Evaluation of East Gainesville Florida Microtransit Mobility Project

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FINAL REPORT

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Metric Conversion Chart

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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16. Abstract

This study evaluates the microtransit pilot program in East Gainesville and provides recommendations to achieve long-term stability of services. We used the following methods in this research: geospatial analysis of existing transit and microtransit services in East Gainesville and their use during 2020, interviews with public officials and community leaders to understand the challenges and opportunities of microtransit, and surveys to understand what neighborhood residents like about the service and what improvements they desire. We completed an evaluation using geospatial analysis of the potential for microtransit expansion in Gainesville's Mobility on Demand (MOD) zones. Most microtransit programs have been piloted and failed within three years due to a lack of long-term funding. With this in mind, we make recommendations on how to ensure financial stability and equitable access to existing services, while emphasizing the importance of transit expansion to other parts of the Gainesville metro area. We discuss the necessity for public-private partnerships by examining other microtransit services that have considerably benefitted from such collaborative approaches. Ultimately, we conclude that diversity in funding and effective outreach are critical components of a successful microtransit program and need to be thoroughly considered by RTS to improve existing services and make service expansion a feasible future plan for the city.

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Executive Summary

Microtransit as a shared ride has recently been offered by transit agencies across the nation either alone or in partnership with transportation network companies (TNCs) or other providers. In early 2019, East Gainesville started a microtransit pilot program with limited services in terms of available times and geographical coverage. In this study, the East Gainesville microtransit pilot program is evaluated for its strengths and weaknesses via literature reviews, surveys, interviews, spatial analysis, and case studies of similar microtransit systems. The main objectives in assessing this system are to understand the gaps that microtransit systems could fill and to explore current capabilities and future opportunities for the Gainesville Regional Transit System (RTS) to better serve the community. This includes both transit and microtransit systems, and considers community members' ages, abilities, and the built-environment characteristics of the neighborhoods.

RTS provides microtransit service to East Gainesville on weekdays during the morning and evening peak hours of travel (5:30 to 8:30 AM and 4:30 to 7:30 PM). The interviews and surveys identify several areas in which the users feel the pilot program has succeeded, such as in its convenience in pick-up and drop-off locations and its ability to connect users to a larger system. Several weaknesses are identified, such as: the hours of operation, the frequency and range of service, and the way the program has been advertised to the community. Suggestions for the expansion of microtransit throughout the city are provided based on individual zone spatial analyses. That analysis confirms that the area where microtransit is provided has the highest priority. General recommendations for Gainesville's microtransit services compared to other agencies across Florida include three pivotal dimensions of microtransit services: financial stability, accessibility, and availability. The most essential recommendations involve using a cautionary approach when considering the expansion of microtransit as a service that can replace fixed-route service when the route's efficiency is low. When a route can benefit from a dynamic push, the service is adopted complementarily. This report considers different aspects of service stability and discusses the success of microtransit services and challenges RTS may encounter in future service expansions. The research concludes with financial, contextual, geographical, and demographic considerations necessary to overcome future challenges and to build an effective relationship between users and non-users.

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Abbreviations

Abbreviation	Term
ADA	Americans with Disabilities Act
AIM	Accelerating Innovative Mobility
AoS	Areas of sustainability
APTA	American Public Transportation Association
ATU	Amalgamated Transit Union
BRT	Bus Rapid Transit
CDC	Center for Disease Control and Prevention
CDTA	Capital District Transportation Authority
DART	Dallas Area Rapid Transit
DCTA	Denton County Transportation Authority
DEA	Data Envelopment Analysis
DRT	Demand-responsive transit
FDOT	Florida Department of Transportation
FMLM	First-mile, last-mile
FTA	Federal Transit Administration
GIS	Geographic information systems
GPS	Global positioning system
HART	Hillsborough Area Regional Transit
ICT	Information and Communication Technology
IRB	Institutional Review Board
KCATA	Kansas City Area Transportation Authority
LAVTA	Livermore Amador Valley Transit Authority
MaaS	Mobility as a service
MBTA	Massachusetts Bay Transportation
MOD	Mobility on demand
MTA	Metropolitan Transportation Authority (New York)
NCTD	North County Transit District
PPP	Private-public partnership
PSTA	Pinellas Suncoast Transit Authority
ROI	Return on Investment
RTD	Regional Transport District (Colorado)
RTS	Regional Transit System (Gainesville, FL)
SOV	Single-occupant vehicle
SVI	Social vulnerability index
TDP	Transit Development Plan
TNC	Transportation Network Company
TRB	Transportation Research Board
UF	University of Florida
VTA	Valley Transit Authority
WRTA	Worcester Regional Transit Authority

1 Introduction

In recent years, transportation planners have focused increasing attention on new mobility services, such as transportation network companies (TNCs), microtransit, and dockless bike sharing and electric scooters. TNC customers use mobile apps to secure individual and carpooling rides from drivers who use their own vehicles. TNCs take advantage of the global positioning system (GPS) capability in smartphones to identify the pick-up location and to keep the customer informed in real time about when their vehicle will arrive. These so called "ride hailing" or "ridesharing" companies were primarily seen as competition with taxi companies, yet their connection with transit is also debated in the literature (Hall, Palsson & Price, 2018; Rayle, Dai, Chan, Cervero & Shaheen, 2016). TNCs can affect public transit through two mechanisms: as an alternative mode of travel, or to overcome the first-mile, last-mile (FMLM) problem caused by public transit's fixed route, fixed schedule services.

Generally, microtransit is a shared ride providing FMLM service to transit service that operates along a predetermined route or assembled on the fly by sophisticated computer algorithms (Hall, Palsson & Price, 2018). Thus, passengers walk to a pick-up location and pay a flat-rate fare. TNCs, such as Via, Chariot, and Bridj, initially provided microtransit in a limited number of markets (Schaller, 2018). More recently, transit agencies have begun to offer microtransit services as lifeline transportation, supplemental paratransit under the Federal Americans with Disabilities Act (ADA), and as a FMLM service to provide transportation in areas without conventional public transit or in highly dispersed travel markets (Schaller, 2018). Transit agencies have provided their own microtransit service, or they have partnered with TNCs or other paratransit providers to operate the service. While many cities are experimenting with microtransit, few studies have been completed on the effectiveness and opportunities for microtransit as a part of a transit system operation.

Beginning in January 2019, the City of Gainesville Regional Transit System (RTS) began to operate microtransit on two routes in East Gainesville. RTS later added a third route. These routes support a geographically dispersed, low-income population that conventional public transit does not easily serve. This project evaluates the microtransit service to understand its deployment, its successes and shortcomings, its funding mechanism, sustainability, the rightsizing of the service, and its applicability to other Florida transit agencies.

1.1 COVID-19 Challenges

1.1.1 Impact on Transit Agencies

COVID-19 had a significant and immediate impact on transit agencies across the world. In the United States, transit ridership plummeted 80% in April 2020 as states locked down to control the virus. Between 2019 and 2020, transit usage declined approximately 62% (APTA, 2021). In Florida, transit agencies saw a slightly lower rate of decline, with transit agencies showing declines of between 22.4% (Pinellas County Transportation Authority) and 62.8% (Tallahassee) between 2019 and 2020 (APTA, 2021).

As the COVID-19 pandemic presents challenges to maintaining steady public transit ridership, microtransit proves to be a flexible and accessible service that accommodates concerns about physical distancing and limited mobility. Microtransit services can provide

mobility as a service and offers an innovative design choice. The use of transit service during the pandemic shows its adaptability in providing service to essential workers who continued to use transit during the pandemic.

Transit agencies have proven adaptable to consequences of ridership during the pandemic. In Sacramento, ridership in the microtransit service, SmART Ride, steadily climbed after sharply declining at the beginning of the pandemic. Out of 45 service zones, 80 percent specifically aided minority riders, including low-income and disabled populations (Sacramento Regional Transit, 2020). In September 2020, SmART Ride completed 2,784 passenger trips in one week (Sacramento Regional Transit, 2020). This places the service among the strongest performing in the U.S., both in ridership and growth. In Texas, the Denton County Transportation Authority (DCTA) expanded its microtransit operation as a result of the pandemic as a replacement service for fixed route transit with low ridership performance (Metro Magazine Staff, 2020). They also supplemented moderately performing bus routes.

1.1.2 Impact on Florida Transit

In Central Florida, public transit found ways to aid populations to assist in transit needs, especially during the pandemic. Orange, Seminole, and Flagler counties provided services for transit-limited seniors to transport them to vaccination sites. Orange County residents were picked up, and a driver waited with them when they received the vaccine (Rivera, 2021). They were then returned to their original location. In the Cypress Creek area of South Florida, microtransit services were used to transport essential service workers to mediate access to potentially limited transit (Berton, 2021). These sorts of examples suggest ways that vulnerable populations were assisted through innovative transit, including microtransit. Fixed route transit could not accommodate older adults waiting to get a vaccine. Nor is it as accessible for transit-dependent individuals, as limited capacity requirements may restrict capacity. Microtransit can provide equitable access for Floridians who need to have essential access to transit services.

Although mobility may have decreased during the pandemic, with lower ridership and less access to service, the availability of microtransit targeted directly to transit-dependent populations became a vital and necessary method of providing mobility as a service. Although the long-term social and economic impacts of microtransit during a pandemic have not been studied, service expansion and adaptability are central to modern transit services, and this is particularly needed during a time of limited mobility. Thus far, no direct correlation has been found between public transit ridership and COVID-19 transmission, in part because of the transit agencies' mask mandates and minimized occupancy (Sam Schwartz Consulting, n. d.). Additionally, the public health implications of single occupancy vehicle usership should be noted, as maintaining public transportation during a pandemic supports sustainable ridership. Moreover, COVID-19 has provided economic and social challenges to agencies, but prioritizing accessibility and safety using on-demand technology increases the security and equity of mobility as a service.

1.1.3 Impact on Data Collection

Due to the COVID-19 pandemic, the research team faced some challenges in accomplishing data collection for this project. The research team completed the literature review and received approval for interviews and surveys in late February 2020; we planned to begin administering the survey after spring break, during the second week of March 2020. Not only did we have to update our research procedures for additional University of Florida (UF)

Institutional Review Board (IRB) approval, but we also needed to form a self-sufficient network for safe, broad, and reliable distribution. We relied heavily on our relationships with community leaders, who expressed a willingness to help by distributing surveys, using their own connections with other community leaders, and identifying community gathering spaces. While this was initially a challenge, it also gave us greater insight into the Gainesville community. We completed interviews from mid-September 2020 through February 2021. The surveys were distributed between January and early April 2021.

1.2 Organization of the document

This final report is the synthesis of five separate memorandums submitted throughout the course of this research. These memorandums were organized sequentially into a framework that the research team developed for better understanding of the ways in which microtransit serves the residents of East Gainesville. This report includes eight total chapters. The first chapter is the introduction section, including the scope of the research and the impacts of COVID-19 on the project. Chapter Two is the conceptual framework for understanding the place of microtransit in the transportation system, and the different elements that contribute to the system's operation. The third chapter consists of the methodology for the data collection and analysis. Chapter Four presents a profile of the residents based upon an analysis of East Gainesville and the results of the data collected and the analysis of East Gainesville. The fifth chapter describes specific case studies completed for comparison to the East Gainesville microtransit project. The sixth chapter discusses the data collected and its relation to other successful programs. Chapter Seven contains the final recommendations provided for the current operations, including possible expansions in Gainesville, and how the lessons learned can translate to other transit systems in Florida.

2 Conceptual Framework

2.1 The Place of Microtransit among Other Transportation Services

In recent years, technology advances have fostered a broad array of innovations in passenger transportation. The rapid evolution of global satellite positioning, wireless communications, high-speed computing, sophisticated affordable sensing (Polzin, 2016), among many other technologies, is making the use of established transportation modes easier, quicker, more reliable, and more predictable, attracting new customers and encouraging new types of trips by reducing uncertainty and increasing the convenience and efficiency of system use (NASEM, 2016). The technological innovations have enabled a variety of new mobility services that have emerged as important and growing components of urban passenger transportation. However, the newly developing options continually blur the lines demarcating one from another. Table 2-1 provides a brief description of these innovative mobility concepts, including shared mobility, transportation network company (TNC) services (or ridesourcing services), microtransit, mobility-on-demand (MOD), and mobility-as-a-service (MaaS).

Table 2-1: Description of New Mobility Concepts

Term	Description
Shared Mobility	Transportation services that are shared among users, including public transit; taxis and limos; bikesharing; carsharing (round-trip, one-way, and personal vehicle sharing); ridesharing (car-pooling, van-pooling); ridesourcing; scooter sharing; shuttle services; neighborhood jitneys; and commercial delivery vehicles providing flexible goods movement. (NASEM, 2016)
Transportation Network Companies/ Ridesourcing	Use of online platforms to connect passengers with drivers and automate reservations, payments, and customer feedback. Riders can choose from a variety of service classes, including drivers who use personal, non-commercial, vehicles; traditional taxicabs dispatched via the providers' apps, and premium services with professional livery drivers and vehicles. (NASEM, 2016)
Microtransit	IT-enabled private multi-passenger transportation services, such as Bridj, Chariot, Split, and Via, that serve passengers using dynamically generated routes, and may expect passengers to make their way to and from common pick-up or drop-off points. Vehicles can range from large SUVs to vans to shuttle buses. They are transit-like services but on a smaller, more flexible scale (NASEM, 2016). Increasingly public transit agencies are offering microtransit service.
Mobility-on-Demand (MOD)	An innovative transportation concept where consumers can access mobility, goods, and services on-demand by dispatching, or using shared mobility, courier services, automated (or self-piloted) aerial vehicles and drones, and public transportation solutions. It is an integrated and connected multi-modal network of transportation options. The most advanced forms of MOD services incorporate trip planning and booking, real-time information, fare payment, artificial intelligence, and predictive analytics into a single user interface (Shaheen & Cohen, 2018).
Mobility-as-a Service (MaaS)	A mobility distribution model that delivers users' transport needs through a single interface of a service provider. It combines different transport modes to offer a tailored mobility package, like a monthly mobile phone contract. Some of the core characteristics of MaaS are: customer's need-based, service bundling, cooperativity and interconnectivity in transport modes and service providers (Hietanen, 2014).
Source: Prepared by research team	

New mobility services such as TNCs, microtransit, MOD, and MaaS, can also be categorized as Information and Communication Technology (ICT)-based mobility services, because they are provided by a combination of ICT with infrastructures, transportation systems, and operator platforms based on real time and location data logistic management (Knieps, 2018).

Some studies have examined the impacts of ICTs on travel demand and travel patterns, including trip generation, destination choice, travel mode, route choice, timing, and duration (Mokhtarian & Tal, 2013). Researchers suggest that there are four types of relationships between "virtual trips and activities" (human interactions and transactions in the absence of physical trips) and physical travel and activities: substitution, complementarity, modifications, and neutrality (Gössling, 2018; Kwan, Dijst, & Schwanen, 2007). In addition to these impacts, other studies show that ICTs increase fragmentation of activities in time and space and enable multitasking during the trip (Van Wee, Geurs, & Chorus, 2013). However, research results represent the combined effects of multiple impacts operating in multiple directions (Mokhtarian & Tal, 2013). Additionally, with more mobility options and better real-time information about them, it is expected that ICT-enabled transportation services, such as on-demand, shared ride services, would substitute for the ownership and use of a private automobile (Hanson & Giuliano, 2004; NASEM, 2016).

In sum, ICTs expand peoples' choice sets of travel, increase the flexibility of these choices, and improve the efficiency of transportation so that more travel can be accommodated within the existing infrastructure. However, one should be aware of the equity implications of incorporating ICTs into the design and operation of public transportation. New technologies are contributing to reshaping the world in unprecedented ways, but this has come at the expense of those individuals who, due to economic conditions, physical disabilities, or other reasons, do not have access (permanently or even temporarily) to many of these technological advancements (Hanson & Giuliano, 2004).

2.1.1 Definition of Microtransit

Microtransit can play a role in formulating multi-modal transportation. The convenience of microtransit and other on demand services can appeal to various market sectors dependent on the transit agency's objectives and business model. Additionally, several pilots have aimed to increase public transit equity. Since microtransit services provide a flexible option to underserved areas, transit agencies often deploy them to improve cost-effectiveness of transit-service provision and to expand services to underserved areas (e.g., low-density areas). Implications of these initiatives include meeting transportation demand in underserved geographic areas, reducing roadway congestion of single occupancy vehicles, improving operational efficiency, and reducing costs for users and transit agencies.

Microtransit pilot projects range in their geographic and demographic context. While some aim to delineate inequity in urban centers, others may provide connectivity in suburban, underserved low-density areas. These distinctions are important as they may create a variation in business models, operational budgets, and outreach strategies.

2.1.2 Recent Trends in Transit Use

The national transit ridership, both in total counts and on a per-capita basis, has been declining since 2014 (Figure 2-1; Higashide & Buchanan, 2019). In 2017, bus ridership was down 5.2 percent from 2016, and down 11 percent from 2007, reaching its lowest point since 1990 (Hughes-Cromwick, 2019).

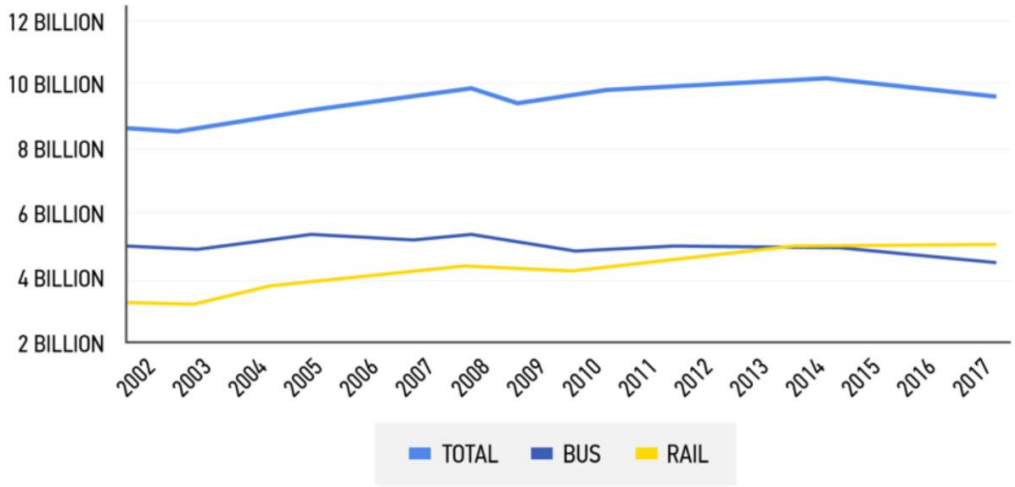


Figure 2-1: Total Transit Ridership over Time (Unlinked Passenger Trips) (Higashide & Buchanan, 2019, National Transit Database)

While transit has been on a nationwide decline, Florida has seen ridership declines two times greater than the average nationwide (Polzin & Godfrey, 2019). At the same time, transit agencies are not necessarily eliminating services. Between 2013 and 2017, twenty-two Florida transit agencies expanded their services, but only five experienced a collective increase in ridership (Polzin & Godfrey, 2019). This means that most of the transit agencies have expanded operations but have experienced decreased ridership. Potentially influential factors may include an overall steady decrease in zero-vehicle households, while vehicle miles travelled by single occupancy vehicles increased between 1 and 5 percent annually (Polzin & Godfrey, 2019).

