOWED</td>
<td>7/11</td>
<td>8pm</td>
</tr>
<tr>
<td>4</td>
<td>Bus/Multimodal over age 37</td>
<td>Q2(38-65) AND [Q4(05-09) AND NOT Q4(05,10)] AND Q4A(06-09)=2 MULTIPLE MODES ALLOWED</td>
<td>7/18</td>
<td>8pm</td>
</tr>
<tr>
<td>5</td>
<td>Bus and Rail/Multimodal over age 37</td>
<td>Q2(38-65) AND Q4(06-09) AND Q4(05,10) AND Q4A(06-09)=2 AND Q4A(05,10)=2 MULTIPLE OTHER MODES ALLOWED</td>
<td>7/12</td>
<td>6pm</td>
</tr>
<tr>
<td>6</td>
<td>Bus and Rail/Multimodal over age 37</td>
<td>Q2(38-65) AND Q4(06-09) AND Q4(05,10) AND Q4A(06-09)=2 AND Q4A(05,10)=2 MULTIPLE OTHER MODES ALLOWED</td>
<td>7/26</td>
<td>8pm</td>
</tr>
<tr>
<td>7</td>
<td>Rail/Multimodal under age 38</td>
<td>Q2(18-37) AND [Q4(05,10) AND NOT Q4(06-09)] AND Q4A(05,10)=2 MULTIPLE MODES ALLOWED</td>
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<td>8pm</td>
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<tr>
<td>8</td>
<td>Rail/Multimodal under age 38</td>
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<td>10</td>
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<td>Q2(18-37) AND [Q4(06-09) AND NOT Q4(05,10)] AND Q4A(06-09)=2 MULTIPLE MODES ALLOWED</td>
<td>7/25</td>
<td>8pm</td>
</tr>
<tr>
<td>11</td>
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<td>Q2(18-37) AND Q4(06-09) AND Q4(05,10) AND Q4A(06-09)=2 AND Q4A(05,10)=2 MULTIPLE OTHER MODES ALLOWED</td>
<td>7/17</td>
<td>8pm</td>
</tr>
<tr>
<td>12</td>
<td>Bus and Rail/Multimodal under age 38</td>
<td>Q2(18-37) AND Q4(06-09) AND Q4(05,10) AND Q4A(06-09)=2 AND Q4A(05,10)=2 MULTIPLE OTHER MODES ALLOWED</td>
<td>7/25</td>
<td>8pm</td>
</tr>
<tr>
<td>13</td>
<td>Spanish-speaking multimodal</td>
<td>Q4(05-10) AND Q4A(05-10)=2 AND CONFIRMED FOR SPANISH-SPEAKING GROUP / MULTIPLE MODES ALLOWED</td>
<td>7/19</td>
<td>6pm</td>
</tr>
<tr>
<td>14</td>
<td>Spanish-speaking multimodal</td>
<td>Q4(05-10) AND Q4A(05-10)=2 AND CONFIRMED FOR SPANISH-SPEAKING GROUP / MULTIPLE MODES ALLOWED</td>
<td>7/19</td>
<td>8pm</td>
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</table>
As mentioned in the beginning of this call, we're inviting people to participate in several group discussions among transportation users in the Arlington area to get their opinions of transportation services in Arlington County. Please be assured that this will not be a sales meeting. It is a part of a market research study. We think that you will find the discussion very interesting and we'd very much like to include your opinions.

You will be provided with $100 and refreshments for attending as a token of our appreciation for your time and opinions. The discussion will last approximately 1½ to 2 hours.

In addition, anyone who arrives at least 15 minutes prior to the group will be entered into a raffle for an additional $50.

Q13.  Will you be able to attend?

    01  Yes  \rightarrow CLARIFY DATE AND TIME AND CONTINUE
    02  No  \rightarrow THANK AND TERMINATE

IF RECRUITED IN SPANISH, CONFIRM: This group will be held entirely in Spanish.

To confirm, the group is scheduled for [INSERT DATE AND TIME] at 1501 Wilson Blvd., Suite 1100, Arlington, VA 22209. We request that you arrive 15 minutes prior to your scheduled group.

So that I may send you a confirmation email, including directions to the group, may I please have your complete email address? Also, I'd like to confirm your full name and telephone number. (RECORD ALL INFORMATION. MUST GIVE EITHER HOME ADDRESS OR EMAIL ADDRESS TO CONTINUE.)

To repeat, the group is scheduled for [DAY/DATE/TIME]. If for some reason you are unable to attend, please call us immediately at the number provided in your letter so we can invite another participant. We are only inviting a small number of people to the discussion. Please plan to bring reading glasses if you think you will need them to read potentially small text.
Focus Group Discussion Guide

WBA Job No. 18-456
June 2018

Focus Group Discussion Guide

I. BACKGROUND SURVEY (While waiting, 10 minutes)

II. INTRODUCTION (10 minutes)

a. Welcome and thank you for joining us this evening.

b. About this focus group session

1. Form of market research, not selling anything
2. Discussion will last about 2 hours
3. Audio/Video Recording (if applicable)
4. One-way mirror; associates viewing, notes may come in
5. All comments will be kept anonymous and confidential
6. Have courage of convictions; don’t let group sway you
7. No right or wrong answers, only your opinion
8. Don’t have to raise hands; but speak one at a time
9. Work for independent market research company
10. Turn off cell phones
11. Feel free to get up to use the restroom and get refreshments

c. Respondent introduction

1. First name
2. Where live in the area?
3. How long lived in the area?
4. Something about self (work/activities/etc.)
5. Ice breaker
III. CURRENT TRAVEL MODES (10 minutes)

Now, I would like to turn to the topic of tonight’s discussions. First, let’s discuss transportation in Arlington/NoVa.

a. What types of places do you go to when traveling in the area?
   1. Work?
   2. School?
   3. Social?

b. Where in the area are you going?
   1. Arlington?
   2. Alexandria?
   3. DC?
   4. Outer VA suburbs?
   5. Maryland?

c. Do you typically go to the same places or do you go to new/different places?

d. Do you plan how you are going to get there (trip mode) ahead of time?
   1. How do you plan?
   2. What impacts your transportation choice?

e. What modes of transportation are available to you?

f. What modes of transportation do you typically use to get around?
   1. Do you use any other modes of transportation?
      Driving a car yourself  Getting a ride in a car
      Carpool/Vanpool  Walk
      Rail (Metro/VRE/MARC)  Taxi
      Bus (WMATA/ART/etc.)  Bicycle/Bikeshare
      STAR/MetroAccess  Uber/Lyft
      Zipcar/Car2Go  Shuttles from work or home
   2. Do you have or have access to a personal vehicle?
   3. Which of these modes do you consider your primary mode of transportation?
   4. Why is ... your primary mode?
   5. Does your primary mode differ by activity type? Why?
   6. If you use different types of modes, how do you decide which mode to take on a given trip?
IV. GENERAL USE OF TECHNOLOGY [10 minutes]

Now I would like to know how much you use technology as part of your daily lives.

a. First, I would like to get a sense of what type of devices you are using as part of your daily life?
   1. Smartphones?
   2. Tablet (iPad, Surface, etc.)?
   3. Laptop?
   4. Desktop?
   5. Smartwatches? Wearable technology?
   6. Other? (Alexa, Ring, Echo, etc.)

b. What device do you prefer in general?

c. What device do you prefer when you are out and on the go?

d. What types of things are you doing on these devices?
   1. Social Media?
      i. Which ones? (Facebook, Twitter, Snapchat, LinkedIn, etc.)
   2. Banking?
      i. What types of purchases?
   3. Shopping?
      i. For what types of things?
      ii. How often?
   4. Travel?
      i. Tickets?
   5. Navigation?
      i. What apps?
V. USE OF TECHNOLOGY WHEN TRAVELING (20 minutes)

a. Now think specifically about when you are using public transportation.

1. Thinking about the last time you needed information about how to get from point A to point B, can you describe what you did?
   i. Were you able to find the information you want/need? Easy? Hard?
   ii. What was/have your experiences been like?
   iii. If you use technology, what types of devices do you use?
   iv. How could the process be improved?

2. How do you get information about the status of specific buses or trains/real-time arrival information?
   i. Are you able to find the information you want/need? Easy? Hard?
   ii. What have your experiences been like?
   iii. If you use technology, what types of devices do you use? Smartphone? Tablet? Other?

3. How satisfied are you with access to real-time transit arrival information?

4. Is the information accurate in general? Does accuracy differ by mode?

5. What is the ideal way you would prefer to receive information?
   i. Method
   ii. Frequency
   iii. Content

6. Bus stops provide a phone number for real-time information (Arlington's is 228-RIDE) where you enter the bus stop number for information.
   i. Have you ever used this service?
   ii. Likes? Dislikes?
   iii. How valuable is it to you to have this option?

7. Some transit agencies use text messaging in the same way to let riders know service status.
   i. Have you ever used this service?
   ii. Likes? Dislikes?
   iii. How valuable is it to you to have this option?

8. Arlington BusFinders are green boxes installed at ART bus stops. (SHOW PICTURE) To use the BusFinder, place your thumb on the circle for your route on the BusFinder. The red light will start to flash in the circle as the BusFinder receives real-time information. Within about 30 seconds, the BusFinder will indicate how many minutes away the bus is from your stop.
   i. Have you ever used this service?
   ii. Likes? Dislikes?
   iii. How valuable is it to you to have this option?
VI. DYNAMIC MESSAGE SCREENS (20 minutes)
   a. During your travels do you encounter dynamic message screens (screens that present real-time transit information)?
      1. Where do you see them?
         i. Office buildings?
         ii. Residences?
         iii. Shopping centers?
         iv. Bus stops?
         v. Metro stations?
            A. Near fare gates?
            B. Platform level?
         vi. Other places?
   SHOW DIFFERENT DMS’S. REPEAT QUESTIONS FOR EACH
   2. What are your general reactions to these screens? Likes? Dislikes?
      i. Do you use them? For what information?
         A. What other information do they provide?
      ii. Are they helpful? In what ways?
      iii. Are they easy to read/understand? If not, why not?
      iv. What suggestions would you make to improve the usefulness of these screens?
   3. AFTER SHOWING ALL: Which of these methods do you prefer?
VII. APPS (30 MINUTES)

a. Let's talk now about how we use technology to help you get around when you are in control and trying to navigate, not just for public transportation. Such as when you are driving, biking, walking, using public transportation, etc.

1. How do you find your way?
2. What technology/apps do you use?
   i. Google Maps
   ii. Apple Maps
   iii. Waze
   iv. Other?

b. Do you use any apps to assist you with your public transportation trips?

1. Which apps do you use for planning a trip? Navigation? To check on real-time status of your train or bus?
   i. Google Maps
   ii. Citymapper?
   iii. Moovit?
   iv. Transit?
   v. Other?

FOR EACH SHOW BASIC SCREEN SHOTS FOR EACH AND ASK:

   A. Have you heard of ___? What do you know about ___?
   B. Are you able to find the information you want/need? Easy? Hard?
   C. What are your reactions? Likes? Dislikes?
   D. Are there certain features that you particularly like? Dislike?
   E. Are they helpful? In what ways?
   F. What suggestions would you make to improve?

2. Do you have a preferred app?
   i. Which one? Why?

3. Thinking about these apps, how satisfied are you with the access to information?

4. Do you use more than one app?

5. Do you want one app or is having multiple apps acceptable?
   i. Do you think there could be one app that meets all of your needs?