Some Florida transit agencies have begun experimenting with on-demand transit and mobility as a service. For example, from 2013 to 2017, St. Lucie County experienced a 31 percent growth in both service and ridership (St. Lucie County Public Transit, 2018). The Direct Connect After Hours program is an initiative in St. Lucie County directed to increasing ridership. The agency is now developing microtransit services for the entire county as well as fare-free transit options (St. Lucie County Public Transit, 2018). In 2020, the Treasure Coast Connector On-Demand microtransit service to connect riders to the Walmart and Sam's Club shopping center, and CVS (All Things Treasure Coast, 2020). St. Lucie County shows that Florida transit agencies can provide flexible transit options, specifically microtransit services, and that a demand exists for them.

Additionally, other Florida cities have created new transportation programs as well. Seminole County experimented with an Uber partnership that provided discounted services for all in connection to five cities (Schwieterman, Livingston & Van Der Slot, 2018). Royal Palm Beach created a partnership with Lyft to increase mobility within the city limits for older adults (Webb, 2018). Cities across the state have invested in addressing existing mobility issues and future needs. The efficiency of transportation systems is affected by numerous factors such as "accessibility, adaptability, availability, and acceptability" (Cervallos, 2020, p. 11). Therefore, transit agencies need to have a multidisciplinary approach to mobility issues while creating a platform for conversations about equitable transportation within the community.

2.2 The Role of Microtransit among Transportation Modes

2.2.1 What Are People Looking for in Microtransit?

The traditional factors affecting transit ridership are economic factors, gas prices, automobile ownership, as well as the amount, quality, and cost of the transit services (Watkins, McDonald, Steiner & Williams, 2019). In recent decades, ICT-enabled daily utilitarian and recreational activities, such as telecommuting, flexible work schedules, and online shopping are increasingly affecting people's demand and frequency of taking transit. Although public transit has always competed with other transportation modes, new technology-based mobility options, such as ridesourcing and shared mobility, are bringing new challenges to the transit industry. Alternatively, these new mobility options may enhance public transit by facilitating last-mile transit connection (Yan, Levine & Zhao, 2019).

The impact of new mobility services on public transit has created a heated debate. Some believe in the demise of transit, seeing that these innovative transportation services divert trips from transit systems and may eventually replace traditional fixed-route services in all but the highest-volume corridors (Polzin, 2016). Others hold that offering new mobility options renders private-owned vehicles obsolete and enables individuals to choose a car-free lifestyle, which may lead to a resurgence of public transit.

Although no consensus has been reached regarding whether new mobility positively or negatively affects public transit, public transit can potentially make good use of new technologies. Indeed, some transit agencies have been trying to modify their service to accommodate changes in the transportation system. By providing information such as arrival time online through smartphone apps, some agencies allow riders to easily know the details of transit service in real time, thereby mitigating the frustration of not knowing when the next transit vehicle will arrive (Brakewood, Macfarlane, & Watkins, 2015; Ferris, Watkins & Borning, 2010). Transit has benefited from new fare technologies, such as app-based smartcard payment systems, which reduces the burden of fare collection while making it easier for riders to pay for and use transit. Moreover, transit agencies are developing new service types, such as microtransit services. Overall, we see many opportunities where transit can incorporate new technologies to make service more reliable, flexible, efficient, and cost-effective, and where transit and new transportation service providers can work together. There is great potential to integrate different mobility services into the public transportation system to improve mobility for the entire spectrum of users.

2.2.2 Substitution versus Complementarity

The question of whether ridesourcing is a substitute or a complement to public transit does not have a simple answer. As the rise of ridesourcing services (Uber/Lyft) coincides with the decline of transit ridership, many speculate that ridesourcing is attracting transit riders away and thus, they view ridesourcing as a threat to public transit. On the other hand, evidence also exists to support the case that ridesourcing complements public transit.

Various considerations can be made to understand whether ridesourcing poses a threat to public transit. The observations that support it as a complement to public transit suggest that people use ridesourcing for different reasons than public transit (Schwieterman et al., 2018). As such, it is possible to consider that ridesourcing is not in direct competition with transit agencies since the purpose of the travel is generally different from that of public transit. Research provided by the Shared Use Mobility Center found that most ridesourcing trips were social trips and usually took place between 10 PM and 4 AM when transit was infrequent (Westervelt et al., 2018). Beyond supporting the fact that ridesourcing often serves

a different trip purpose, this finding also suggests that ridesourcing trips are addressing a gap in public transit services (Westervelt, Schank, Bradgon, Lewis & Bastian, 2016).

Survey data evaluating Uber services suggest that, “in several cities, 25-40% of all Uber pick-ups and drop-offs are near a public transit station” (Hall et al. 2018, p. 3). Admittedly, Uber representatives acknowledge that there is no further data to support the claim that riders are making rides to connect to public transit when they are dropped off at locations close to transit stops. Hall and his co-authors (2018) argue that riders will substitute ridesourcing trips through Uber, for example, if the service is fast and convenient enough to outweigh the additional cost. The authors continue by citing an example in which people can take public transit early in the evening but return in an Uber late at night because the transit service is less frequent at that time (Hall et al., 2018). This is supported by a survey performed by the Pew Research Center in 2016 that suggests that 9% of those who do not take Uber use public transit, and 56% of those who use Uber also use public transit (Smith, 2016).

Hall and his co-authors (2018) further assert that there is a strong case to support the idea that Uber complements public transit. Using data from the National Transit Database, Hall found a one standard deviation increase in transit ridership, which is equivalent to a 1.38% increase, in correlation with Uber’s penetration to a given agency. Additionally, the effect of Uber seems to increase slowly over time, as they found a 5% increase in transit ridership after two years of Uber’s entry. However, it must be emphasized that Uber created better complementarity in larger cities and for transit agencies with lower ridership prior to Uber’s introduction. Moreover, Hall and his co-authors (2018) found Uber to be a complement to larger rail agencies.

These findings suggest that ridesourcing may be a complement to public transit. While ridesourcing does not seem to be a substitution for public transit, it definitely underscores challenges faced by public transit agencies, particularly in terms of service such as inadequacies during off-peak hours and underserved geographic areas. The fact that transit agencies have overlooked some connectivity issues reflects the reality that they have been “chronically under-resourced” across the U.S. for decades (Kodransky & Lewenstein, 2014). However, there is optimism about the potential of ridesourcing in its capacity to address these issues. The proposal is that ridesourcing can help extend public transit to areas not previously served, or address service gaps in a more cost-effective fashion (Kodransky & Lewenstein, 2014).

The proposal is attractive, considering the reality of under-resourced agencies. For decades, agencies have proposed numerous ideas that have not provided the much-needed spark that TNCs may generate. The proposal is not one-sided. Uber officials, for example, understand that to be able to make use of revenue sources, partnerships with public transit agencies can be mutually beneficial, and the capacity for this is becoming clear (Westervelt et al., 2016). The idea of complementarity has been discussed extensively and has led to various approaches, particularly in terms of developing partnerships that we discuss further below.

For all the optimism drawn by consideration of complementarity, cases also exist where TNCs have shown a potential threat to transit agencies and the services they provide. In 2014, Lyft Line and Uber Pool were launched as services that provided carpooling services as dynamic routes were created according to the demand of people going in similar directions (Westervelt et al., 2018).

In 2017, Lyft began operating a fixed route service in San Francisco and Chicago called Shuttle, with a fixed price that was demand responsive (Westervelt et al., 2018). Riders

would hail the service through the app and would then move to the designated pick-up area at the appropriate time. Traditionally, fixed route services have been provided by public transit agencies, but this new idea invokes the possibility of replacement of transit services if it proves to be successful and cost effective. In another example, an on-demand shuttle service provider, Chariot, would identify areas of critical need by reviewing demographics and public opinion, among other data, and would create fixed routes in said areas to address these concerns (Westervelt et al., 2018). Before the company was bought out in 2019 by Ford Smart Mobility, LLC, Chariot employed a route planning process that was in no way dissimilar to that of many transit agencies.

The capacity for substitution is tangible, but the reality of substitution can be limited. While the privately-provided services are attractive, they can only be provided to those who can afford them. Therefore, when transit services are adequate, transit riders are likely to stick with using transit due to its low costs. In fact, a 2017 report of a survey performed by the University of California, Davis suggests that people choose ride-hailing over public transit because transit services are too slow or they travel at times passengers don't travel, further supporting the fact that perceived service gaps are significantly influential in passengers' mode choice (Westervelt et al., 2018). Moreover, Westervelt et al. (2018) argues that because ridesourcing services are private, there is an understanding that they are not directly advocating for public concern in the same way public transit agencies and municipalities do, ensuring in part that essential services remain delegated to public transit agencies.

Nonetheless, in 2017, substitution of public transit became a reality for a Canadian suburb. Innisfil, Ontario went from providing public transit to paying for Uber rides. Citizens would reserve a ride through the app and the municipality would pay up to $5 in subsidies. Rides to public institutions such as libraries or community centers were further discounted at a flat rate of $3. The added benefit to riders is that this service, on top of being publicly subsidized, also carried all the benefits of being on-demand, adding to the appeal of convenience. An audit of their program demonstrates that the cost of subsidizing Uber rides for citizens was significantly more cost effective than providing fixed route bus service (Schwieterman et al., 2018). Where it directly cost an estimated average of $33 per passenger trip to operate buses, it only cost an average of $5.62 per passenger trip to subsidize Uber trips (Schwieterman et al., 2018).

The capacity for TNCs to be a substitute for public transit seems to be contingent upon two major factors: cost effectiveness in relation to traditional public transit services, and the need to address service gaps. However, in either case, it seems that substitution can be more of a benefit than a harm. This is true because many agencies currently face severe budget constraints that in turn disallow proper remediation of service gaps. Whereas the suspicion about the capacity of TNCs to replace public transit has at times been misconstrued as a direct targeting of said agencies, the reality has been very different, both in cases of complementarity and substitution. Additionally, the suspicion about competition is further degraded by the fact that TNC services are not providing their services at a price that matches that of public transit agencies: "The median minimum for an Uber fare is $5, while transit fares average just $1" (Hall et al., 2018).

The key to address the capacity for substitution or complementarity is to understand the nature of TNCs in relation to the public transit agency. A Pinellas Suncoast Transit Authority (PSTA) wanted to develop an effective relationship between TNCs and various agencies. They felt it was important to understand TNCs as tech and marketing companies, and not strictly as transportation companies (Westervelt et al., 2016).

Across the U.S., a new wave of opportunity has swept through public transit agencies in an unprecedented manner, in the form of partnerships between transit agencies and TNCs. “As recently as late 2015, partnerships between public bodies and TNCs were largely nonexistent. By early 2018, more than two dozen were underway” (Schwieterman et al., 2018, p. 2). Partnerships have established mutually beneficial collaborations between public transit agencies and TNCs. Central to these partnerships is the recognition that the potential for complementarity between agencies and TNCs has mutually beneficial rewards; above all, the much hoped for revitalization of public transit agencies seems to be at hand. This section explicitly reviews partnerships of TNCs that are exclusively providing ridesourcing services, namely Uber and Lyft, since these have been more common.

In a recent publication for the Chaddick Institute for Metropolitan Development at DePaul University, Schwieterman et al. (2018) provided extensive work in understanding the various partnerships that exist across the US. Their analysis of partnerships describes these programs as addressing or achieving one of five categories of goals: 1) incentives that encourage connections between transit and rideshares, 2) an effort to combine transit and rideshares in a single app, 3) addressing parking issues, 4) addressing paratransit and other services for specific individuals, and 5) indirect sharing of data aimed to improve transportation overall (Schwieterman et al., 2018).

Schwieterman et al. (2018) further divided the first category of partnerships that dealt with incentives to encourage connections between transit and rideshares into three groups: a) programs that provide discounts between all points in an area, b) programs that provide discounts for trips on and off peak hours, and c) programs that provide discounts only during off-peak hours (Schwieterman et al., 2018). Table 2-2 summarizes the various types of partnerships.

Undeniably, the transformation that can be perceived in mobility is due to the rapid advancement of technology. Considering that TNCs have focused on integrating new forms of technology into their services, the Transportation Research Board recommends that policy makers and regulators attempt to incorporate some of the systems TNCs have implemented into the existing transportation networks (Westervelt et al., 2016). This recommendation has spurred innovation in public transportation, but overall, has motivated a will to understand how this affects people and their decisions to try new alternatives to the existing approaches to mobility. Concern for access to some of these new alternatives are also centered on the provision of technology in more public settings. For example, Westervelt et al. (2016) recommend the implementation of mobility hubs to address equity issues with those who do not have access to the technology. RTS has developed solutions to implement these hubs as part of their ten-year TDP discussed later in this document.

Currently, however, most MOD services are provided through some applications. The interface is designed to address services that have historically been provided on-site at locations designated by transit agencies, typically at stations or onboard modes of transit. One of these services is fare collection. In a time where methods of payment are as easy as the click of a button on a smartphone, the popularity of MOD services can be attributed in part to the convenience of the in-app payment experience. Implementation of tech-enabled fare collection will be essential and will require an upgrade of current payment technology

Table 2-2: Typology of Partnerships between Ridesharing Operators and Public Bodies

Program Type	Programs in this Category	Example of Large-Scale Program in Category
1. Programs that broadly encourage TNC/transit connections or enhance mobility in areas poorly serviced by transit	*Group A: Discounts between all points* Altamonte Springs - Sanford, FL* Dublin, CA Monrovia, CA	**Monrovia, CA** offers $0.50 flat rate fares on all Lyft trips that start and end within city boundaries.
	Group B: Discounts for particular trips during both peak and off-peak times Austin, TX Centennial, CO* Charlotte, NC Dublin, CA Dayton, OH Marin, CA Philadelphia, PA* Phoenix, AZ* St. Petersburg, FL San Clemente, CA Tacoma, WA Vallejo, CA	**Austin, TX** offers free RideAustin trips within its Exposition Zone, home to many tech workers.
	Group C: Discounts for particular trips only at off-peak times: Detroit, MI St. Petersburg, FL Tacoma, WA	**Detroit, MI** provides $5 fare reductions on weekday Lyft rides to/from its 53 Woodward corridor between midnight and 5am.
2. Programs to develop smartphone apps that encourage combining transit and ridesharing	Dallas, TX Denver, CO Los Angeles, CA Portland, OR	**Portland, OR's** TriMet has fully integrated Lyft service options into its "RideTap" search tool.
3. Programs to address parking shortages or to forestall the need for more investments in parking	Bend, OR* Boulder, CO* Sacramento, CA* Summit, NJ	**Summit, NJ**, offers $2 Lyft trips to/from its commuter-rail station for parking permit holders.
4. Programs providing service to seniors or alternatives to conventional paratransit service	Boston, MA Las Vegas, NV Royal Palm Beach, FL	All seniors and travelers with disabilities in the **Boston area** receive a limited number of discounted TNC rides per month.
5. Specialty programs that *indirectly* promote transit use or transit improvements	Cincinnati, OH San Diego, CA Tacoma, WA Washington, DC**	The "iCommute" program in **the San Diego area** allows residents to periodically request a rideshare or taxi home in case of illness or emergency.

**Program no longer active.*
*** Program not yet in effect; discussions ongoing.*

Source: Schwieterman et al., 2018: 3.

at many transit agencies (Westervelt et al., 2016). However, most transit agencies are still relying on traditional cash payments (and many also accept credit or debit cards at designated areas) in exchange for tickets. However, this can limit the potential of users who wish to be able to pay for services through the convenience of their smartphones.

Beyond this, a surge in the capacity for multimodal trips has created an interesting set of circumstances. Suddenly, individuals are presented with the capacity to complete their trips using any one of the new shared mobility options, or a combination thereof, in a manner that adequately addresses connectivity concerns. The addition of carsharing, bike sharing, scooter sharing, and microtransit, in almost a single stride, has gained popular support worldwide (Yan et al., 2019). These forms of shared mobility have been able to capture, match and serve the demands of consumers while appealing to convenience, flexibility, and

cost-savings in real time and on the basis of individual need. Moreover, the capacity to summon various modes of transportation through a smartphone application is the main factor of convenience that has allowed for its use (Yan et al., 2019).

Partnerships are not foreign in this particular approach either. “A few partnerships are supported by apps that allow travelers to see both public transit and TNC routing options through a single search mechanism” (Schwieterman et al., 2018, p.8). In addition to the convenience of using the smartphone, further convenience is being considered in the form of a single app that can display numerous services in one place. These apps are associated with the term MaaS, which has the capacity to formulate various mobility options, multimodal combinations, real-time visualization of transit and single payment through one app (Yan et al., 2019). Providing a single platform to access every mobility service has been captivating for both customers and mobility service providers, both public and private, since the coordination of mobility in a single manner allows for ease of transaction, planning and decision making. In addition to providing the best possible routes and combinations of modes to achieve this goal, some MaaS products allow for customization. Customers can add their schedules, desired modes, and other personalized settings to provide for the optimal, multimodal option.

Nonetheless, there are concerns in terms of how MaaS can affect public transit. On the one hand, services traditionally provided might be reduced to fixed-route services in high-density areas; however, public transit agencies would be the only entity on any given MaaS app that operated a variety of transportation modes (Yan et al., 2019). Great promise is dynamically intertwined with great uncertainty. In such a short period of time, public transit agencies have had to rethink mobility and meet a new standard, effective in the new decade, while at the same time needing to solve long-standing concerns related to funding, coverage, and equity.

2.2.3 Examples of Pilot MOD Programs

These kinds of questions will continue to be evaluated as great concern and detail is needed to create optimal systems of mobility. One major effort can be seen from the Federal Transit Administration (FTA). They are funding research that can help understand how public transit can be combined with rapidly emerging tech through the MOD Sandbox Program. The program aims to improve mobility options through technologically facilitated multimodal applications. In their Fiscal Year 2016 report, FTA lists various programs to which $7,931,080 in research funds were distributed. Table 2-3 displays the distribution of funds for individual projects, the goals and main features.

Table 2-3: Distribution of Federal Funds from the Sandbox Program			
Agency	**Goals**	**Main Features**	**Amount Received**
Regional Transportation Authority of Pima County, AZ	Transit ridership Growth, Congestion Mitigation	In-app payment, shared platform for mobility companies, real-time traveler information system	$669,158
Valley Metro Rail, Inc., AZ	Multimodal trip planning	In-app payment, shared platform for mobility companies	$1,001,000
City of Palo Alto, CA	Multimodal Trip Planning, agency planning methods, congestion mitigation	Shared platform for mobility companies, commute trip reduction software, parking rebates, analytics for commuting comparison	$1,085,000
Los Angeles County Metropolitan Transportation Authority, CA	FMLM solutions	Rides from transit station	$1,350,000
San Francisco Bay Area Rapid Transit, CA	Multimodal trip planning, Transit ridership growth	Identification of ADA customers, in-app parking reservations, carpool ridesourcing	$358,000
Pinellas Suncoast Transit Authority, FL	Paratransit solutions	Payment options, central dispatch software, shared platform for mobility companies	$500,000
Chicago Transit Authority, IL	Multimodal Trip Planning	Shared platform for mobility companies, bikesharing options	$400,000
Tri-County Metropolitan Transportation District, OR	FMLM solutions, multimodal trip planning	Shared platform for mobility companies, data sharing, live information system	$678,000
Dallas Area Rapid Transit, TX	FMLM solutions, Multimodal trip planning	In-app payment, shared platform for mobility companies	$1,204,000
Vermont Agency of Transportation, VT	FMLM solutions, paratransit solutions, rural trip planning	Shared platform for mobility companies, live information system, statewide trip planner system	$480,000

Table 2-3: Distribution of Federal Funds from the Sandbox Program			
Agency	**Goals**	**Main Features**	**Amount Received**
Pierce County Public Transportation Benefit Area Corporation, WA	FMLM solutions, regional trip planning, multimodal trip planning	Shared platform for mobility companies, service hour extension, service equity	$205,922
Source: Prepared by research team			

Virtually all current projects being funded by the FTA have focused on providing different variations of MaaS in their MOD partnerships. It is important to recognize that MaaS is a tool that can be integrated dynamically into MOD partnerships. Most partnerships also focus on integrating multiple modes of transportation into one app, mostly to address FMLM issues, increase transit ridership significantly and in turn, reduce congestion. In-app payment and the convenience of live information systems are cited as features of projects across the board.

Interesting innovations that could bear great implications on the future of mobility include Vermont's Agency of Transportation rural transportation planning. Granting some levels of accessibility across the entire state, especially in generally inaccessible rural areas, can provide great connections to improve mobility to residents across the state.

Additionally, the Bay Area Fair Value Commuting Demonstration in the City of Palo Alto, California seemed to bear great promise in understanding the applications of a variety of software that can analyze transit trends as they occur. The two software programs showcased allowed agencies to analyze commuter trends and possibilities. Additionally, parking is addressed, along with the common multimodal mobility platforms that are being adopted and explored at agencies. The Palo Alto project seems to be comprehensive and has the capacity to provide more clear solutions to potential transit issues.

2.3 The Equity Implications of Microtransit Services

Public transit agencies are often charged with meeting the equity goal of serving the needs of people with limited mobility options. Thus, when debating how incorporating new technology-based mobility services can enhance public transit, one should consider how these services can facilitate transportation accessibility for disadvantaged travelers. While microtransit may help fill gaps in the urban transportation system, it may not benefit all populations equally. Notably, some are concerned that these new mobility services may be less accessible to rural residents and the transportation disadvantaged populations, including older adults, individuals with disabilities, and low-income populations (NASEM, 2016; Moran, Ettleman, Stoeltje, Hansen & Pant, 2017). Several aspects of equity issues are summarized in this section.

2.3.1 Equity Issues Related to Microtransit Services

2.3.1.1 Technology Barriers

The use of technology-based mobility services often requires smartphone apps and payment by a debit or credit card. Some transportation-disadvantaged populations may be deterred from these services because they are not able to access or have trouble using these technologies due to their financial or physical conditions. Some low-income people may not have a smartphone, a data plan, or a bank account. Older adults may have difficulty in operating applications on a smartphone and thus may prefer a desktop computer. Individuals with disabilities, such as those with visual impairment, may find their needs to arrange travel have not been met yet by the existing features and functionality of smartphone apps (Simek et al., 2018).

2.3.1.2 Reduced Transit Services

Some transit agencies are cutting underperforming transit lines and replacing them with new mobility services such as ridesourcing. While this may increase the efficiency of transit systems and save the operational budget, it may leave some highly transit-dependent customers further behind. As mentioned above, low-income populations and individuals without bank accounts may be excluded from the new mobility services because of the technology barriers and potential transportation-cost increases. Thus, if the on-demand ride services replaced the conventional fixed-route, fixed-schedule transit services, this essentially means taking away the essential transportation services that these individuals rely on.

2.3.1.3 Geographic Disparity

Private companies tend to operate in markets where customer demand is greatest. Existing research shows that a majority of the new mobility customers are younger, have higher levels of education, earn higher incomes, and live in dense urban areas such as downtown core neighborhoods (Grahn, Harper, Hendrickson, Qian & Matthews, 2019; NASEM, 2018). Transportation disadvantaged populations living in rural areas tend to have a greater need for convenient on-demand ride services since rural areas usually have limited public transit, are less walkable, and have fewer concentrations of activities and public amenities. However, these private, for-profit companies lack the incentive to address the inequality of service provision (Kuhr, Bhat, Duthie, & Ruiz, 2017).

2.3.1.4 Lack of Equipped Vehicles and Medically Trained Drivers

Serving disadvantaged populations is often not the priority of the private technology-based transportation enterprises such as TNCs. TNCs do not offer wheelchair-accessible vehicles in many markets, and they rarely have the capability to accommodate electric wheelchairs and scooters (Daus, 2016). Although ADA regulations apply to the partnerships between transit agencies and TNCs if federal funds are involved, to ensure quality, equity, and timeliness of the services represents a challenge. For example, TNC drivers may not be sensitive to the needs of older adults and individuals with disabilities, and they may lack understanding of the specific implications of various disability conditions (FTA, 2018). Additionally, transit agencies have found it extremely difficult to provide an equivalent response time for a customer who needs an accessible vehicle (NASEM, 2019).

2.3.1.5 Potential Discrimination and Difficulties in Service Monitoring

Because of their physical conditions, older adults and individuals with disabilities can possibly suffer from discrimination, and there is evidence that new mobility services operate with some racial bias (Cohen & Cabansagan, 2017). This situation has caused concerns about service unreliability. For those who need a ride to receive health treatment or go back home after treatment, any late pickups or vehicles that never show up could negatively affect or even indirectly cause serious damage to the customers' physical health. Hence, it is necessary for transit agencies to assure service monitoring and play the role of guardians to prevent the service providers from harming or taking advantage of vulnerable populations. However, without data sharing, transit agencies cannot observe the real-time performance of the TNC services and may not be able to monitor service quality and equity.

2.3.2 Advantages and Challenges of Microtransit in Achieving Transport Equity

Equity issues that have been discussed above are partly due to the "private, for-profit" nature of most of the new technology-based transportation companies. This leads to a call for agency-owned microtransit to fill in system gaps in public transportation and solve the equity issues, including ADA concerns, geographic disparity, and data sharing problems as mentioned above. As an example, consider the RTS microtransit program in the city of Gainesville since 2019. The program aims to achieve transportation equity by supporting low-income populations who live in a geographically dispersed area who are not easily served by conventional public transit. To better serve the transportation disadvantage populations, all routes are wheelchair accessible. Because this service is provided by RTS and the fleet is also agency-owned, it is much easier for the transit agency to organize and coordinate different transportation subsystems to ensure that services are provided equally for the transportation disadvantaged as well as the general public.

Microtransit services are generally distinct from the services provided by TNCs. However, some private companies, such as Via, who operates as a TNC, also operates microtransit services. Many public transit agencies partner with TNCs to provide microtransit services where the fleet is owned by the latter. Although some microtransit programs have aimed to increase transportation equity by providing out-of-span services or serving underserved geographic areas, challenges still exist in meeting the travel demands of the transportation disadvantaged population.

2.3.3 Opportunities for Microtransit to Improve Transportation Equity

Transit agencies have opportunities to improve the use of transportation technologies by addressing the unaccommodated needs of those who are left out by new mobility services.

2.3.3.1 Public Engagement in Service Design and Improvement

Public engagement is especially valuable for transportation programs that target older adults, individuals with disability, and low-income populations. It is critical to expand efforts to get these populations and communities involved in the service planning and design process as early as possible to ensure solutions respond to their needs and concerns. It would also be a benefit to have human service agencies involved in the process, considering that these agencies serve a target population and have better knowledge and a closer connection with individuals with special mobility needs. Thus, the feedback of engaged populations reached through public outreach could serve as a valuable resource to properly shape the program design throughout its life cycle (FTA, 2018).

2.3.3.2 Coordination with Existing Services

Microtransit programs launched and administered by transit agencies should work in concert with other transit services, including complementary paratransit, to improve the overall mobility in an area. Transit agencies should also coordinate with human service agencies that also provide transportation services. Technically, a full range of services should be integrated into a central call center or a trip planning app that can make it easier for users to choose their service type and improve transit agency operational efficiency as well (FTA, 2018). From the financial perspective, when transit agencies evaluate transit routes and other new mobility alternatives, they should make sure that the subsidy structure accounts for the affordability of low-income customers and try to keep fares from increasing over current fares (Cohen & Cabansagan, 2017).

2.3.3.3 Addressing Technology Barriers

Transit agencies need to address technology barriers that may exclude unbanked populations and people without smartphones from using microtransit services. For the trip request, a dispatching platform should be developed so that a call center employee can book and monitor trips for customers (FTA, 2018). Providing low-income populations with a limited-capacity loaner smartphone can also address barriers to accessibility. As for the fare payment, transit agencies should allow unbanked users to pay using pre-paid debit or gift cards. In the long run, it would be more convenient if customers could deposit cash into a smart fare card that could be used to pay for multiple types of services (NASEM, 2019).

2.3.3.4 Marketing and Travel Instruction

Compared with private sectors, public agencies have better resources to communicate with a wider base of older adults, individuals with disabilities, and low-income populations. They should make sure that their outreach materials are truly accessible to the transportation disadvantaged to collect users' opinions, inform them of the service's availability, and clearly explain the service content. For example, conducting an on-line survey or investing in web-based timetables only works for users who have access to the internet, whereas in-person surveys or printed timetables are more useful to users who have limited access to the internet (Mokhtarian & Tal, 2013). In addition to marketing, travel instructions and training are also necessary to educate potential users about the services and to encourage their usage. Human service agencies could provide instructions and training and work closely with people who need special attention and assistance (FTA, 2018).

3 Data Collection and Analysis

3.1 Review and Analysis of Microtransit Programs in Other Transit Agencies

Microtransit uses on-demand technology, public or private sector investments, consumer demand, and flexible routing systems to create more accessible, and often, multi-modal transportation systems (Volinski, 2019). Because microtransit is a relatively new concept, its broader technological, social, and economic implications are still being explored. At the same time, this type of program offers an opportunity for transit agencies to serve a market that is difficult to serve.

It is important to understand what limitations different regions in Florida face in running a reliable and efficient microtransit service. Several cities across the country have looked at microtransit services as the next mobility revolution that could fill in this established gap in the provision of public transportation. The current report provides some examples of microtransit pilot programs for mid-size cities that are comparable to the city of Gainesville (Table 3-1). Each of these cities is discussed and considered in relation to the system currently operating in East Gainesville.

Table 3-1: Cities with Microtransit Programs

City, State	Size of Services	Program Partners	Years Active	Available Funding
Albany, NY	97,889	TransLoc	2020-2021	CDTA and TransLoc (De Socio, 2020)
Worcester, MA	185,195	Via	2020-2021	MassDOT grant, WRTA (Via Mobility Services, 2020)
Carlsbad, CA	113,670	RideCo, WeDriveU	2019-2020	NCTD, San Diego Association of Governments, City of Carlsbad (Diehl, 2020)
Antioch, CA	110,730	TransLoc, then Via	2019-2021	Tri Delta Transit (Tri Delta Transit, 2020)
Pinellas County, FL	975,280	Uber, Lyft, United Taxi, Wheelchair Transport	2016-2021	FTA Accelerating Innovative Mobility (Pinellas Suncoast Transit Authority, 2020)

Source: Produced by research team

Reviewing the policies of different cities and transit agencies provides a foundation for understanding the current level of service. The studies provide context for solutions that consider the financial and political aspects as well as introducing the possibilities of public-private partnerships.

3.2 Understanding and Documenting the Role of Microtransit in East Gainesville

The research team used several different methods of data collection and analysis to understand the operations of the Gainesville microtransit and the perceptions of residents in the neighborhood about the service. We used the following forms of data collection that are described in detail below: trip data from RTS (including origins and destinations), interviews with community leaders, surveys completed by community members (both users and non-users of the service), a review of the existing Transit Development Plan (TDP) and the data used in preparing those plans, and a geospatial analysis of possible areas for expansion.

The primary data used for the analysis presented is the microtransit ridership data obtained from RTS. These data provide the following details for every trip made using the microtransit system over three, four-month periods of time (Spring, Summer and Fall 2020): (1) latitude and longitude of the trip start and end locations, (2) trip start and end times and (3) source of trip booking. A screenshot of the dataset for a few trip records is shown in Figure 3-1 below. In Appendix A, we include a monthly summary of the trip data we received from the RTS.

A	B	C	D	E	F	G
origin_latitude	origin_longitude	origin_timestamp	destination_latitude	destination_longitude	source	completed_at
29.63529879	-82.28034396	2020-02-03 05:30:00.000 UTC-5	29.6460019	-82.3227094	rider_microtransit	2020-02-03 05:56:51.000 UTC-5
29.63520087	-82.28044622	2020-02-03 05:30:00.000 UTC-5	29.6640539	-82.3008303	rider_microtransit	2020-02-03 05:50:37.000 UTC-5
29.64414588	-82.27175586	2020-02-03 05:56:47.000 UTC-5	29.6460019	-82.3227094	rider_microtransit	2020-02-03 06:14:23.000 UTC-5
29.6460019	-82.3227094	2020-02-03 06:05:00.000 UTC-5	29.6377982	-82.3255375	rider_microtransit	2020-02-03 06:09:31.000 UTC-5
29.6422978	-82.272905	2020-02-03 06:15:00.000 UTC-5	29.6460019	-82.3227094	dispatcher	2020-02-03 06:19:27.000 UTC-5
29.6422978	-82.272905	2020-02-03 06:30:00.000 UTC-5	29.6337025	-82.3153744	dispatcher	2020-02-03 06:42:07.000 UTC-5
29.6383566	-82.30071735	2020-02-03 06:30:00.000 UTC-5	29.64179789	-82.3094165	rider_microtransit	2020-02-03 06:34:25.000 UTC-5
29.6378849	-82.3036601	2020-02-03 06:40:00.000 UTC-5	29.6460019	-82.3227094	dispatcher	2020-02-03 06:45:25.000 UTC-5
29.63529205	-82.31670985	2020-02-03 06:41:40.000 UTC-5	29.6460019	-82.3227094	driver	2020-02-03 06:45:24.000 UTC-5
29.6422978	-82.272905	2020-02-03 06:55:00.000 UTC-5	29.6487924	-82.3019641	rider_microtransit	2020-02-03 07:59:50.000 UTC-5
29.6317072	-82.2690909	2020-02-03 07:00:00.000 UTC-5	29.6460019	-82.3227094	dispatcher	2020-02-03 07:32:13.000 UTC-5
29.6535756	-82.2709963	2020-02-03 07:00:00.000 UTC-5	29.6471583	-82.2708903	dispatcher	2020-02-03 07:11:43.000 UTC-5
29.6389891	-82.3049992	2020-02-03 07:00:00.000 UTC-5	29.6455157	-82.3091521	dispatcher	2020-02-03 06:57:24.000 UTC-5
29.6460019	-82.3227094	2020-02-03 07:00:00.000 UTC-5	29.6202293	-82.2820643	rider_microtransit	2020-02-03 07:04:16.000 UTC-5
29.63211791	-82.28250984	2020-02-03 07:00:30.000 UTC-5	29.6471583	-82.2708903	rider_microtransit	2020-02-03 07:41:45.000 UTC-5
29.6422978	-82.272905	2020-02-03 07:00:34.000 UTC-5	29.6460019	-82.3227094	rider_microtransit	2020-02-03 08:08:22.000 UTC-5
29.6317072	-82.2690909	2020-02-03 07:01:00.000 UTC-5	29.6460019	-82.3227094	dispatcher	2020-02-03 07:32:17.000 UTC-5
29.64116	-82.304147	2020-02-03 07:03:16.000 UTC-5	29.6455157	-82.3091521	dispatcher	2020-02-03 07:26:49.000 UTC-5
29.6539978	-82.2666683	2020-02-03 07:05:00.000 UTC-5	29.6471583	-82.2708903	dispatcher	2020-02-03 07:11:43.000 UTC-5
29.6379099	-82.3000233	2020-02-03 07:10:00.000 UTC-5	29.6455157	-82.3091521	dispatcher	2020-02-03 07:26:49.000 UTC-5

Figure 3-1: Screenshot of Trip Dataset (Source: RTS, 2020)

3.2.1 Interviews with Community Leaders

The research team began the interview process by inviting local officials and community leaders to participate. The goal of the interviews was to understand attitudes about the microtransit services, its role in transportation choices in the community, how the service improves reliability and accessibility for the community, and the long-term plan for the services. The primary list of interviewees was created using snowball sampling from areas within, or in close proximity to, the microtransit boundaries using Geographic Information Systems (GIS) and Google Maps. The interviews started with contacts to city commissioners and then continued based on snowball sampling to ensure a diversity of persons interviewed. The research team interviewed people in different professional categories from city commissioners and previous city appointees to executive directors of grassroots organizations. In sampling the interviewees, three main factors were considered: (1) interviewee's level of knowledge about microtransit services; (2) their potential connection to East Gainesville communities; (3) their previous experiences with city or grassroots

organizations in Gainesville. The persons interviewed represent a diversity of perspectives and a group of people who are knowledgeable about microtransit in East Gainesville.

During the interview period, 14 were completed, with 6 male and 8 female participants. The profession of the interview participants can be found in the following table (Table 3-2). Community leaders were specifically chosen as a way to get an overall view of microtransit in Gainesville and to discover how to distribute surveys in a socially-distant manner.

Table 3-2: Interview Participant Demographics

Demographic Characteristic	n (%)
Gender	
Male	6 (43.3)
Female	8 (57.1)
Profession	
City/County Officials	5 (35.7)
Healthcare	1 (7.1)
Retail	1 (7.1)
Previous City Appointees	2 (14.3)
Other Elected Officials	1 (7.1)
Non-Profit Coordinator	3 (21.4)
Faith-based Organization	1 (7.1)
Table created by research team	

COVID-19 and social distancing policies complicated the initially proposed procedure on data collection. However, we were able to modify our approach and still gather the necessary data by using virtual interviews (via Zoom) with community leaders and local officials as well as self-administered surveys for microtransit users and nonusers. Through snowball sampling, we were able to focus on interviewees who were knowledgeable about microtransit services, who were connected to East Gainesville communities, and who had experience with city or grassroots organizations in the area. This gave us a diverse set of perspectives to represent the broader community. The period for interviews was extended to fit the schedule of participants who are actively engaged in the community. We had trouble scheduling interviews due to other conflicts, including the November election and the Christmas and New Year's holidays. The interviews were conducted between September 2020 and February 2021.

3.2.2 Surveys of Users and Non-Users

The second step of data collection included surveys of residents in the neighborhood, including microtransit users and non-users. The participants for the surveys were identified via the businesses surrounding the established microtransit zones, as well as distribution by researchers at the stops and on the routes (Figure 3-2). The surveys were available on paper and were posted online using Qualtrics, allowing us to reach more of the community. Distributing paper surveys was particularly important in this area because U.S. Census data identified many low-income residents, which could potentially indicate lower ownership of smartphones or access to high-speed internet.