6. What or who might impact your preference for one of these or another app?
CLOSING (10 minutes)

C. Before we wrap up, I would like you to complete an activity as a group. Pretend you are part of a committee tasked with improving communications about public transportation with people who live, work, go to school in and play in Arlington. What would you do to help them be able to get around Arlington?

d. Raffle winner
Focus Group Background Questionnaire

DS&B MG ARLINGTON REAL-TIME TRANSIT INFORMATION FOCUS GROUPS
BACKGROUND QUESTIONNAIRE

<table>
<thead>
<tr>
<th>#</th>
<th>Type</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rail only over age 37</td>
<td>7/11</td>
<td>6pm</td>
</tr>
<tr>
<td>2</td>
<td>Bus/Multimodal over age 37</td>
<td>7/11</td>
<td>8pm</td>
</tr>
<tr>
<td>3</td>
<td>Multimodal over age 37</td>
<td>7/12</td>
<td>6pm</td>
</tr>
<tr>
<td>4</td>
<td>Rail only under age 38</td>
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<td>8pm</td>
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<tr>
<td>5</td>
<td>Bus/Multimodal under age 38</td>
<td>7/17</td>
<td>6pm</td>
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<tr>
<td>6</td>
<td>Multimodal under age 38</td>
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<td>8pm</td>
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<td>7</td>
<td>Bus/Multimodal over age 37</td>
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</tbody>
</table>

NAME: ____________________________________________

While you are waiting for the focus group to begin, please complete this background survey. Once you have completed the survey, please let the host/hostess know. Thank you for joining us this evening.
TRANSPORTATION PROFILE

Q1. What types of transportation do you use in a typical week? Please think about all trips you take for all purposes.

FOR EACH MODE USED IN Q1, ASK:

Q1A. In a typical week, how many one-way trips do you take by each mode listed below? Please count each round trip as two one-way trips. If you are unsure, please use your best guess.

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q1A</th>
<th># of Trips/Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving your car alone</td>
<td>01</td>
<td>99</td>
</tr>
<tr>
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<td>99</td>
</tr>
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<td>Walking</td>
<td>16</td>
<td>99</td>
</tr>
<tr>
<td>Other (specify)</td>
<td>95</td>
<td>99</td>
</tr>
</tbody>
</table>

Q2. How many vehicles are owned or leased by members of your household?

________

Q3. How many licensed drivers are in your household?

________

Q4. How long is your typical daily commute to work or school one way? How long is it in miles or minutes?

In miles __________
In minutes __________
Q5. MOVED

ATTITUDBAL STATEMENTS – TRANSPORTATION, TECHNOLOGY, REALTIME INFORMATION

Q6. For each of the following statements, please tell me whether you strongly disagree, mostly disagree, mostly agree or strongly agree.

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>Strongly Disagree</th>
<th>Mostly Disagree</th>
<th>Mostly Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. I am comfortable using high-tech devices</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b. I prefer to find my own way rather than ask for directions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c. I am often one of the first to get new technology or devices</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d. When I need information, I would rather ask a person than use technology</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e. I get annoyed when my travel is delayed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f. I would use technology to look for travel information more if it were easier to get the information I need</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>g. Having real-time arrival information is important to me when using public transportation</td>
<td>1</td>
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<td>4</td>
</tr>
<tr>
<td>h. I check for real-time arrival information about public transportation before I leave my home</td>
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<td>3</td>
<td>4</td>
</tr>
<tr>
<td>i. Having real-time information when using public transportation helps me relax</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>j. Public transportation is convenient for most of my trips</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td>k. I would use public transportation more if it did not take so long</td>
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<td>2</td>
<td>3</td>
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<tr>
<td>l. I cannot rely on public transportation to be on schedule or on time</td>
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<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td>m. It is confusing to figure out how to use public transportation to get places</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>n. I don’t mind transferring between modes of public transportation to get where I need to go</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>o. It is important for me to be able to use a smartphone to get public transportation information</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>p. Paper schedules and flyers are the best way for me to get public transit information</td>
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<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>q. I like when the schedules are posted at the bus stop or rail station</td>
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<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>r. I am satisfied with the information provided by public transit agencies</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>STATEMENTS</td>
<td>Strongly Disagree</td>
<td>Mostly Disagree</td>
<td>Mostly Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>-----------------</td>
<td>--------------</td>
<td>----------------</td>
</tr>
<tr>
<td>s. I am often frustrated by the lack of information when I am using public transportation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>t. I travel on the same routes or lines of public transportation all the time.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

**Q10.** In what county or jurisdiction do you work or go to school?  
01 Fairfax County  
02 Fairfax City  
03 Falls Church  
04 City of Alexandria  
05 Arlington County  
06 Montgomery County  
07 Prince George's County  
08 District of Columbia  
95 Other (SPECIFY)

**Q11.** In which county or jurisdiction do you live?  
01 Fairfax County  
02 Fairfax City  
03 Falls Church  
04 City of Alexandria  
05 Arlington County  
06 Montgomery County  
07 Prince George's County  
08 District of Columbia  
95 Other (SPECIFY)

**Q7.** For each of the following statements, please tell me whether you strongly disagree, mostly disagree, mostly agree or strongly agree.

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>Strongly Disagree</th>
<th>Mostly Disagree</th>
<th>Mostly Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. I feel that travel on public transportation is safer than other forms of travel in this area</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c. I like the convenience of driving a car</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d. Driving during rush hour is very stressful</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e. I often feel concerned about my personal safety in public places</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f. I often go out for dining, or to social, entertainment or sporting events</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>i. For me, saving time is often more important than saving money</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>K. I need to have a car available during the workday in case of emergencies</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>l. My work schedule is unpredictable</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Q8. On a scale of 1 to 10 where 10 means it is extremely important to you and 1 means it is not at all important to you, please rate how important each of the following is when choosing which mode of public transportation you will use.