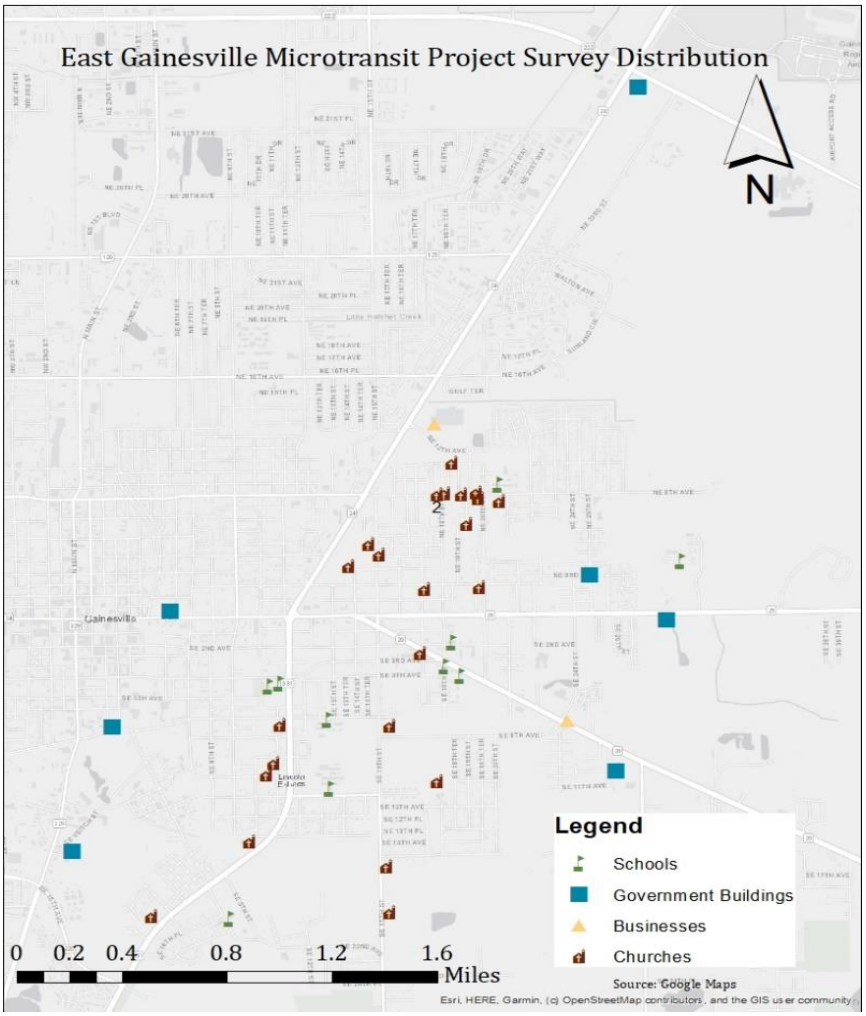


Figure 3-2: East Gainesville Survey Distribution Map. Created by research team.

At the beginning of the survey, respondents were asked to indicate if they had ever used microtransit. Depending upon their response, they then completed a three-part survey. For all survey respondents the first and third part were the same; they described travel behavior and patterns (first part) and demographic information (third part). For the second part, the survey of users asked questions about the microtransit service, and demographic information. For non-users, the middle portion of the survey featured five questions that evaluated the non-users' knowledge of available services. The surveys were set up in this way to compare the travel patterns and demographics of users and non-users and to more easily allow for further analysis.

The paper and online surveys featured identical questions. Each survey totalled four pages: a cover letter, a consent form with qualifying questions, Survey A (user survey), and Survey B (non-user survey). Because the survey could not be administered in person, 500 paper surveys were printed for distribution. The paper survey allowed the research team to reach a broader audience. It could be used by participants with limited access to smartphones or other internet-enabled devices, and it could be placed in locations throughout the community. Each paper survey also included a return envelope with prepaid postage.

The research team initially submitted the interviews and surveys to the UF IRB approval before the COVID-19 pandemic. After it became evident that the original approach would be implausible because it required face-to-face contact, the team redesigned the survey to be self-administered for users and non-users. This protocol was developed based on IRB guidelines and submitted as a revision to the original project to the UF IRB (IRB-02) by adapting to remote survey distribution. Part of the interview portion of this project included an extensive discussion with four of the drivers for the microtransit program. This discussion facilitated further survey distribution because the drivers were able to provide the best locations to contact the system users.

3.2.3 Review of Data and Reports of Regional Transit System

The Florida Department of Transportation requires an update of the TDP every five years to cover a ten-year span. In 2019, RTS released the 2020-29 TDP for the Gainesville metropolitan area (City of Gainesville, 2019). The RTS TDP includes baseline conditions, peer and trend analysis, transit demand assessment, goals, and initiatives, and a 10-year finance plan for transportation investments. This report reviewed elements of that plan for their relation to microtransit and other applicable data.

In February 2019, as a part of their community outreach for the TDP, RTS conducted an onboard usage and evaluation survey with about a quarter of RTS's fixed-route transit users. The onboard survey was completed via tablet as researchers approached riders and asked for participation. In the process of conducting these onboard surveys, a separate attitudinal and service evaluation survey was distributed through a website and QR code. After the responses were reviewed, the tablet part of the onboard survey generated 2,400 usable results while the service evaluation survey had 941 participants. A subsequent online survey was also open to the public from April to June of 2019 that generated over two hundred responses (City of Gainesville, 2019). The results included a profile of the population currently accessing RTS services and the recommendations on how to expand to other groups. The online survey gave an indication of user perspective on general RTS services and the most prominent issues in need of addressing.

3.2.4 Analysis of Opportunities for Expansion of Microtransit in Gainesville

In the process of creating recommendations for the Gainesville area, a spatial analysis was conducted to outline specific geographic spots for expansion of microtransit throughout the service territory of Gainesville's RTS. In this analysis, all attribute maps were reduced to small pixels with values corresponding to each demographic the pixels represent. Those values were between one and five, five being the least desirable value, and were assigned using the natural breaks method in the data. The outcome is the result of applying the raster calculator tool that added all the values corresponding to each area in the 11 attribute maps. Each separate MOD zone was analyzed for characteristics such as mobility patterns, demographics, and estimated transit trip times. After considering these characteristics, the zones were ranked from low to high in their comparative needs for expansion.

4 Lessons from the Microtransit Pilot in Gainesville

4.1 Overview of East Gainesville and Its Population

4.1.1 Population characteristics

East Gainesville's population largely consists of racial minorities. The microtransit boundary falls under three census tracts in East Gainesville. The microtransit zones do not cover these

census tracts exactly, so the data is not exact in the percentage of the residents cited for each characteristic. According to the five-year estimates from the U.S. Census Bureau's American Community Survey, approximately 25% of the population within the areas served by microtransit lives below the poverty level. The population of microtransit pick-up zone includes most of the Black population (72%), with the remaining population identifying as White or as various other minorities (Table 4-1) (Figure 4-1). One part of the identified area has 34.4% of the population below poverty (Figure 4-2), compared to the 2019 national poverty rate of 10.5%.

Regarding tenancy, the microtransit zones exist in two census tracts, one with 50% of the occupied housing as owner-occupied and the other with 58% as seen in Figure 4-3. For personal vehicle ownership and access, Figure 4-4 shows one census tract has 5% and 15% of the other of the occupied housing in these zones are without any sort of private automobile access.

Table 4-1: Percentage of Black Population in Microtransit Pick-Up Zone

Boundary	Total Population	Estimated Black Population	Percentage of Black Population
Alachua County	265,443	53,278	20.8
City of Gainesville	188,197	45,256	23.8
Microtransit Pick-Up Zone	16,120	11,560	72.0

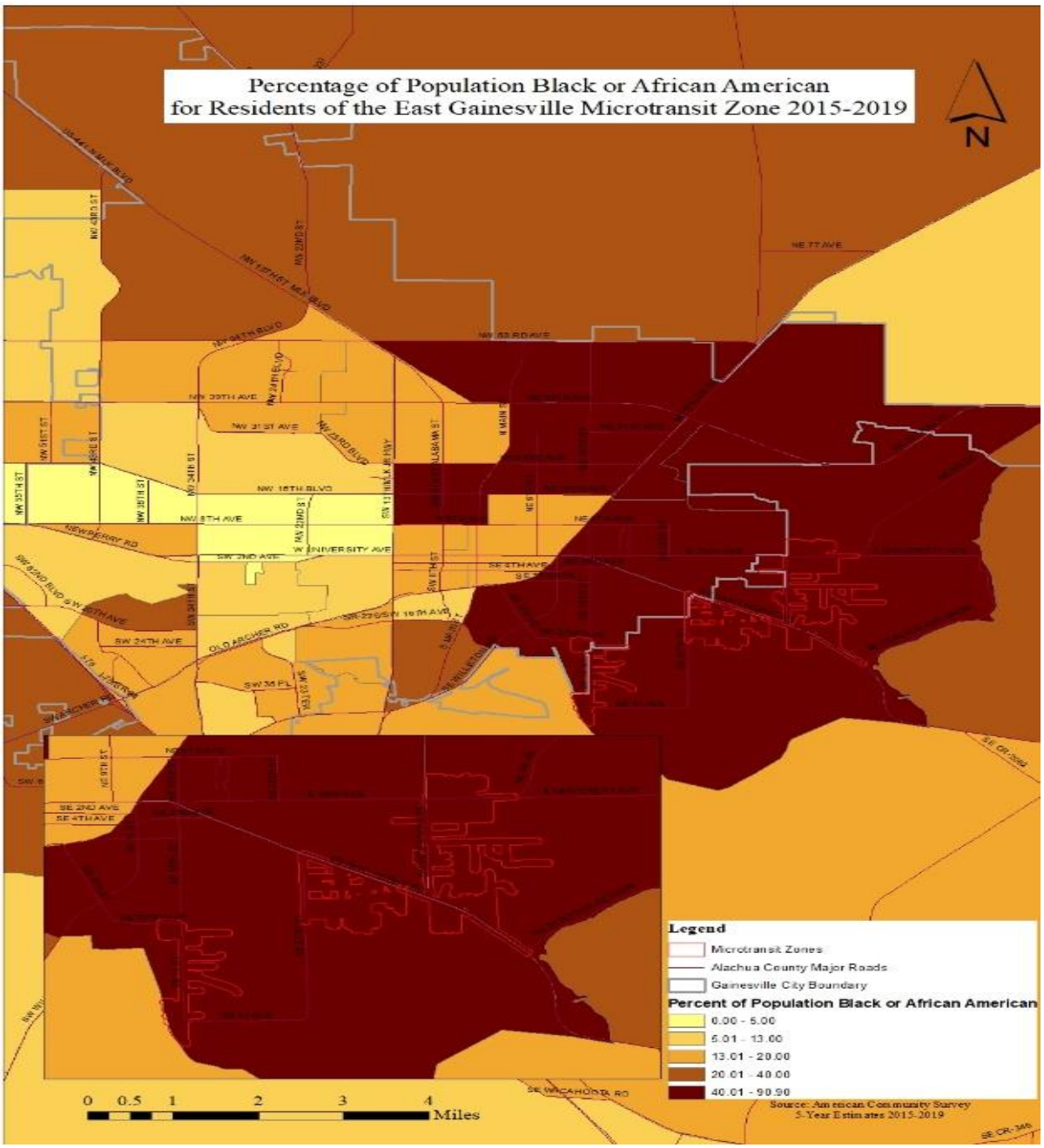


Figure 4-1: Microtransit Demographic Map: Race. Created by research team.

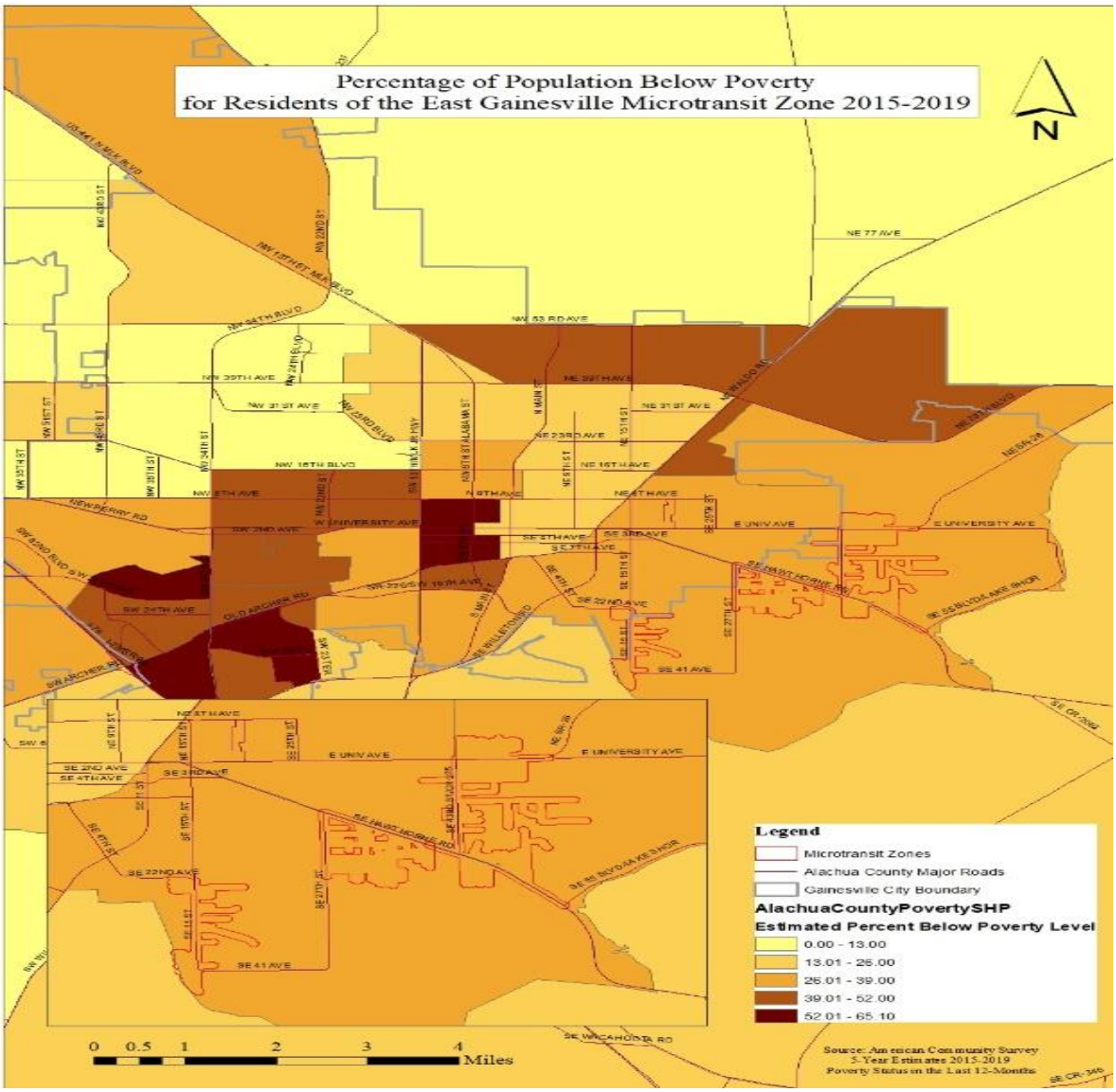


Figure 4-2: Microtransit Demographic Map: Poverty Level. Created by research team.

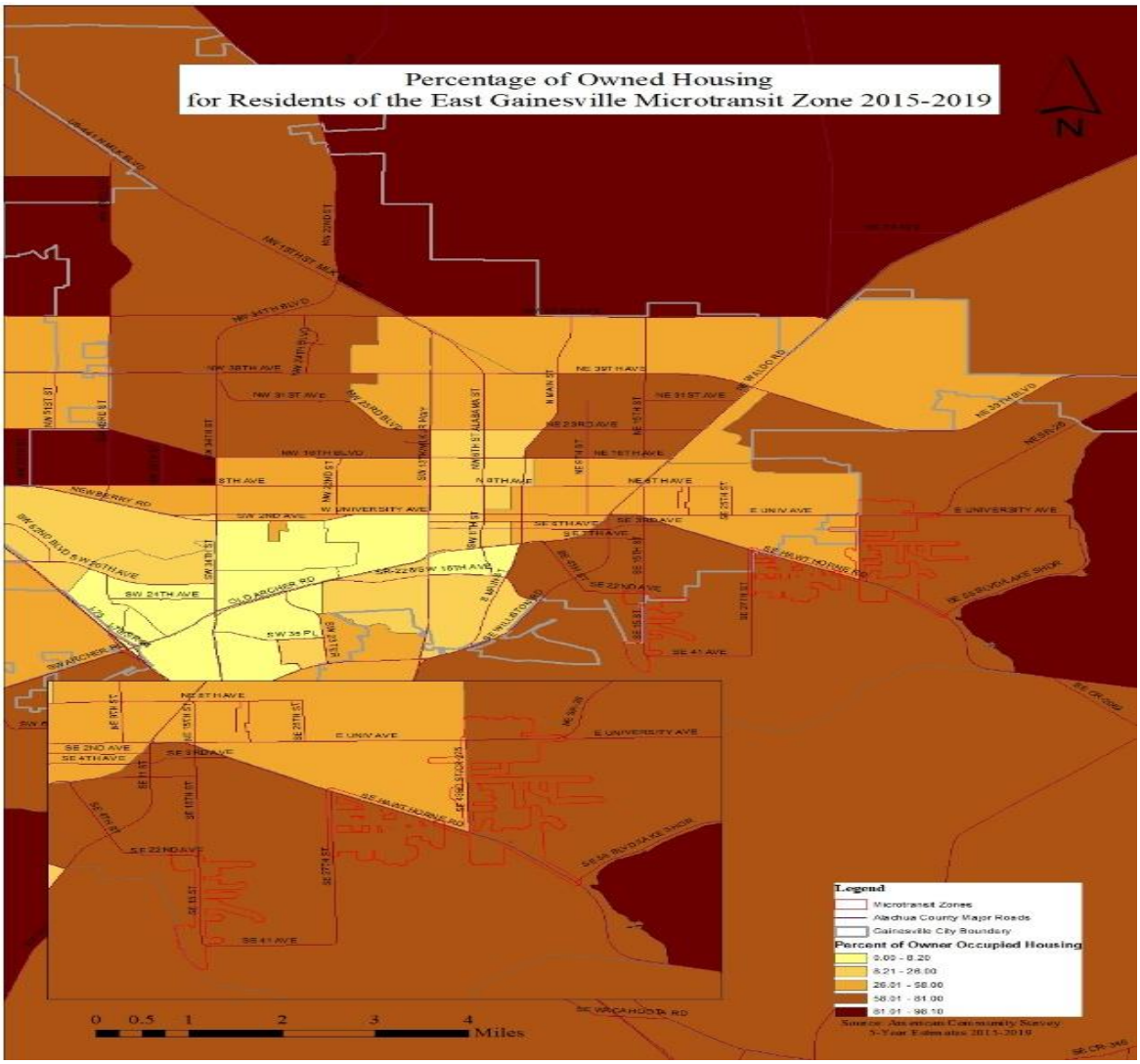


Figure 4-3: Microtransit Demographic Map; Tenancy. Created by research team.