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Is available when you need it</td>
<td></td>
</tr>
<tr>
<td>b. Is low cost, compared to other modes of transportation</td>
<td></td>
</tr>
<tr>
<td>c. Offers good value for the money</td>
<td></td>
</tr>
<tr>
<td>e. Is a fast way to travel</td>
<td></td>
</tr>
<tr>
<td>f. Would get you to your destination on time</td>
<td></td>
</tr>
<tr>
<td>g. Is easy to use</td>
<td></td>
</tr>
<tr>
<td>h. Is convenient</td>
<td></td>
</tr>
<tr>
<td>i. Is a relaxing and stress-free way to travel</td>
<td></td>
</tr>
<tr>
<td>l. Goes to the places you need to go</td>
<td></td>
</tr>
<tr>
<td>m. Is a smart way to commute for people who can use it</td>
<td></td>
</tr>
<tr>
<td>o. Is safe from crime</td>
<td></td>
</tr>
<tr>
<td>p. Provides riders with access to real-time arrival information</td>
<td></td>
</tr>
<tr>
<td>q. Provides transit stops close to where you live</td>
<td></td>
</tr>
<tr>
<td>r. Provides transit stops close to your destinations</td>
<td></td>
</tr>
</tbody>
</table>

Q9. Now I am going to ask you about specific aspects of public transportation in Arlington County. Please use a scale of 1 to 10 where 10 means you strongly agree and 1 means you strongly disagree. Public transportation in Arlington County ...

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Is available when you need it</td>
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<tr>
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<td>h. Is convenient</td>
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<tr>
<td>i. Is a relaxing and stress-free way to travel</td>
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<tr>
<td>l. Goes to the places you need to go</td>
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</tr>
<tr>
<td>m. Is a smart way to commute for people who can use it</td>
<td></td>
</tr>
<tr>
<td>o. Is safe from crime</td>
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<tr>
<td>p. Provides riders with access to real-time arrival information</td>
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<tr>
<td>q. Provides transit stops close to where you live</td>
<td></td>
</tr>
<tr>
<td>r. Provides transit stops close to your destinations</td>
<td></td>
</tr>
</tbody>
</table>
DEMOGRAPHICS

Q12. How old are you?

Age: _______

Q13. What is your employment status? Are you...

01 Employed full-time,
02 Employed part-time,
03 A student,
04 Retired,
05 A homemaker, or
06 Not currently employed?

Q14. What is your gender?

01 Male
02 Female

Q15. Are you of Hispanic or Latino descent?

01 Yes
02 No

Q16. What is your race?

01 Caucasian,
02 African-American,
03 Native-American or Alaskan native,
04 Asian or Asian-American,
05 Native Hawaiian or Pacific Islander,
06 Multi-racial, or
85 Something else (specify) ________
Q17. What is your marital status?

01 Married or Partnered,
02 Single,
03 Divorced, Separated, or
04 Widowed?

Q18. What is the primary language spoken at your home?

01 English
02 Spanish
03 Chinese/Mandarin/Cantonese
04 French
05 Arabic
06 Vietnamese
07 Tagalog
09 Korean
95 Other (specify) ________________

Q19. Which category includes your total annual taxable household income?

01 Less than $35,000
03 $35,000 to less than $50,000
04 $50,000 to less than $75,000
05 $75,000 to less than $100,000,
06 $100,000 to less than $150,000
07 $150,000 or more

Q20. What is the last grade of school you completed?

01 Grade school or less
02 Some high school
03 High school graduate
04 Technical training beyond high school
05 Some college
06 College graduate
07 Graduate school or professional degree

Q21. Including yourself, how many people live in your household?
Q22. How many years have you lived in the [insert] area?

01 Less than one year,
02 One year,
03 Two to four years,
04 Five to nine years,
05 10 to 19 years, or
06 20 years or more

Q23. What is your home zip code?

________  ______  ______  ______

Those are all the questions I have. Thank you very much for your cooperation. Please let the host/hostess know that you have completed this survey.
DS&MG ARLINGTON REAL-TIME TRANSIT INFORMATION
ONLINE QUESTIONNAIRE

Please move from page to page in the survey using only the buttons provided at the bottom of each page. Using other methods, such as a "back" or "forward" button on the browser or using the "enter" key on your keyboard, may result in errors which can prevent you from finishing the questionnaire.

Answer each question by clicking on the response that best describes your opinion or by typing your response in the space provided. If the page is longer than your viewable screen, scroll down the screen to see the remaining responses or questions. When you have answered all the questions on a page, click the "Continue" button at the bottom of the page to move to the next page. You may move backward by using the "Back" button at the bottom of the screen.

If you should have to stop while taking the survey, simply close your browser and your answers will be automatically preserved so that you may return and complete the survey at a more convenient time. When you’re ready to return, click on the link provided and you will begin right where you left off.

S1. In which county or jurisdiction do you work or go to school? [ALLOW MULTIPLE RESPONSE]

01 Fairfax County
02 Fairfax City
03 City of Falls Church
04 City of Alexandria
05 Arlington County
06 Montgomery County
07 Prince George’s County
08 District of Columbia
95 Other (specify)
96 Not Applicable

S2. In which county or jurisdiction do you live?

01 Fairfax County
02 Fairfax City
03 City of Falls Church
04 City of Alexandria
05 Arlington County
06 Montgomery County
07 Prince George’s County
08 District of Columbia
95 Other (specify)

IF [S1(05) OR S2(05)], CONTINUE OTHERWISE THANK AND TERMINATE.
TRANSPORTATION PROFILE

Q1. What types of transportation do you use in a typical week? Please think about all trips you take for all purposes.

FOR EACH MODE USED IN Q1, ASK:

Q1A. In a typical week, how many one-way trips do you take by each mode listed below? Please count each round trip as two one-way trips. Please include biking and walking to public transportation. If you are unsure, please use your best guess.