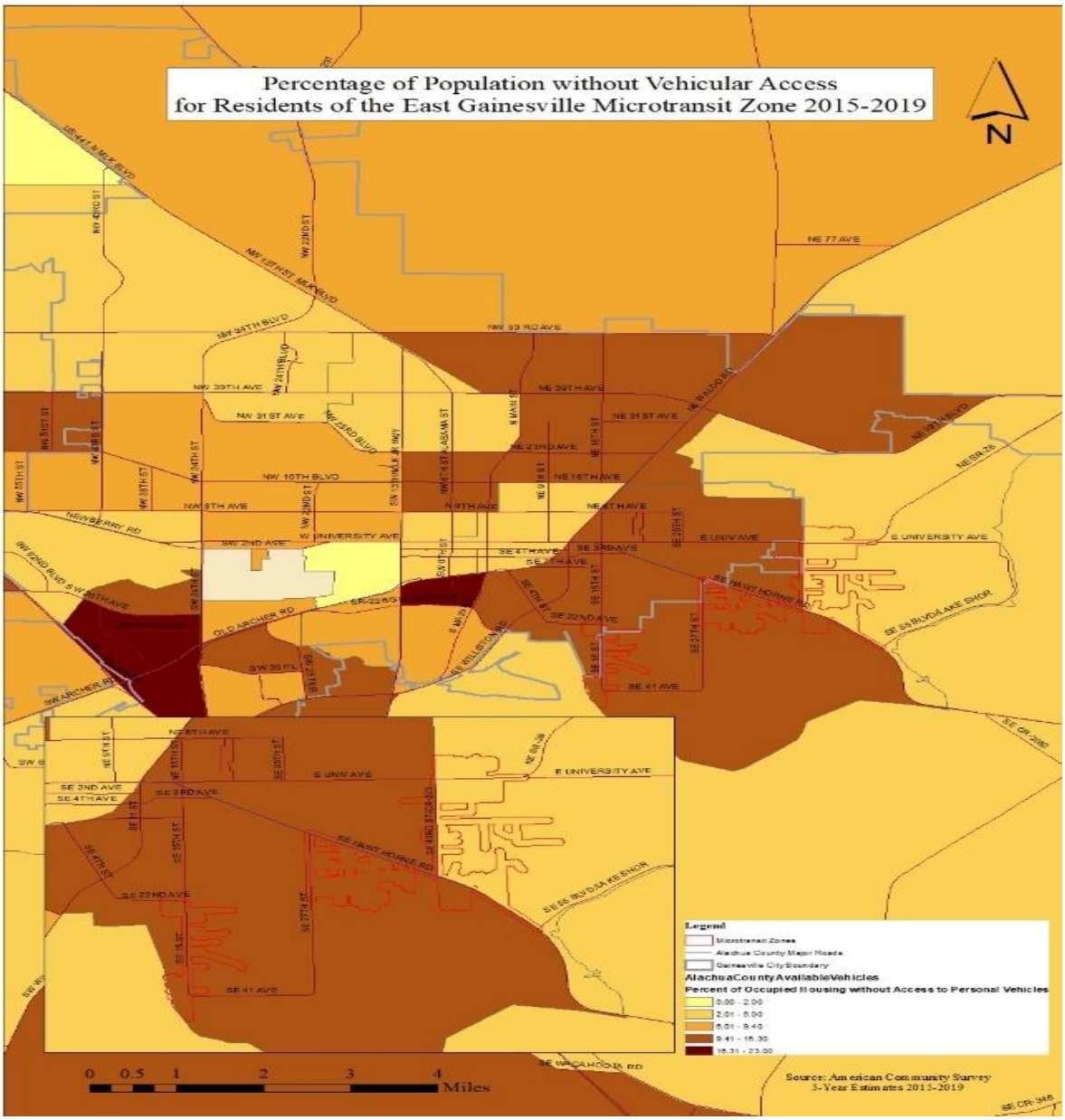


Figure 4-4: Microtransit Demographic Map; Personal Vehicles. Created by research team.

The research team made a comparison between East Gainesville and other parts of the city based on the Center for Disease Control and Prevention's (CDC) social vulnerability index (SVI). This index tracks 15 social factors such as poverty, lack of vehicle access, and crowded housing, and then groups them into four interrelated themes (CDC, 2021). The SVI score ranges from 0 to 1, with 1 showing the highest vulnerability. As is shown, a considerable portion of East Gainesville has a higher SVI compared to the rest of the city (Figure 4-5). The darker blue areas shown in the map have an SVI ranging from 0.7549 to 0.9213, which indicates a high level of vulnerability compared to the central and western parts of Gainesville. As the SVI considers transportation/housing, socioeconomic inequality, household composition, race/ethnicity, and language as main categories, this comparison provides an example of how vulnerable East Gainesville communities are when it comes to external forces that impact their overall health and wellbeing.

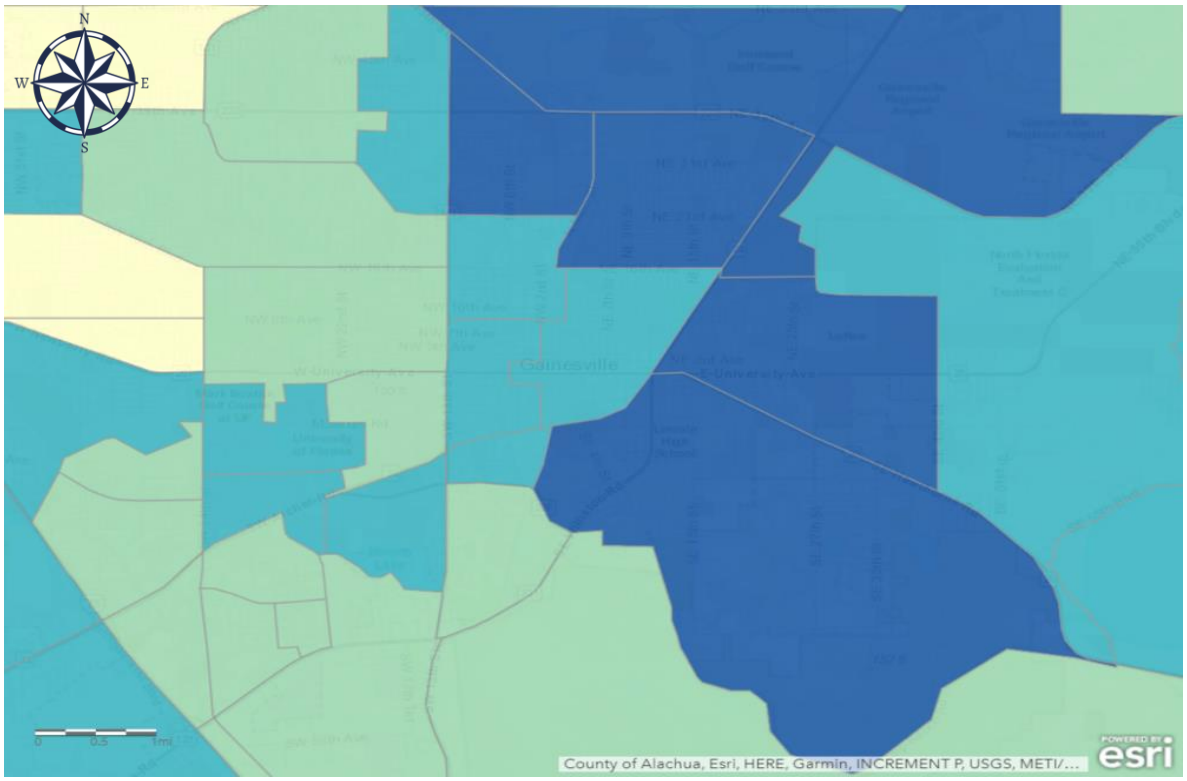


Figure 4-5: Social Vulnerability Index for Gainesville. Retrieved from: County of Alachua ESRI.

4.1.2 Existing Transit Service (fixed-route, fixed-schedule)

4.1.2.1 Existing RTS Transit Service

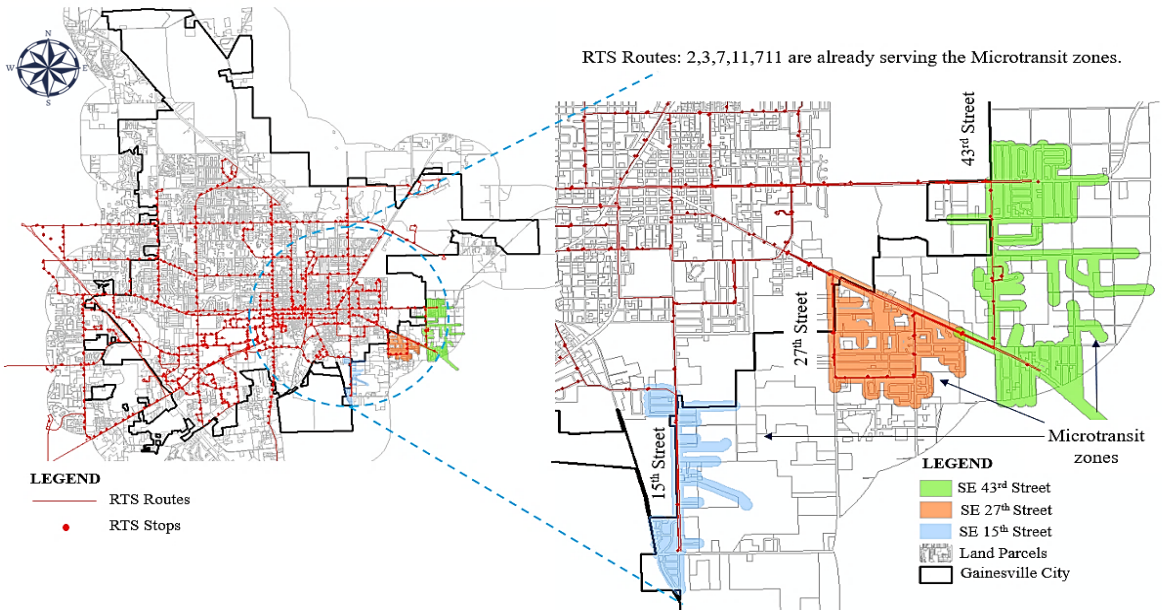


Figure 4-6: RTS Routes and Microtransit Service Zones

Figure 4-6 displays the current existing routes and the microtransit service zones. East Gainesville is characterized by predominantly low-income neighborhoods. The fixed-route bus routes that serve East Gainesville are shown in Table 4-2, below. The weekday morning and evening frequencies of the buses on all of these routes are low (one per hour on average) on weekdays.

Table 4-2: Routes Serving East Gainesville

Route ID	Name	Start Time	AM Frequency	PM Frequency
2	Rosa Parks to NE Walmart Supercenter	5:33 AM	One per Hour	One per Hour
3	Rosa Parks to North Main Post Office	9:30 AM	One per Hour	One per Hour
7	Rosa Parks to Eastwood Meadows	6:00 AM	One per Hour	One per Hour
11	Rosa Parks to Eastwood Meadows	5:30 AM	One per Hour	Two per Hour

Route ID	Name	Start Time	AM Frequency	PM Frequency
711	Rosa Parks to Eastwood Meadows	8:00 PM	NA	One per Hour

Most of the land parcels in East Gainesville fall well within a quarter mile buffer of these routes (Figure 4-6). A quarter-mile buffer around a transit stop is often considered a reasonable catchment-area for transit systems. Thus, the spatial coverage of these fixed-routes services within East Gainesville is arguably effective. However, they do not provide direct connections to many critical destinations within the city such as UF, Butler Plaza and Oaks Mall (Table 4-2). To be connected with the rest of the city, riders need to make a minimum of one transfer at the Rosa Parks Downtown Station, one of the major transfer stations in the system. Thus, the utility of microtransit services is not only for the trips that are confined within East Gainesville but also for connecting residents to the Downtown station point, where they can board bus services to destinations throughout the City.

The timeframe of ridership analysis for this project was the year 2020, which was also the year the COVID-19 pandemic substantially impacted transit ridership all over the world. Correspondingly, there has been a decline in the monthly route level ridership for all the routes operating in Gainesville in 2020 compared to the previous years of 2018 and 2019. Percentage decline in ridership for each month and for every route was calculated using following formula:

$$\% \text{ Decline in Monthly Ridership} = (X-Y)/ X *100$$

where:

X = Average of monthly ridership in 2018 and 2019

Y = Monthly ridership in 2020

Figure 4-7 below shows the average of percentage decline in ridership (monthly declines averaged between January and November 2020) for all the routes that remained operational throughout the year. All the routes that served East Gainesville (Route ID 2, 3, 7, 11, and 711) had the least average percentage decline in the ridership among the RTS routes in 2020. This again suggests that riders from East Gainesville are more transit dependent (i.e., captive riders) than riders in the rest of the city.

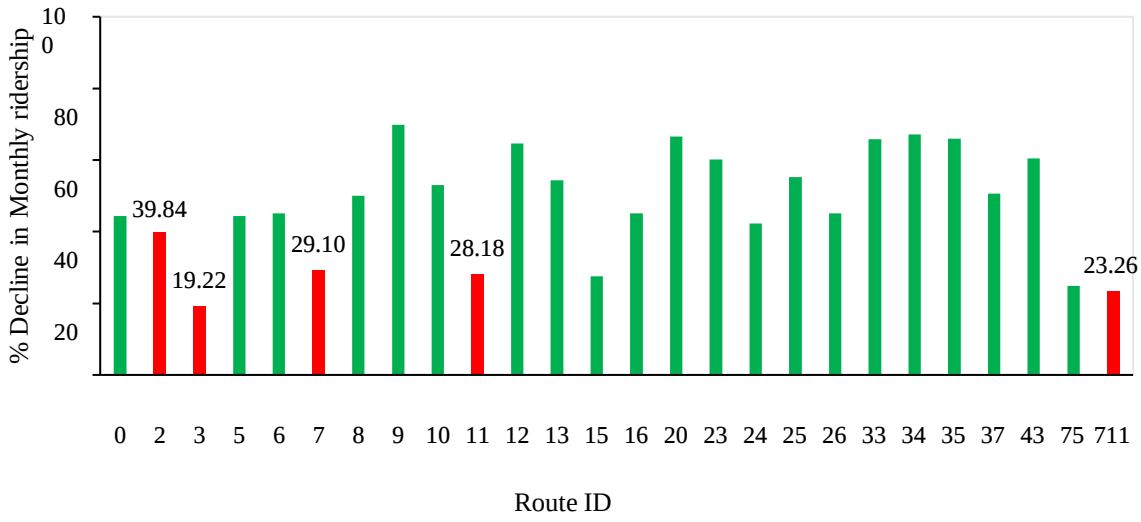


Figure 4-7: Percent Decline in Route-level Ridership

The low frequency and limited service hours of RTS routes serving East Gainesville, the limited connectivity provided by these routes to the rest of the city, and the higher captivity of the low-income residents of this area to the transit system suggest that the microtransit service in East Gainesville is potentially a critical mobility solution.

4.1.2.2 Long Term Planning Review

The purpose of the surveys in the RTS TDP was generally to gauge the public usage of services and to investigate how it could be improved. The numbers showed a strong loyalty to RTS. Many of the participants had used the services for five or more years. Starting with the onboard survey results, they indicated that 16% of riders would not make their trips if RTS was not available. When evaluating the attitudinal survey results, the driver's manner, the directness of the routes, and personal safety were among the highest-rated factors that affected transit users' daily experiences with RTS. Respondents provided the lowest ratings on the availability of shade at bus stops and the punctuality of the drivers.

When they were asked about interest in limited-use premium service, 60% of the participants said that they might use it while 20% said they would use it. The most recommended corridors for expanding services were Archer Road and 13th Street. RTS is also investigating the possibilities of implementing high-capacity service on high traffic corridors in the form of Bus Rapid Transit (BRT) or streetcars (City of Gainesville, 2019).

The surveys introduced key themes related to microtransit and in the broader scope of transportation accessibility. Regarding service availability, the services and information about existing routes were not easily available for a wide variety of transportation users. Additionally, respondents expressed concerns about the lack of effective communication between RTS staff and the public. The participants in these surveys had strong opinions about the role of RTS in the region. When considering the participants in the online survey, 94% indicated their desire to see the city invest more into the expansion of general mobility services. Among respondents, 44.6% thought the cost of these services should be covered by user fees, but 31.9% believed that the services should be free. Approximately three-quarters (73%) of the respondents thought that the travel needs of those without automobiles were not being met, and 86% saw a need for better communication between RTS and the general public on transportation options.


Call 393-RIDE
4378

It is important to consider that, while the TDP states that 25% of rides were properly canvassed, the respondents to the surveys were mainly students or university (UF or Santa Fe) employees. Approximately two-thirds of the respondents in the onboard survey indicated that they used their Gator 1 ID to access RTS ride while 84.8% of the attitudinal survey responded with the same information. Additionally, over 68% of the respondents to the on-board survey were between 18 and 24 years of age. While this may be indicative of the services offered or of biased sampling methods, it could simply represent the more general patterns of RTS patronage which may be concentrated among university students and employees. The RTS ridership is commonly stated as 75% students and 25% residents of the city; it is uncertain whether faculty and staff, who also receive unlimited access to the RTS system, are included with students or as residents of the city.

The TDP further reviewed the areas that are expected to have the highest increase in future development. These are served by key routes – including Routes 6, 15, and 21– for which the plan proposes a doubling in frequency of available transportation. The plan proposes an expansion of transit services on Route 75 to provide consistent 30-minute frequency and to extend the hours of service on this route to 11 PM The surveys provided an insight into riders' and non-riders' concerns and needs, with a general perspective on the consensus for an expansion in East Gainesville, particularly for services to the airport and new connections to the northwestern side of the city. In the 10-year plan, with service improvements, microtransit routes 600 and 601 are recommended to be expanded to match the coverage of route 7 and create a substantial link between local and express services. In the existing plan, microtransit is viewed as an opportunity to reach areas of suburban sprawl and connect them to areas of higher density.

4.1.3 Overview of the Microtransit service

Microtransit service is a type of mobility-on-demand service that is available to the residents of East Gainesville in addition to the conventional fixed-route bus services mentioned in Table 4-2. Microtransit services are available to users from Monday to Friday (weekdays) in the mornings from 5:30 AM to 8:30 AM and in the evenings from 4:30 PM to 7:30 PM The service does not operate on weekends.

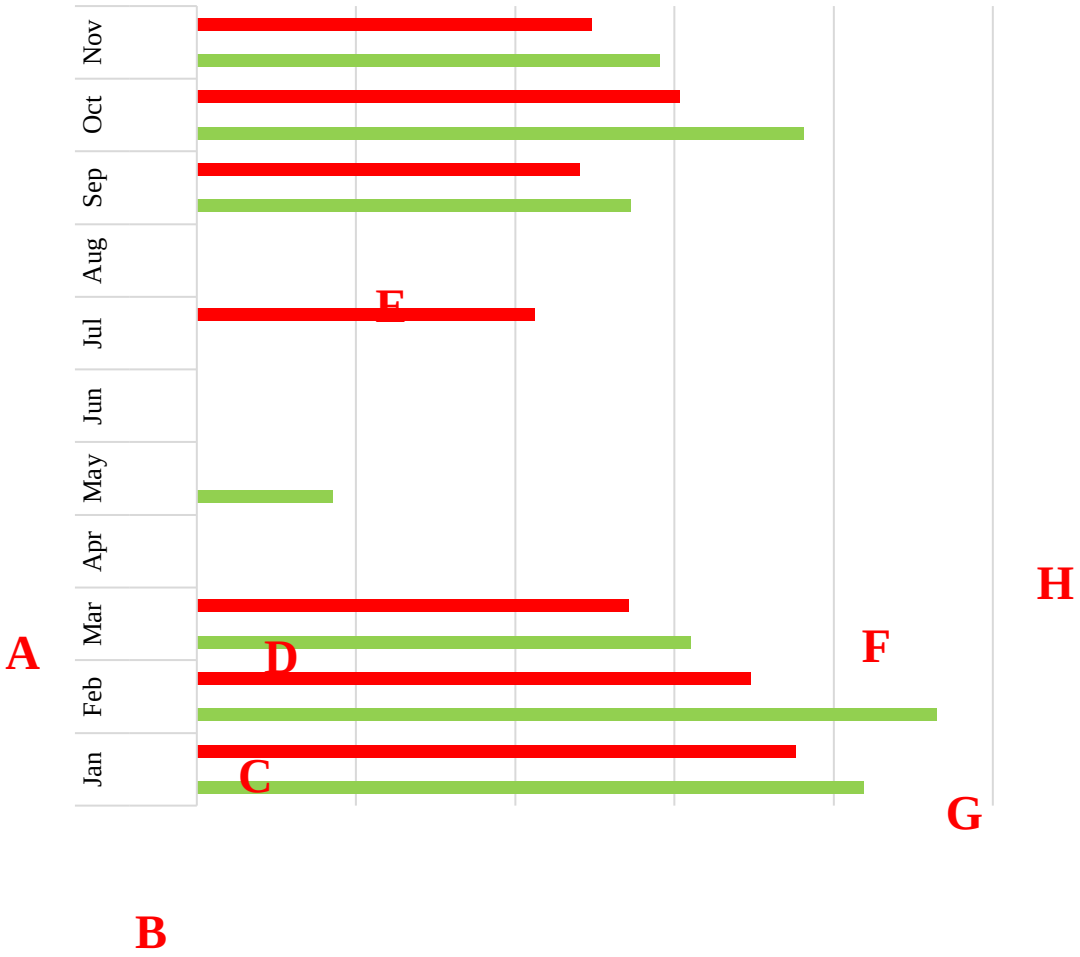
Figure 4-8 below depicts pictures of the shuttles that are used for providing the services. Shuttles have a seating capacity of 12 passengers. However, during the pandemic, social distancing concerns only allowed for 50% of the total seating capacity to be used.

Figure 4-8: Microtransit Service Shuttles. Photos by Juan Suarez.

These services do not have a fixed route and operate more like an open-ended on-demand service. Service routes are flexible on the basis of ride requests made by the riders to board the services. However, the service is designed to cover three service zones (Figure 4-6) that lie in the vicinities of SE 15th Street, SE 27th Street and SE 43rd Street. Three shuttles serve these three zones with one shuttle allocated per zone. Figure 4-9 presents some of the major points of interest or destinations in the eastern part of Gainesville. Based on the analysis of ridership data (shown in subsequent sections) the reader will note that a significant majority of microtransit trips are from/to these destinations.

4.1.3.1 Existing Microtransit Routes

Data on trip start and end times were used to determine the month of the year when the trip was made and whether the trip was made in the morning (5:30 to 8:30 AM) or evening (4:30 to 7:30 p. m.). Figure 4-10 below depicts number of trips that were made in each month starting from January to November 2020. The number of trips are segregated on the basis of morning and evening time slots for each month. The monthly distribution of trips closely matches with the schedule of UF and the Alachua County School System. There are more monthly trips during the Spring and Fall panel as compared to the Summer panel. Except for the month of August, every month had more trips recorded in the morning in the Spring and Fall panel. In the Summer panel, the trend seemed to be reversed; that is, a greater number of trips were taken in the afternoon than in the morning. The decline in ridership from the month of March can be attributed to COVID-19 as shuttles were running at half the capacity due to social distancing recommendations.



LEGEND

A = Rosa Parks Downtown Station

B = Gainesville Housing Authority

C = Lincoln Middle School

D = William Elementary School

E = Walmart Super Center

F = Lake Forest School

G = Eastside High School

Figure 4-9: Major Landmarks in East Gainesville. Retrieved from Google Maps.

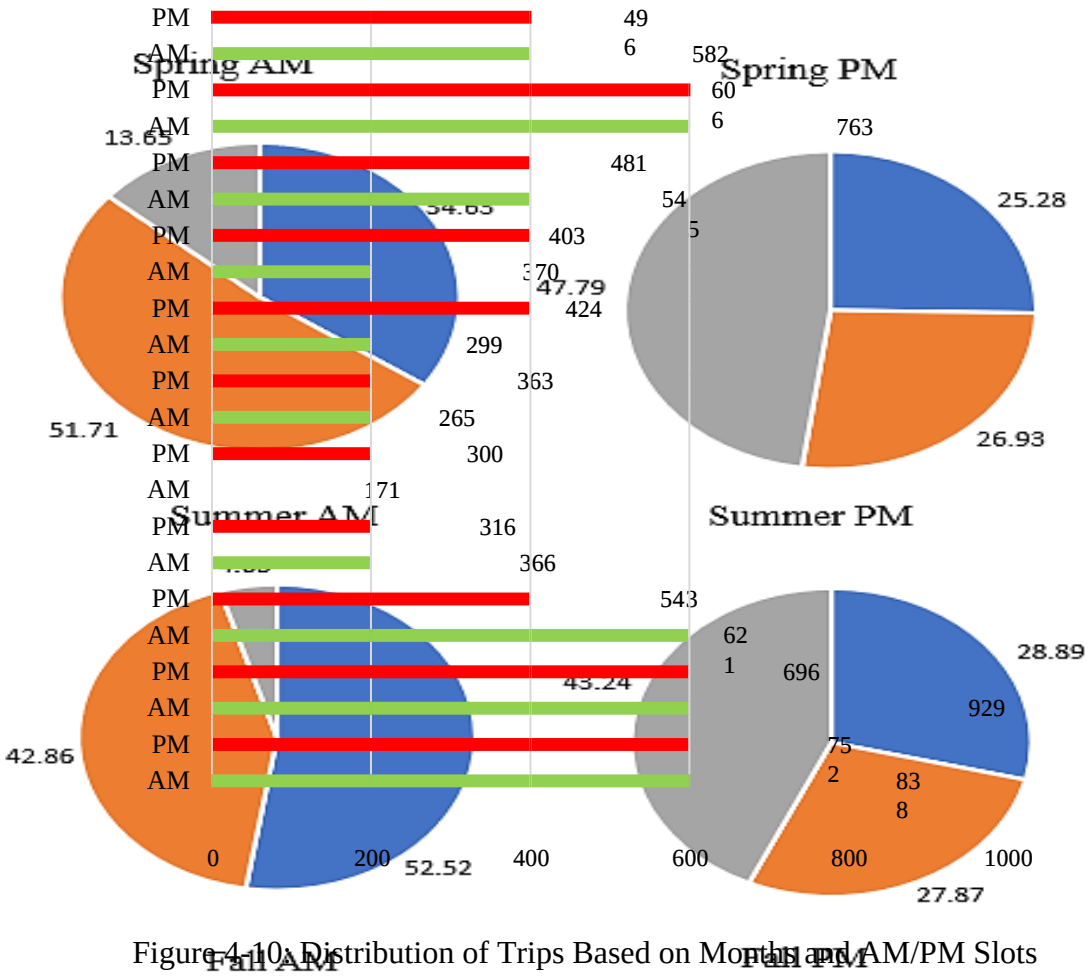


Figure 4-10: Distribution of Trips Based on Months and AM/PM Slots

Services can be booked on an on-demand basis as well as in advance. Riders can use four methods to book a trip: app (mobile based application, Refer to Appendix B for an overview of the app), dispatcher (telephone call), walk-on (hailing from roadside and boarding the service), and rider_web (internet-based platform). In February 2021, RTS discontinued the walk-on method. Figure 4-11 below shows the distribution of percentage of trips based on the source of booking for the morning and evening of the Spring (January-April), Summer (May-July) and Fall (August-November) panels. “rider_web” was the least used choice for trip booking among the users and had negligible number of records in the data (less than 40 trips before April and none since). This choice was removed from further data analysis.

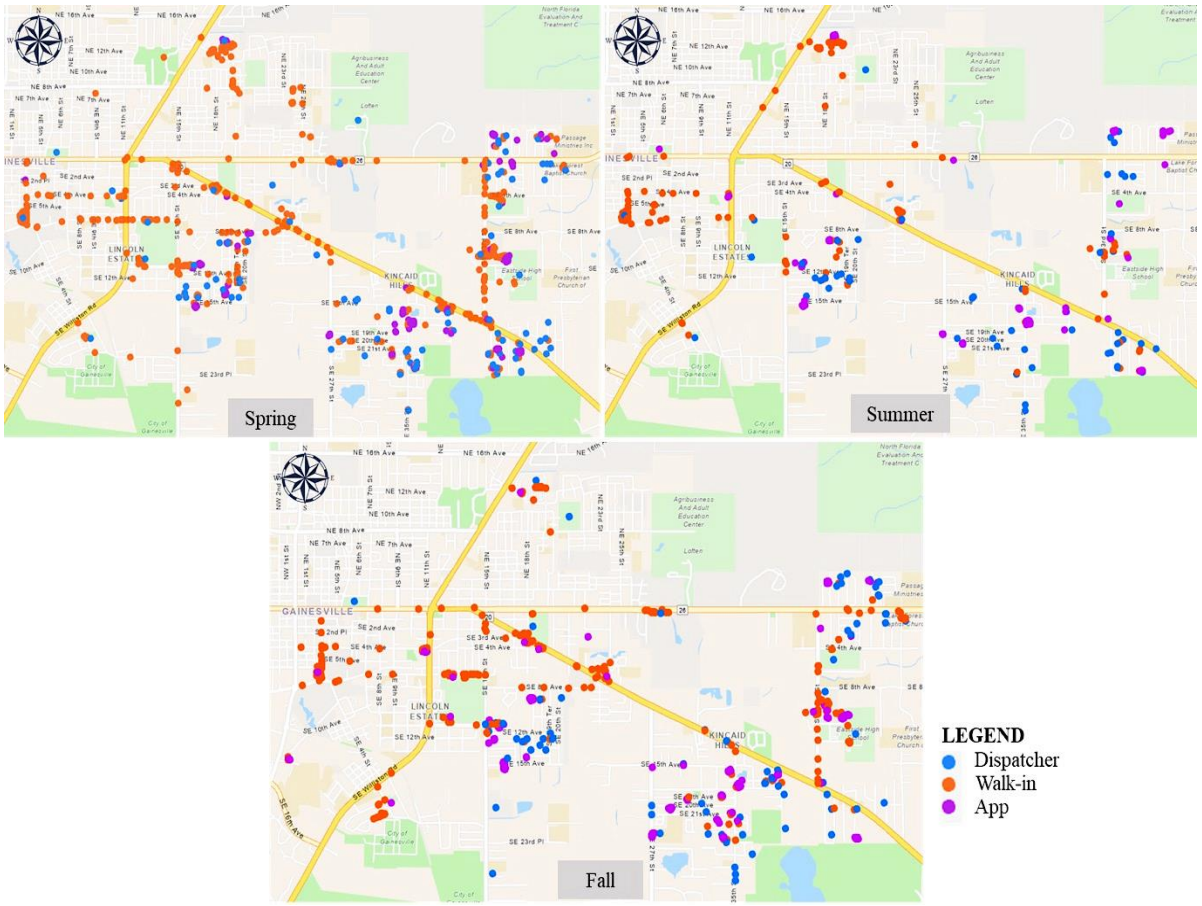

Spring
Summer
Fall
GAINESVILLE
LINCOLN ESTATES
KINCAID HILLS
LEGEND
Dispatcher
Walk-in
App

Figure 4-11: Distribution of Trips based on Source

The charts clearly indicate that walk-on trips are significantly higher in the evening than in the morning, although the overall proportion of walk-on trips have been declining. Correspondingly, the proportion of app and dispatcher-based trips have been increasing in the evening. The proportion of app and dispatcher-based trips are much higher in the morning period with almost 95% of the summer morning trips scheduled via these two channels.

Trips that were booked through different sources were mapped on a GIS platform (Figure 4-11) using the geo-coordinates of the trip's origin. As expected, most of the walk-on trips originated from the major arterials of East Gainesville (orange dots in Figure 4-12). In addition, walk-on trips are also likely to originate at Rosa Parks Downtown Station. Trips that were booked through the app or dispatcher originated from more of the interior locations (possibly residences). It is also interesting to note that the number of walk-on trips originating along the major arterials during the summer months was smaller.

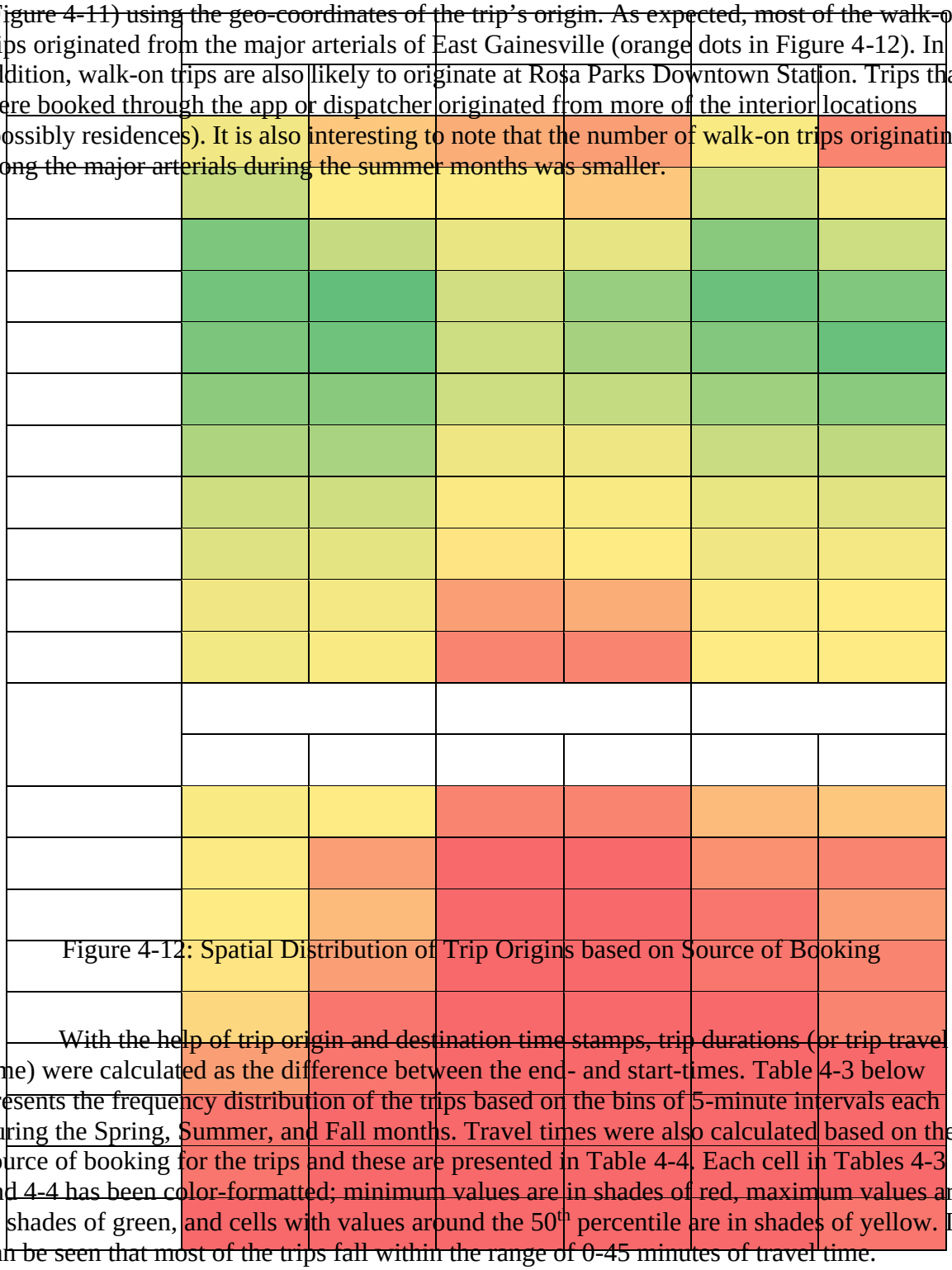


Figure 4-12: Spatial Distribution of Trip Origins based on Source of Booking

With the help of trip origin and destination time stamps, trip durations (or trip travel time) were calculated as the difference between the end- and start-times. Table 4-3 below presents the frequency distribution of the trips based on the bins of 5-minute intervals each during the Spring, Summer, and Fall months. Travel times were also calculated based on the source of booking for the trips and these are presented in Table 4-4. Each cell in Tables 4-3 and 4-4 has been color-formatted; minimum values are in shades of red, maximum values are in shades of green, and cells with values around the 50th percentile are in shades of yellow. It can be seen that most of the trips fall within the range of 0-45 minutes of travel time.

When we completed these calculations, some trips had negative, zero or very high (as high as 75-90 minutes) travel times (Tables 4-3 and 4-4). Also, it is evident from Table 4-4, that such inconsistencies are more frequently observed in the trips that were booked through the dispatcher or the app. Further, there were more inconsistencies in morning trips than evening trips (recall that morning trips are also more likely to be scheduled via app or

dispatcher). Based on discussions with RTS, the following points were identified as reasons for these issues.

Travel time for the trips (particularly those that were booked through app or dispatcher) is the difference between the time when trip was requested and completed. A person who is booking a trip well in advance could be picked up within a15-minute buffer before or after the requested time. For instance, if a person requested a trip at 8:00 AM, he could be picked up between 7:45 AM - 8:15 AM So, if a person was picked up at 7:45 AM and s/he alights at 7:50 AM, then the system will report origin and destination time stamps as 8:00 AM (time when the trip was requested, despite the fact that the passenger now boards at 7:45 AM) and 7:50 AM respectively, thus resulting in negative trip travel time.

Drivers adhere to a hierarchy of trip prioritization based on the trip request method. Trips that are booked through the app are prioritized over the trips that are booked through dispatcher or walk-on trips. Based on the requests that are made through mobile application, drivers decide the direction and route to be followed for the shuttle. Riders who walk on and expect to go in the opposite direction have to travel for longer durations. In addition, the riders who book the trip through the dispatcher at the time of high demand may or may not have to travel for longer durations depending on how well their drop-off location aligns with the direction and route of the shuttle.

Table 4-3 highlights the fact that walk-on trips have shorter travel times compared to the trips that are booked through apps and dispatcher. Figure 4-13 further clarifies this point. The average travel time during both the morning and afternoon is on the lower side for walk-on trips compared to the trips booked through the other two sources. However, it should be noted that for the calculation of average travel time, only trips that have travel times within 10 seconds to 45 minutes were considered.