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q1A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving your car alone</td>
<td>D1</td>
</tr>
<tr>
<td>Driving your car with passengers</td>
<td>D2</td>
</tr>
<tr>
<td>Riding in a car as a passenger</td>
<td>D3</td>
</tr>
<tr>
<td>Carpooling or vanpooling</td>
<td>D4</td>
</tr>
<tr>
<td>WMATA Metrorail</td>
<td>D5</td>
</tr>
<tr>
<td>WMATA Metrobus</td>
<td>D6</td>
</tr>
<tr>
<td>Arlington Transit (&quot;ART Buses&quot;)</td>
<td>D7</td>
</tr>
<tr>
<td>Fairfax Connector</td>
<td>D8</td>
</tr>
<tr>
<td>DC Circulator</td>
<td>D9</td>
</tr>
<tr>
<td>Virginia Railway Express (VRE)</td>
<td>D10</td>
</tr>
<tr>
<td>Taking another public transportation service (specify)</td>
<td>D11</td>
</tr>
<tr>
<td>Taking a taxi or limousine</td>
<td>D12</td>
</tr>
<tr>
<td>Using a ride sharing service like Uber or Lyft</td>
<td>D13</td>
</tr>
<tr>
<td>Riding a motorcycle</td>
<td>D14</td>
</tr>
<tr>
<td>Riding a bicycle</td>
<td>D15</td>
</tr>
<tr>
<td>Using bikeshare</td>
<td>D17</td>
</tr>
<tr>
<td>Walking</td>
<td>D16</td>
</tr>
<tr>
<td>Other (specify)</td>
<td>D15</td>
</tr>
</tbody>
</table>

Q2. How many vehicles are owned or leased by members of your household?

Q2A. How often do you have a vehicle available to you?

01. All the time
02. Most of the time
03. Occasionally
04. Rarely
05. Never

Q3. How many licensed drivers are in your household?

Q4. How long is your typical daily commute to work or school one way? How long is it in miles or minutes? (ALLOW DECIMALS)

In miles ________
In minutes ________
98 Not applicable

Page 2 of 18
IF USE PUBLIC TRANSPORTATION [Q1(05–11)], ASK:

Q4A. How long are you willing to wait for your bus to arrive once you are at the stop/station? 
___ minutes

Q4B. How long are you willing to wait for your train to arrive once you are at the stop/station? 
___ minutes

ASK EVERYONE:

ATTITUDESAL STATEMENTS – TRANSPORTATION, TECHNOLOGY, REAL-TIME INFORMATION

Q5. Which of the following do you use? **RANDOMIZE**

<table>
<thead>
<tr>
<th></th>
<th>Yes, use</th>
<th>No, do not use</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Smartphone</td>
<td>01</td>
<td>02</td>
</tr>
<tr>
<td>b. Tablet computer or iPad</td>
<td>01</td>
<td>02</td>
</tr>
<tr>
<td>c. Laptop computer</td>
<td>01</td>
<td>02</td>
</tr>
<tr>
<td>d. Smartwatch, Fitbit or other wearable technology</td>
<td>01</td>
<td>02</td>
</tr>
<tr>
<td>e. Alexa, Echo, Google Home or other similar technology</td>
<td>01</td>
<td>02</td>
</tr>
</tbody>
</table>

Q5A. How much time do you spend on social media in a typical day?

01  More than 2 hours
02  More than 1 hour to 2 hours
03  30 minutes to 1 hour
04  15 to 30 minutes
05  1 to 15 minutes
96  Do not use

Q5B. Which of the following do you regularly do? **RANDOMIZE**

<table>
<thead>
<tr>
<th></th>
<th>Yes, I do this</th>
<th>No, I do not do this</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Track shipments of purchases you make online</td>
<td>01</td>
<td>02</td>
</tr>
<tr>
<td>b. Check departure time and gate information for air travel</td>
<td>01</td>
<td>02</td>
</tr>
<tr>
<td>c. Track an Uber or Lyft car you ordered</td>
<td>01</td>
<td>02</td>
</tr>
<tr>
<td>d. Check the arrival time of your bus or train prior to arriving at the bus stop or station</td>
<td>01</td>
<td>02</td>
</tr>
<tr>
<td>e. Track food purchases that you made online</td>
<td>01</td>
<td>02</td>
</tr>
</tbody>
</table>

Q6. How strongly do you agree or disagree with each of the following statements? **RANDOMIZE**, **SET UP ON SEVERAL SCREENS**

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>Strongly Disagree</th>
<th>Mostly Disagree</th>
<th>Neither</th>
<th>Mostly Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. I am comfortable using new technology</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>STATEMENT</td>
<td>Strongly Disagree</td>
<td>Mostly Disagree</td>
<td>Neither</td>
<td>Mostly Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------</td>
<td>----------------</td>
<td>---------</td>
<td>--------------</td>
<td>----------------</td>
</tr>
<tr>
<td>b. I prefer to find my own way rather than ask for directions</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>c. I am often one of the first to get new technology or devices</td>
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<td>02</td>
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<td>04</td>
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<td>02</td>
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<td>04</td>
<td>05</td>
</tr>
<tr>
<td>e. I get annoyed when my travel is delayed</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>f. On-time arrival is important when I commute</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>g. On-time arrival is important when I travel for leisure</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>h. I would use technology to look for travel information more if it were easier to get the information I need</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>i. Having real-time arrival information is important to me when using public transportation</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>j. I check for real-time arrival information about public transportation before I leave my home</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>k. Having real-time information when using public transportation helps me relax</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>l. Public transportation is convenient for most of my trips</td>
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<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>m. I would use public transportation more if it did not take so long</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>n. I cannot rely on public transportation to be on schedule or on time</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>o. It is confusing to figure out how to use public transportation to get places</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>p. I don’t mind that public transportation sometimes requires transfers</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>q. It is important for me to be able to use a smartphone to get public transportation information</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>r. Paper schedules and flyers are the best way for me to get public transportation information</td>
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<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>s. I like when the schedules are posted at the bus stop or rail station</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
</tbody>
</table>
Q7. How strongly do you agree or disagree with each of the following statements? (RANDOMIZE)

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>Strongly Disagree</th>
<th>Mostly Disagree</th>
<th>Neither</th>
<th>Mostly Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>t. I am satisfied with the information provided by public transportation agencies</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>u. I am often frustrated by the lack of information when I am using public transportation</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>v. I travel on the same routes or lines of public transportation all the time</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>w. I often go to new and different places</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>x. I don't mind if public transportation is delayed</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
</tbody>
</table>