Table 4-3: Distribution of trips based on Travel Time and Panels

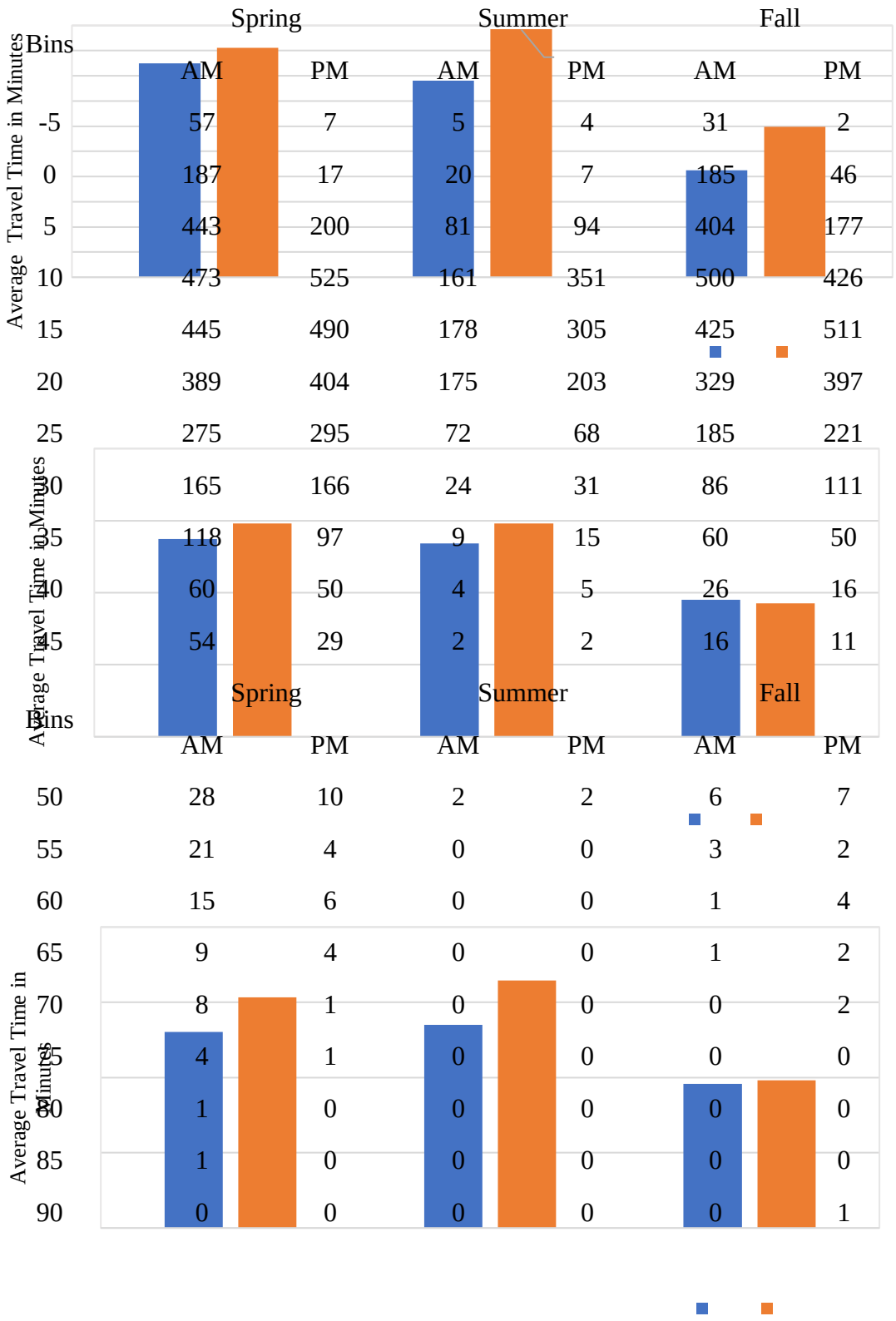


Table 4-4: Distribution of Trips based on Travel Time and Source of Booking

Bins	App		Dispatcher		Walk-in	
	AM	PM	AM	PM	AM	PM
-5	40	11	53	2	0	0
0	164	41	221	27	3	2
5	311	132	419	85	190	254
10	340	255	531	202	256	845
15	487	408	450	397	104	501
20	441	398	403	366	41	240
25	244	217	261	251	26	115
30	110	137	148	132	16	39
35	66	62	114	84	6	16
40	31	32	56	35	3	4
45	30	15	42	22	0	5
50	12	9	24	8	0	2
55	8	1	16	5	0	0
60	3	5	12	5	1	0
65	5	4	5	1	0	1
70	2	1	5	1	1	1
75	1	0	3	1	0	0
80	0	0	1	0	0	0
85	0	0	1	0	0	0
90	0	0	0	1	0	0

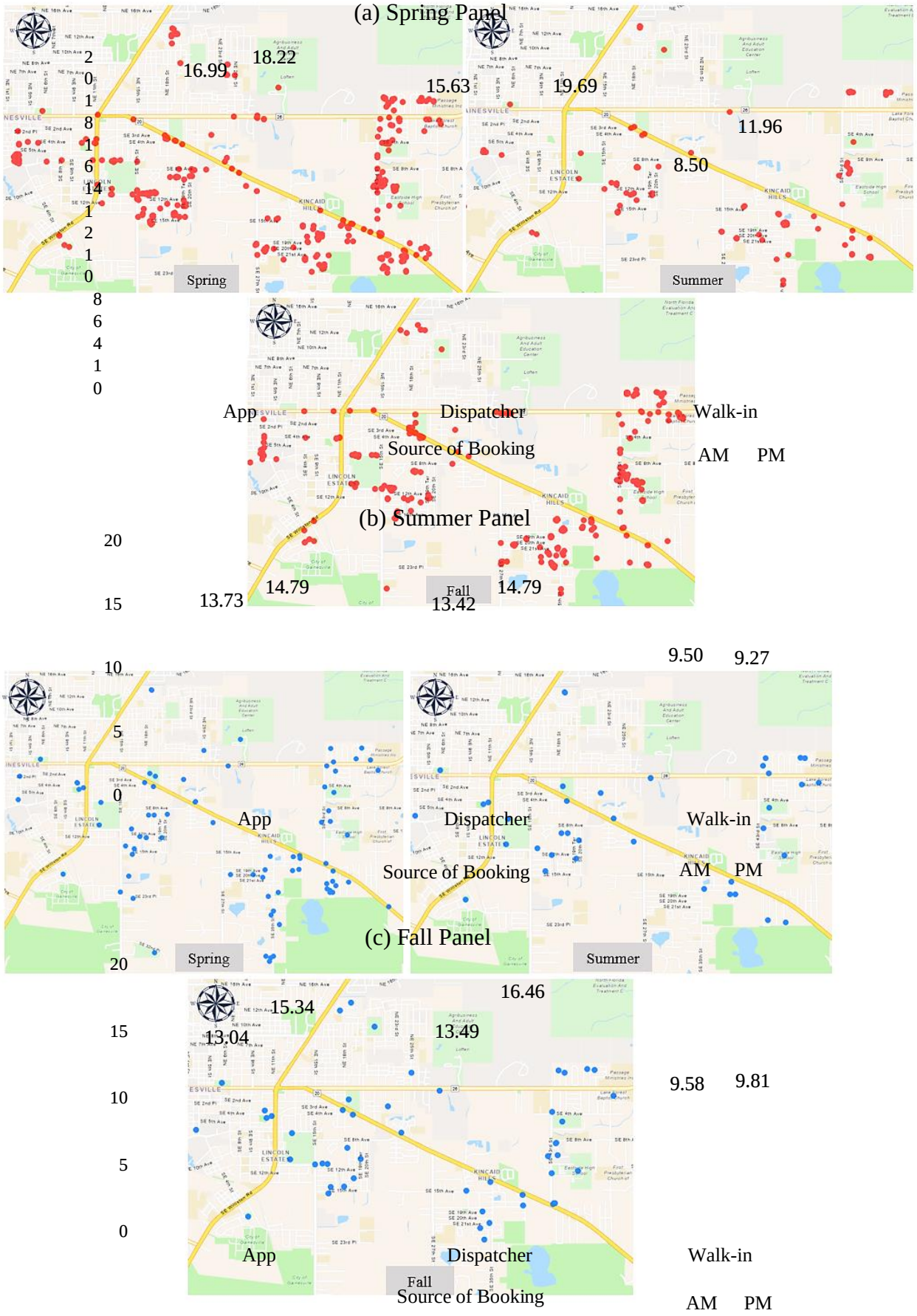
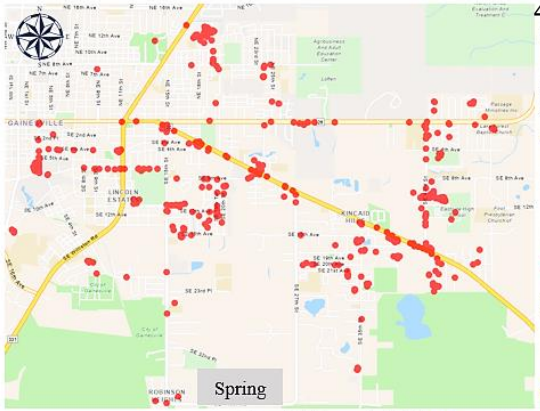
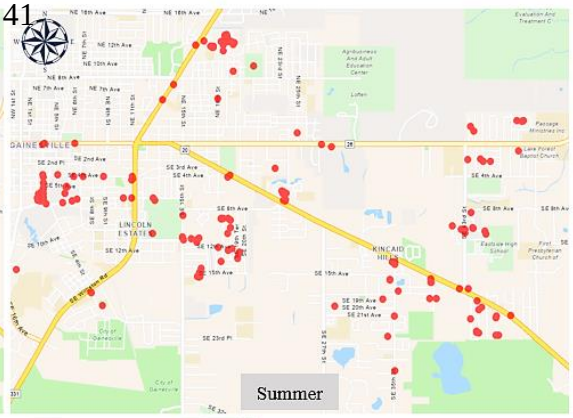
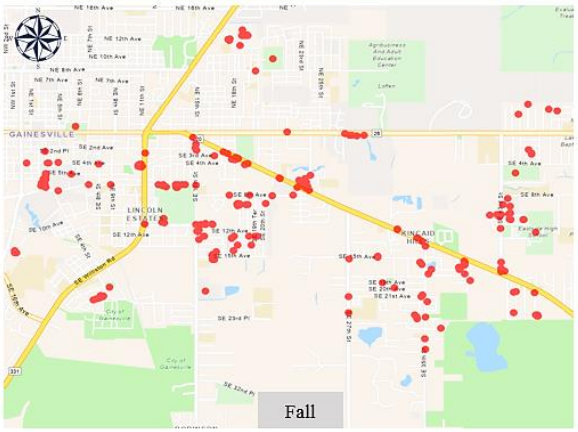
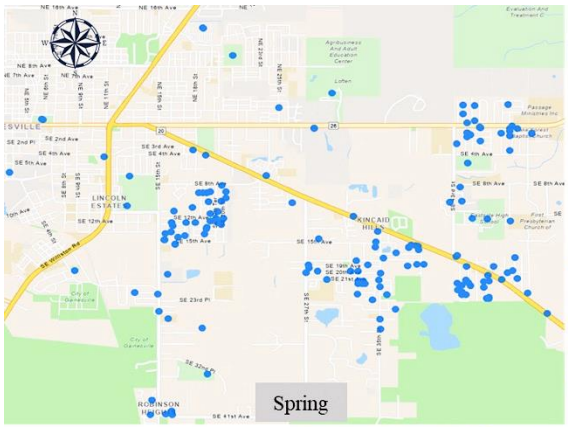


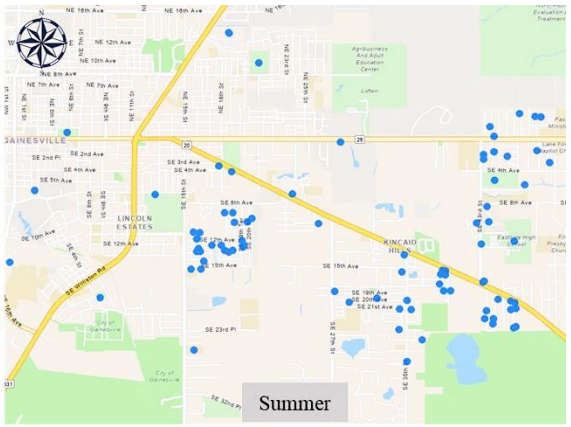
Figure 4-13: Average Travel Time of Trips Based on Source and Time Slots

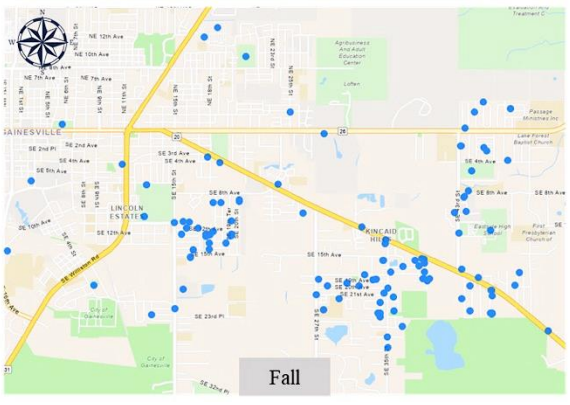

Spring


Summer


Fall


Spring


Summer


Fall

4.2 Spatial Analysis

4.2.1 Analysis of Origins and Destinations of Microtransit Trips

The trip-end locations (latitudes and longitudes) were overlaid on a GIS-based network and land-use data for Gainesville to understand the spatial distribution of the microtransit trips. In the rest of this section, two types of analyses are presented. This section presents the variety of trip-end locations. In other words, we examine the number of unique locations where trips have either originated or ended, without consideration of how many trips start or end there. We focus on locations with the highest intensity of trip ends. Specifically, we examined the top 5 most common origins and destinations.

Each trip-record has associated trip-end (origins and destinations) geo-coordinates. These coordinates were mapped on the GIS platform to ensure that they were located well within the geographical areas served by the microtransit system. Figures 4-14 through 4-16 illustrate scatter plots for AM/PM origin and destination points for the three panels. Data points have been color coded with different shades (red points are origins, and blue points are destinations). No inconsistency was found, based on the geographic locations of the origin and destination points from the data records.

Figure 4-14 depicts scatter plots for AM origins for the three panels. Origins of the trips made during the spring and fall semester seem to be more concentrated around the major arterials, which is not the case for trips during the summer. Figure 4-14 depicts scatter plots for morning destinations for three panels. Destination locations do not vary much among the three panels. The number of unique origin points in the morning are greater in number than the number of unique destination points (Figures 4-14 and 4-15); that is, destination maps are more condensed than the origin maps for all three panels. This is probably because riders try to board the services from their respective locations of comfort while their destinations are major landmarks, or points of interest, such as schools and churches, particularly in the morning.

Figure 4-16 shows the scatter plots for evening origins for three panels. For the evening as well, the origins of trips made in the spring and fall panel seem to be more concentrated around the major arterials, which is not the case for trips made during the summer panel. Figure 4-17 depicts scatter plots for evening destinations for three panels. Destination locations do not vary much for the three panels during the evening either. The number of unique origin points in the evening is greater in number than the number of unique destination points (Figures 4-16 and 4-17); that is, destination maps are more condensed than the origin maps for all three panels for evening as well.

Figure 4-14: Scatter Plots for AM Origins

Figure 4-15: Scatter Plots for AM Destinations

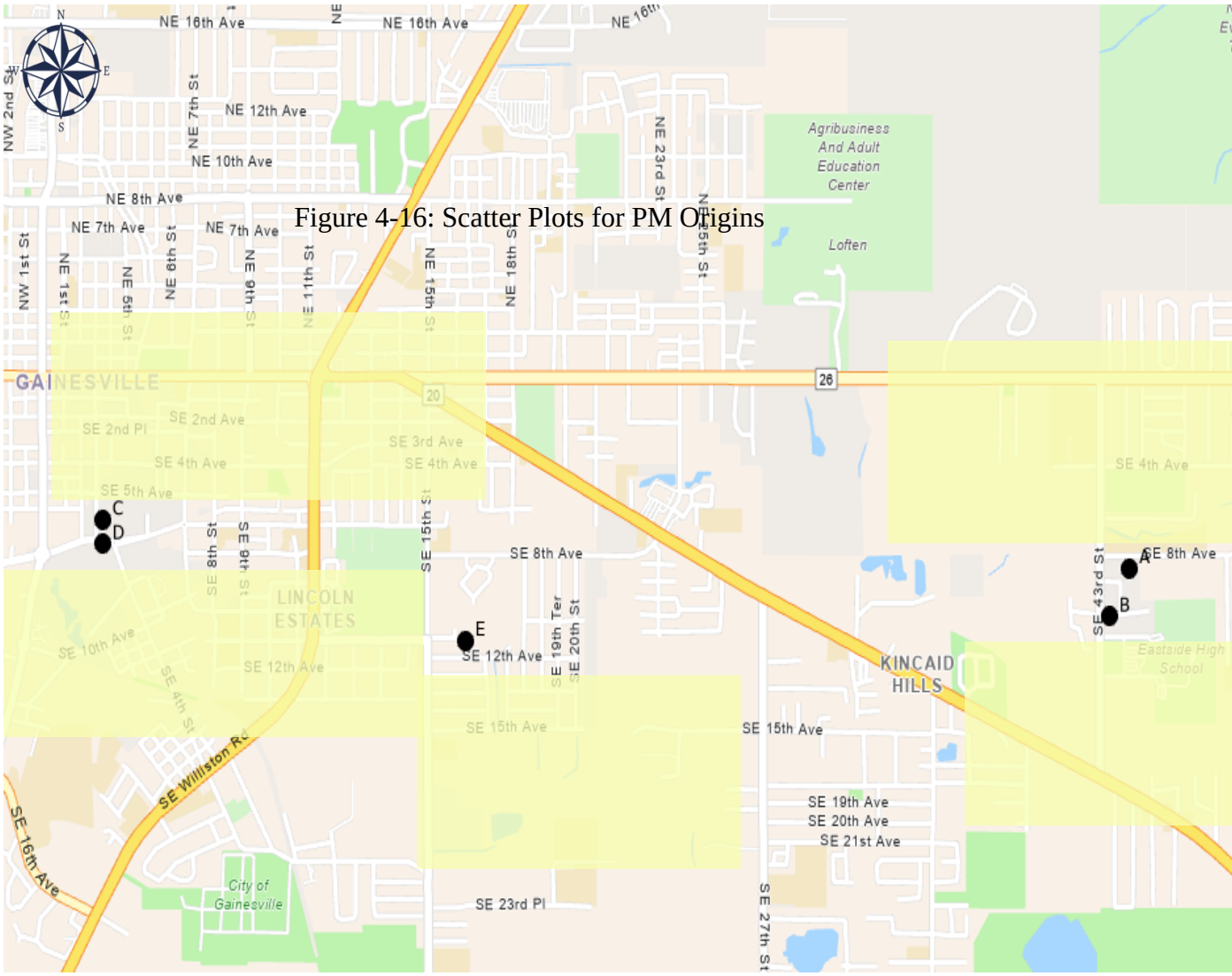


Figure 4-16: Scatter Plots for PM Origins

Figure 4-17: Scatter Plot for PM Destinations

The previous analysis describes the variety of locations accessed by microtransit services. In this section we examine the locations that had the most intensity of trip-ends (both origins and destinations). The trip-end latitudes and longitudes were rounded off to three decimal places prior to aggregation so that locations that shared close proximity on the real ground could be identified as a single location. Table 4-5 below depicts the top five locations as origins and destinations for each panel in the AM/PM time slot along with the percentage of trips associated with the locations.