Q8. On a scale of 1 to 10 where 10 means it is extremely important to you and 1 means it is not at all important to you, please rate how important each of the following is when choosing which mode of public transportation to use. (RANDOMIZE)

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Is available when you need it</td>
<td></td>
</tr>
<tr>
<td>b. Is low cost, compared to other modes of transportation</td>
<td></td>
</tr>
<tr>
<td>c. Offers good value for the money</td>
<td></td>
</tr>
<tr>
<td>e. Is a fast way to travel</td>
<td></td>
</tr>
<tr>
<td>f. Would get you to your destination on time</td>
<td></td>
</tr>
<tr>
<td>g. Is easy to use</td>
<td></td>
</tr>
<tr>
<td>h. Is convenient</td>
<td></td>
</tr>
<tr>
<td>i. Is a relaxing and stress-free way to travel</td>
<td></td>
</tr>
<tr>
<td>j. Goes to the places you need to go</td>
<td></td>
</tr>
<tr>
<td>m. Is a smart way to commute for people who can use it</td>
<td></td>
</tr>
</tbody>
</table>
Q9. Now please think about specific aspects of public transportation in Arlington County. Please use a scale of 1 to 10 where 10 means you strongly agree and 1 means you strongly disagree. Public transportation in Arlington County ...

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Is available when you need it</td>
<td></td>
</tr>
<tr>
<td>b. Is low cost, compared to other modes of transportation</td>
<td></td>
</tr>
<tr>
<td>c. Offers good value for the money</td>
<td></td>
</tr>
<tr>
<td>e. Is a fast way to travel</td>
<td></td>
</tr>
<tr>
<td>f. Would get you to your destination on time</td>
<td></td>
</tr>
<tr>
<td>g. Is easy to use</td>
<td></td>
</tr>
<tr>
<td>h. Is convenient to use</td>
<td></td>
</tr>
<tr>
<td>i. Is a relaxing and stress-free way to travel</td>
<td></td>
</tr>
<tr>
<td>j. Goes to the places you need to go</td>
<td></td>
</tr>
<tr>
<td>m. Is a smart way to commute for people who can use it</td>
<td></td>
</tr>
<tr>
<td>a. Is safe from crime</td>
<td></td>
</tr>
<tr>
<td>p. Provides riders with access to real-time arrival information</td>
<td></td>
</tr>
<tr>
<td>q. Provides transit stops close to where you live</td>
<td></td>
</tr>
<tr>
<td>r. Provides transit stops close to your destinations</td>
<td></td>
</tr>
<tr>
<td>s. Provides access to public transportation information</td>
<td></td>
</tr>
<tr>
<td>t. Is familiar to me</td>
<td></td>
</tr>
<tr>
<td>u. Is used by friends, family and/or co-workers</td>
<td></td>
</tr>
</tbody>
</table>
REAL-TIME INFORMATION CONCEPTS

Q10. At bus stops around Arlington County and other areas, there is often a sign with a phone number that you can call to get bus information, including real-time information about when the next bus will arrive. Have you ever used this phone number to get information?

01 Yes
02 No
99 Not sure

IF YES [Q10(01)], ASK:

Q11. How satisfied were you with your experience calling to get real-time information about when the next bus would arrive?

05 Completely satisfied
04 Mostly satisfied
03 Somewhat satisfied
02 Not very satisfied
01 Not at all satisfied

IF NO [Q10(02)], ASK:

Q11A. Why not? Please check all that apply. (RANDOMIZE. ALLOW MULTIPLE RESPONSE)

01 Don't like to talk to operators
02 Do not think they are reliable
03 Operators give me too many options
04 Gives scheduled time not real time
05 Gives information that does not apply to my stop or route
07 I was not aware of this number/have not seen it before
95 Other (specify)

ASK EVERYONE:

Q12. How valuable would you say it is for Arlington County to provide a phone number or other kind of contact information at the bus stop for riders to get real-time bus arrival information?

04 Very valuable
03 Somewhat valuable
02 Not very valuable
01 Not at all valuable

Q13. Some transportation systems offer a service that riders can sign up for that will send them text message updates when there is a delay in the arrival of their bus or train. Have you ever signed up and used these text message updates to get information?

01 Yes
02 No
99 Not sure
IF YES [Q13(01)], ASK:

Q14. How satisfied were you with your experience getting real-time information from text messages about when the next bus or train would arrive when there was a delay?

05 Completely satisfied
04 Mostly satisfied
03 Somewhat satisfied
02 Not very satisfied
01 Not at all satisfied

IF NO [Q13(02)], ASK:

Q13A. Why not? Please check all that apply. (RANDOMIZE, ALLOW MULTIPLE RESPONSE)

01 Do not like to receive text messages
02 Do not think they are reliable
03 System I use does not offer text messages
04 They are not beneficial to me
05 Did not know about this service
95 Other [specify]

ASK EVERYONE:

Q15. How valuable would you say it is for Arlington County to provide riders with the option of text message updates for real-time bus or train arrival information?

04 Very valuable
03 Somewhat valuable
02 Not very valuable
01 Not at all valuable

Q16. Arlington Transit has a website called www.ArlingtonTransit.com that allows you to find when the next ART bus will arrive at your stop. You can search by RealTime number (found on the bus flag) or by your route and stop. Have you ever used this website to search for real-time information?

01 Yes
02 No
99 Not sure

IF YES [Q16(01)], ASK:

Q17. How satisfied were you with your experience getting real-time information from the ArlingtonTransit.com website?

05 Completely satisfied
04 Mostly satisfied
03 Somewhat satisfied
02 Not very satisfied
01 Not at all satisfied
IF NO [Q16[02]], ASK:

Q17A. Why not? Please check all that apply. [RANDOMIZE, ALLOW MULTIPLE RESPONSE]

01 Website is difficult to use
02 Do not think the website is reliable
03 Website does not offer the information I need
04 I do not use the ART bus
05 Did not know about this website
95 Other (specify)

ASK EVERYONE:

Q18. How valuable would you say it is for Arlington County to provide riders with real-time information through the www.ArlingtonTransit.com website?

04 Very valuable
03 Somewhat valuable
02 Not very valuable
01 Not at all valuable
Q19. At bus stops around Arlington County and other areas, there are green boxes installed called "BusFinders".

To use a BusFinder, place your thumb on the circle for your bus route. The red light will start flashing as the BusFinder receives real-time information. Within 30 seconds, the BusFinder will indicate how far away the next bus is from you. Have you ever used or seen a BusFinder in Arlington?

01  Yes, used
02  Yes, seen but not used
03  No, have not seen or used
99  Not sure

**IF YES, USED [Q19[01]], ASK:**

Q20. How satisfied were you with your experience using BusFinder to get real-time information about when the next bus would arrive?

05  Completely satisfied
04  Mostly satisfied
03  Somewhat satisfied
02  Not very satisfied
01  Not at all satisfied

**ASK EVERYONE:**

Q21. How valuable would you say it is for Arlington County to provide BusFinder at the bus stop for riders to get real-time bus arrival information?

04  Very valuable
03  Somewhat valuable
02  Not very valuable
01  Not at all valuable
Q22. Around Arlington County and other communities, there are often message boards like the one pictured here to provide information about public transportation, including real-time information about when the next bus or train will arrive. **SHOW PICTURE OF MESSAGE BOARD.**

Have you ever seen or used one of these message boards?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Yes, used</td>
</tr>
<tr>
<td>02</td>
<td>Yes, seen but not used</td>
</tr>
<tr>
<td>03</td>
<td>No, have not seen or used</td>
</tr>
<tr>
<td>99</td>
<td>Not sure</td>
</tr>
</tbody>
</table>

**IF YES, USED [Q22(01)], ASK:**

Q23. How satisfied were you with your experience getting real-time information from these message boards about when the next bus or train would arrive?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>05</td>
<td>Completely satisfied</td>
</tr>
<tr>
<td>04</td>
<td>Mostly satisfied</td>
</tr>
<tr>
<td>03</td>
<td>Somewhat satisfied</td>
</tr>
<tr>
<td>02</td>
<td>Not very satisfied</td>
</tr>
<tr>
<td>01</td>
<td>Not at all satisfied</td>
</tr>
</tbody>
</table>
ASK EVERYONE:

Q24. How valuable would you say it is for Arlington County to provide a message board like this at bus stops for riders to get real-time bus arrival information?

04 Very valuable
03 Somewhat valuable
02 Not very valuable
01 Not at all valuable

MESSAGE BOARDS - ROTATE ORDER OF [Q22-24 AND Q25-27 AND Q28-30]

Q25. Around Arlington County and in other areas, there are often message boards like the one pictured here to provide information about public transportation, including real-time information about when the next bus or train will arrive. SHOW PICTURE OF MESSAGE BOARD.

Have you ever seen or used these message boards?

01 Yes, used
02 Yes, seen but not used
03 No, have not seen or used
99 Not sure

IF YES, USED [Q25(01)], ASK:

Q26. How satisfied were you with your experience getting real-time information from these message boards about when the next bus or train would arrive?

05 Completely satisfied
04 Mostly satisfied
03 Somewhat satisfied
02 Not very satisfied
01 Not at all satisfied
ASK EVERYONE:

Q27. How valuable would you say it is for Arlington County to provide a message board like this at bus stops for riders to get real-time bus arrival information?

04 Very valuable
03 Somewhat valuable
02 Not very valuable
01 Not at all valuable

MESSAGE BOARDS - ROTATE ORDER OF [Q22-24 AND Q25-27 AND Q28-30]

Q28. Around Arlington County and in other areas, there are often message boards like the one pictured here to provide information about public transportation, including real-time information about when the next bus or train will arrive. SHOW PICTURE OF MESSAGE BOARD.

Have you ever seen or used these message boards?

01 Yes, used
02 Yes, seen but not used
03 No, have not seen or used
09 Not sure
Q25. How satisfied were you with your experience getting real-time information from these message boards about when the next bus or train would arrive?

05 Completely satisfied
04 Mostly satisfied
03 Somewhat satisfied
02 Not very satisfied
01 Not at all satisfied

ASK EVERYONE:

Q30. How valuable would you say it is for Arlington County to provide a message board like this at bus stops for riders to get real-time bus arrival information?

04 Very valuable
03 Somewhat valuable
02 Not very valuable
01 Not at all valuable

Q31. Where would you find value in a message board like this? (RANDOMIZE RESPONSES 01-04. ALLOW MULTIPLE RESPONSE.)

01 In hospitals
02 In lobbies of commercial buildings
03 In lobbies of apartment buildings
04 In malls/shopping centers
95 Other (specify)
96 I would not find value in a message board like this in any location

Q32. On a scale of 1 to 10, in which 10 means it is extremely important to you and 1 means it is not at all important to you, please rate how important it is for message boards such as these to have the following. (RANDOMIZE)

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Offer all possible transportation modes including walking, driving, biking, ride-hailing, and others</td>
<td></td>
</tr>
<tr>
<td>b. Provide route maps</td>
<td></td>
</tr>
<tr>
<td>c. Present all possible options and combinations</td>
<td></td>
</tr>
<tr>
<td>d. Allow you to adjust your departure time</td>
<td></td>
</tr>
<tr>
<td>e. Be a one-stop tool for all your transportation-information needs</td>
<td></td>
</tr>
<tr>
<td>f. Provide a map interface that you are familiar with</td>
<td></td>
</tr>
<tr>
<td>g. Include the newest transportation options like ride-hail, bikeshare, electric scooters, and others</td>
<td></td>
</tr>
</tbody>
</table>
### Apps

Q33. For each of the following apps, please indicate if you have never heard of it, heard of it but never downloaded, downloaded but never used, downloaded and use occasionally or downloaded and use regularly. **(RANDOMIZE)**

<table>
<thead>
<tr>
<th></th>
<th>Never heard of</th>
<th>Heard of but never downloaded</th>
<th>Downloaded but never use</th>
<th>Downloaded and use occasionally</th>
<th>Downloaded and use regularly</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Apple Maps</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>b. Google Maps</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>c. City Mapper</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>d. Moovit</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>e. Transit</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
</tbody>
</table>

**FOR EACH APP CURRENTLY HAVE AND USE [Q33(04–05)], ASK:**

Q34. How satisfied were you with your experience getting real-time information from these apps about when the next bus or train would arrive?

<table>
<thead>
<tr>
<th></th>
<th>Not at all satisfied</th>
<th>Not very satisfied</th>
<th>Somewhat satisfied</th>
<th>Mostly satisfied</th>
<th>Completely satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Apple Maps</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>b. Google Maps</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>c. City Mapper</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>d. Moovit</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>e. Transit</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
</tbody>
</table>

**ASK EVERYONE:**

Q35. How valuable would you say it is to have an app like these (Apple Maps, Google Maps, City Mapper, Moovit, Transit, etc.) to get real-time information about when the next bus or train will arrive?

- 04 Very valuable
- 03 Somewhat valuable
- 02 Not very valuable
- 01 Not at all valuable

Q36. How likely would you be to use an app like this to get real-time information about when the next bus or train would arrive?

- 01 Very likely
- 02 Somewhat likely
- 03 Not very likely
- 05 Not at all likely

Q37. On a scale of 1 to 10, in which 10 means it is extremely important to you and 1 means it is not at all important to you, please rate how important it is for apps such as these to have the following. **(RANDOMIZE)**
<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Offer all possible transportation modes including walking, driving, biking, ride-hailing, and others</td>
<td></td>
</tr>
<tr>
<td>b. Offer written and visual/map directions</td>
<td></td>
</tr>
<tr>
<td>c. Present all possible options and combinations</td>
<td></td>
</tr>
<tr>
<td>d. Allow you to adjust your departure time</td>
<td></td>
</tr>
<tr>
<td>e. Allow you to customize the app to offer only modes of transportation you use</td>
<td></td>
</tr>
<tr>
<td>f. Be a one-stop app for all your transportation-information needs</td>
<td></td>
</tr>
<tr>
<td>g. Provide a map interface that you are familiar with</td>
<td></td>
</tr>
<tr>
<td>h. Include the newest transportation options like ride-hail, bikeshare, electric scooters, and others</td>
<td></td>
</tr>
<tr>
<td>i. Adjust for you as your travel and situations change</td>
<td></td>
</tr>
</tbody>
</table>

**DEMOGRAPHICS**

D1. How old are you?   Age: _______

D2. What is your employment status? Are you...?

01   Employed full-time
02   Employed part-time
03   A student
04   Retired
05   A homemaker
06   Not currently employed

D3. What is your gender?

01   Male
02   Female

D4. Are you of Hispanic or Latino descent?

01   Yes
02   No

D5. What is your race?

01   Caucasian
02   African-American
03   Native-American or Alaskan native
04   Asian or Asian American
05   Native Hawaiian or Pacific Islander
06   Multi-racial
95   Something else (specify)_________
D6. What is your marital status?

01 Married or Partnered
02 Single
03 Divorced or Separated
04 Widowed

D7. What is the primary language spoken at your home?

01 English
02 Spanish
03 Chinese/Mandarin/Cantonese
04 French
05 Arabic
06 Vietnamese
07 Tagalog
08 Korean
95 Other [specify]

D8. Which category includes your total annual taxable household income?

01 Less than $35,000
03 $35,000 to less than $50,000
04 $50,000 to less than $75,000
05 $75,000 to less than $100,000
06 $100,000 to less than $150,000
07 $150,000 or more

D9. What is the last grade of school you completed?

01 Grade school or less
02 Some high school
03 High school graduate
04 Technical training beyond high school
05 Some college
06 College graduate
07 Graduate school or professional degree

D10. Including yourself, how many people live in your household? ___

**IF MULTI-PERSON HOUSEHOLD [D10>1], ASK:**

D10a. Of the [INSERT RESPONSE FROM [D10]] people who live in your household, how many are children under 18 years old? ___
D11. How many years have you lived in the Washington, DC metropolitan area?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Less than one year</td>
</tr>
<tr>
<td>02</td>
<td>One year</td>
</tr>
<tr>
<td>03</td>
<td>Two to four years</td>
</tr>
<tr>
<td>04</td>
<td>Five to nine years</td>
</tr>
<tr>
<td>05</td>
<td>10 to 19 years</td>
</tr>
<tr>
<td>06</td>
<td>20 years or more</td>
</tr>
</tbody>
</table>

D12. What is your home ZIP code?       

D13. Do any of the following apply to you?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Deaf or have serious difficulty hearing</td>
</tr>
<tr>
<td>b.</td>
<td>Blind or serious difficulty seeing even when wearing glasses</td>
</tr>
<tr>
<td>c.</td>
<td>Serious difficulty concentrating, remembering or making</td>
</tr>
<tr>
<td></td>
<td>decisions</td>
</tr>
<tr>
<td>d.</td>
<td>Serious difficulty walking or climbing</td>
</tr>
<tr>
<td>e.</td>
<td>Difficulty dressing or bathing</td>
</tr>
<tr>
<td>f.</td>
<td>Physical, mental or emotional condition making it difficult</td>
</tr>
<tr>
<td></td>
<td>to do errands</td>
</tr>
</tbody>
</table>

<p>| | | |</p>
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<thead>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>01</td>
<td></td>
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<td></td>
<td>02</td>
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<td>01</td>
<td></td>
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<tr>
<td></td>
<td>02</td>
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</tr>
</tbody>
</table>

Those are all the questions we have. Thank you very much for your cooperation.