It is interesting to note that the top-5 locations represent about 64% of all trip origins in the evening and 70% of trip destinations in the morning during the Spring. The numbers were 68% and 92%, respectively, for Summer, and 45% and 70% for the Fall panel, respectively.

In contrast, the top 5 trip destinations for the evening and the top 5 origins for the morning represent only about 33.62% and 40.52% of all trips for Spring, respectively. The same numbers are 47.35% and 41.67%, respectively, for Summer and 32.12% and 47.63%, respectively, for the Fall panel.

This is reasonable because trip origins for the evening and trip destinations in the morning are likely to be major points of interest or landmarks that are likely to be more common trip locations and account for a higher percentage of trips. Trip destinations during the evening and trip origins during the morning are more likely to be residential locations, which are more dispersed.

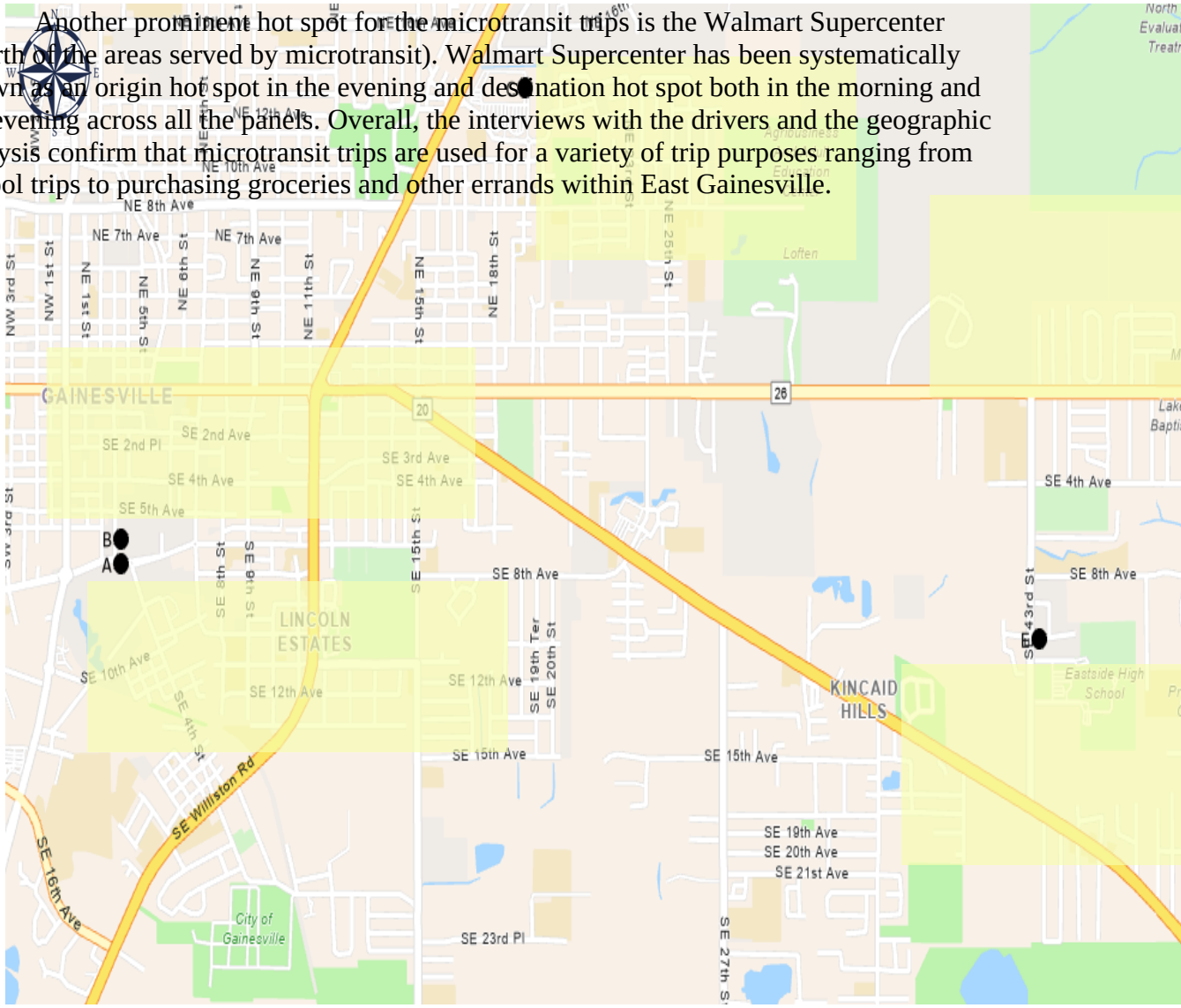
Table 4-5: Hot Spots and Percentage Distribution of Trips

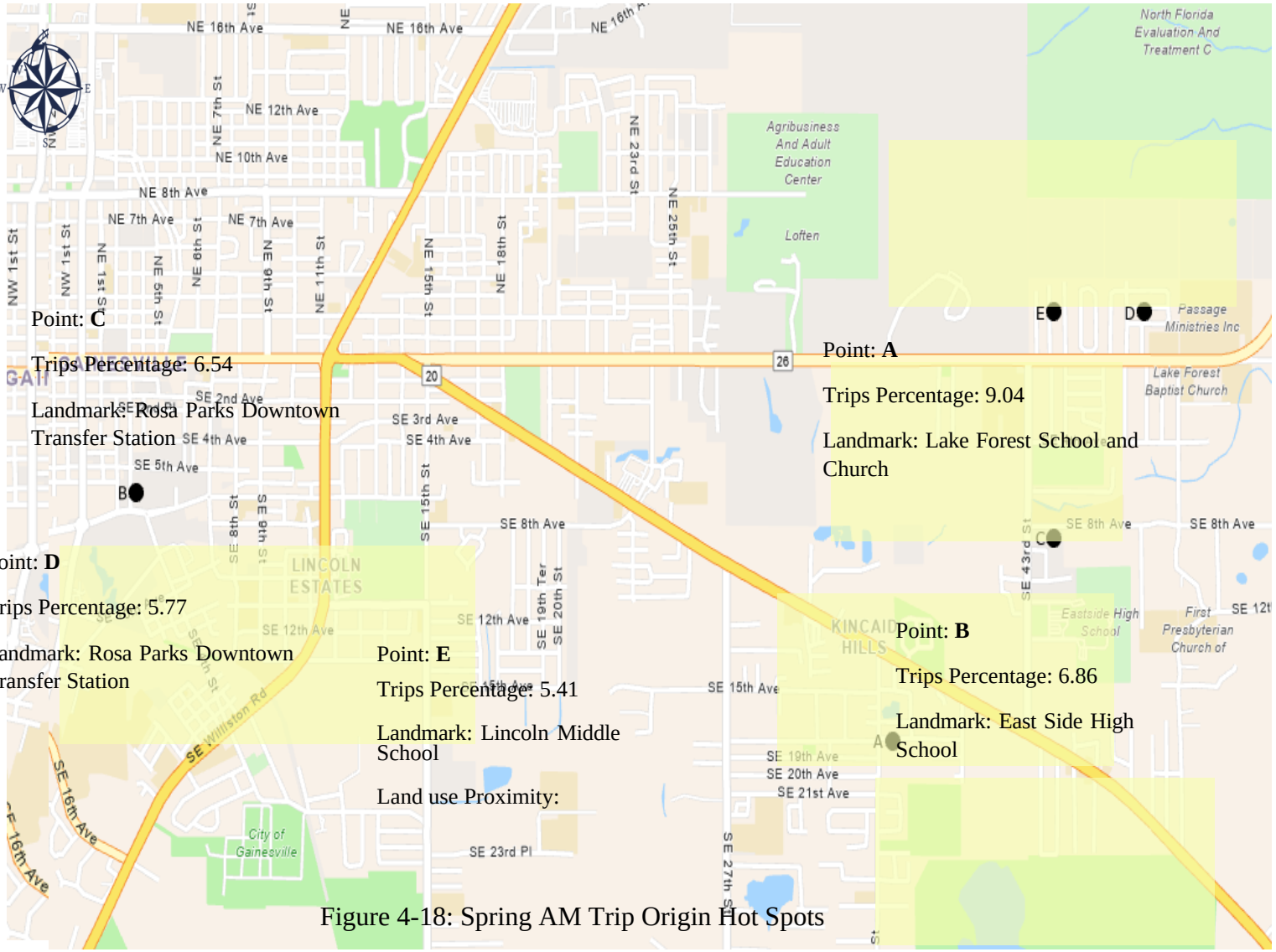
Trip Origins						
Panels	Spring		Summer		Fall	
Location Rank	AM	PM	AM	PM	AM	PM
1	9.04	29.47	16.05	31.09	10.04	24.42
2	6.86	21.23	11.43	18.49	6.81	12.13
3	6.54	6.76	8.16	10.76	5.49	10.12
4	5.77	3.03	6.53	4.42	5.18	4.08
5	5.41	2.86	5.17	2.76	4.60	3.83
Rest of the locations	66.38	36.65	52.65	32.47	67.88	45.42
Trip Destinations						
Panels	Spring		Summer		Fall	
Location Rank	AM	PM	AM	PM	AM	PM
1	37.15	13.17	63.81	16.19	38.72	13.65
2	13.58	9.05	15.78	8.83	9.25	11.13
3	8.28	6.67	5.03	5.70	9.07	10.27
4	5.85	6.58	4.22	5.61	8.23	7.05
5	5.16	5.05	2.86	5.34	4.91	5.54
Rest of the locations	29.98	59.48	8.30	58.33	29.82	52.37

Figures 4-18 to 4-28 display the most common origin and destination points in the AM/PM slot of each panel. A high percentage of trips across from all the three panels and AM/PM time slots are either to or from Rosa Parks Downtown Station. The Rosa Parks Station is the major transfer hub for fixed-route bus services and remains the hot spot for most of the microtransit trips as well.

Four drivers from RTS, who primarily drive microtransit services on a daily basis, were interviewed. They were asked to share their experiences and to identify the most preferred locations of the riders as origins and destinations. The drivers shared the fact that microtransit services are used extensively for school trips in the morning. During almost a year of operation of these services, parents now share a trust bond with the drivers to drop their kids safely at the school locations. These locations were identified in the ridership data as well. Locations in the proximity of schools such as Lincoln Middle School, Williams Elementary school, Eastside High School and Lake Forest School have significantly contributed as destination hot spots in the morning. In the morning, 27.02% and 23.23% in the Spring and Fall panel, respectively were scheduled to these destinations (Figure 4-18 and Figure 4-28). However, in the Summer, only about 2.85% of the trip destinations are to these locations (Figure 4-21) because schools have limited activities in summer.

Another prominent hot spot for the microtransit trips is the Walmart Supercenter (North of the areas served by microtransit). Walmart Supercenter has been systematically shown as an origin hot spot in the evening and destination hot spot both in the morning and the evening across all the panels. Overall, the interviews with the drivers and the geographic analysis confirm that microtransit trips are used for a variety of trip purposes ranging from school trips to purchasing groceries and other errands within East Gainesville.





Point: **C**

Trips Percentage: 6.54

Landmark: Rosa Parks Downtown Transfer Station

Point: **A**

Trips Percentage: 9.04

Landmark: Lake Forest School and Church

Point: **D**

Trips Percentage: 5.77

Landmark: Rosa Parks Downtown Transfer Station

Point: **E**

Trips Percentage: 5.41

Landmark: Lincoln Middle School

Point: **B**

Trips Percentage: 6.86

Landmark: East Side High School

Land use Proximity:

Figure 4-18: Spring AM Trip Origin Hot Spots

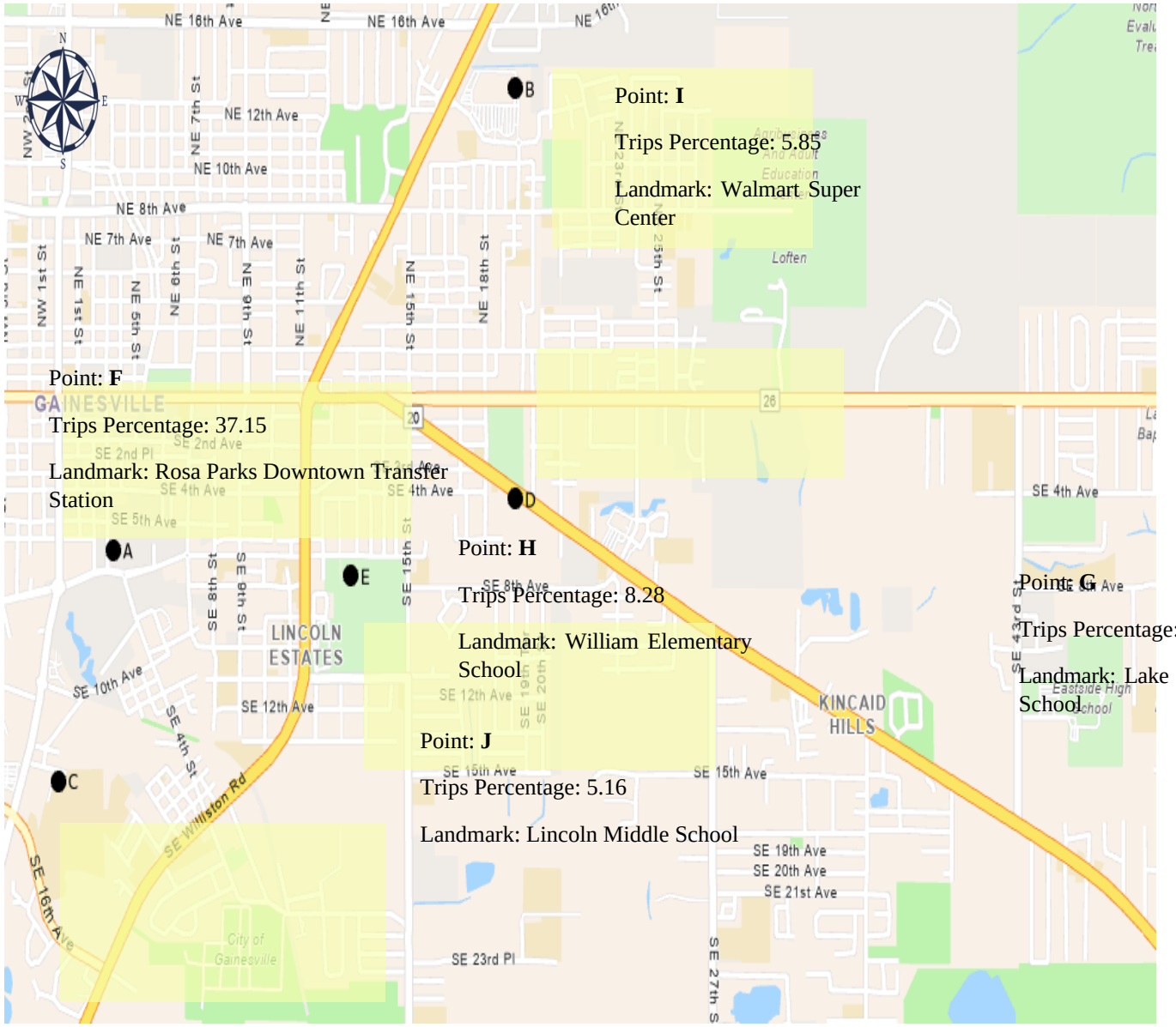


Figure 4-19: Spring AM Trip Destinations Hot Spots

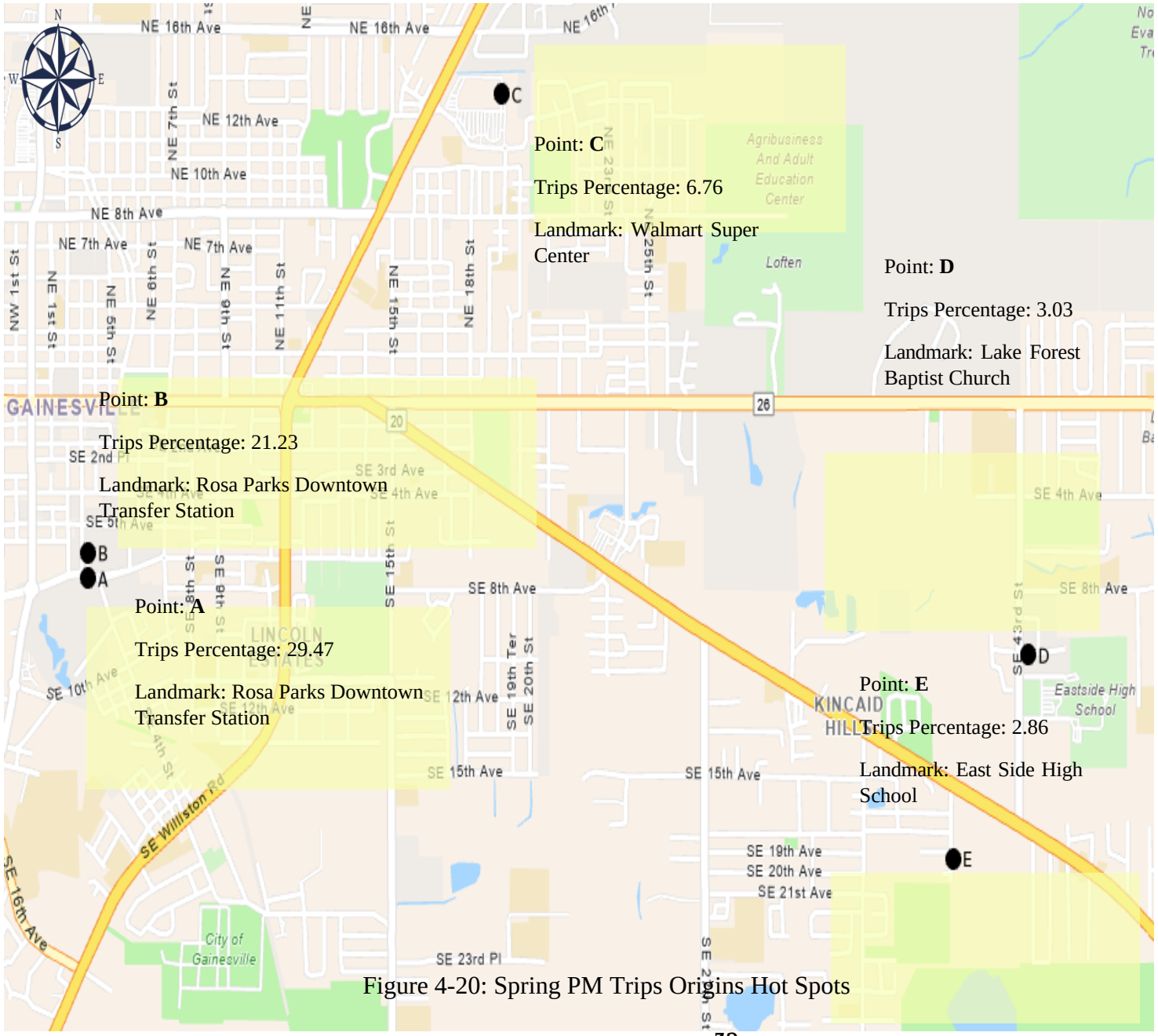
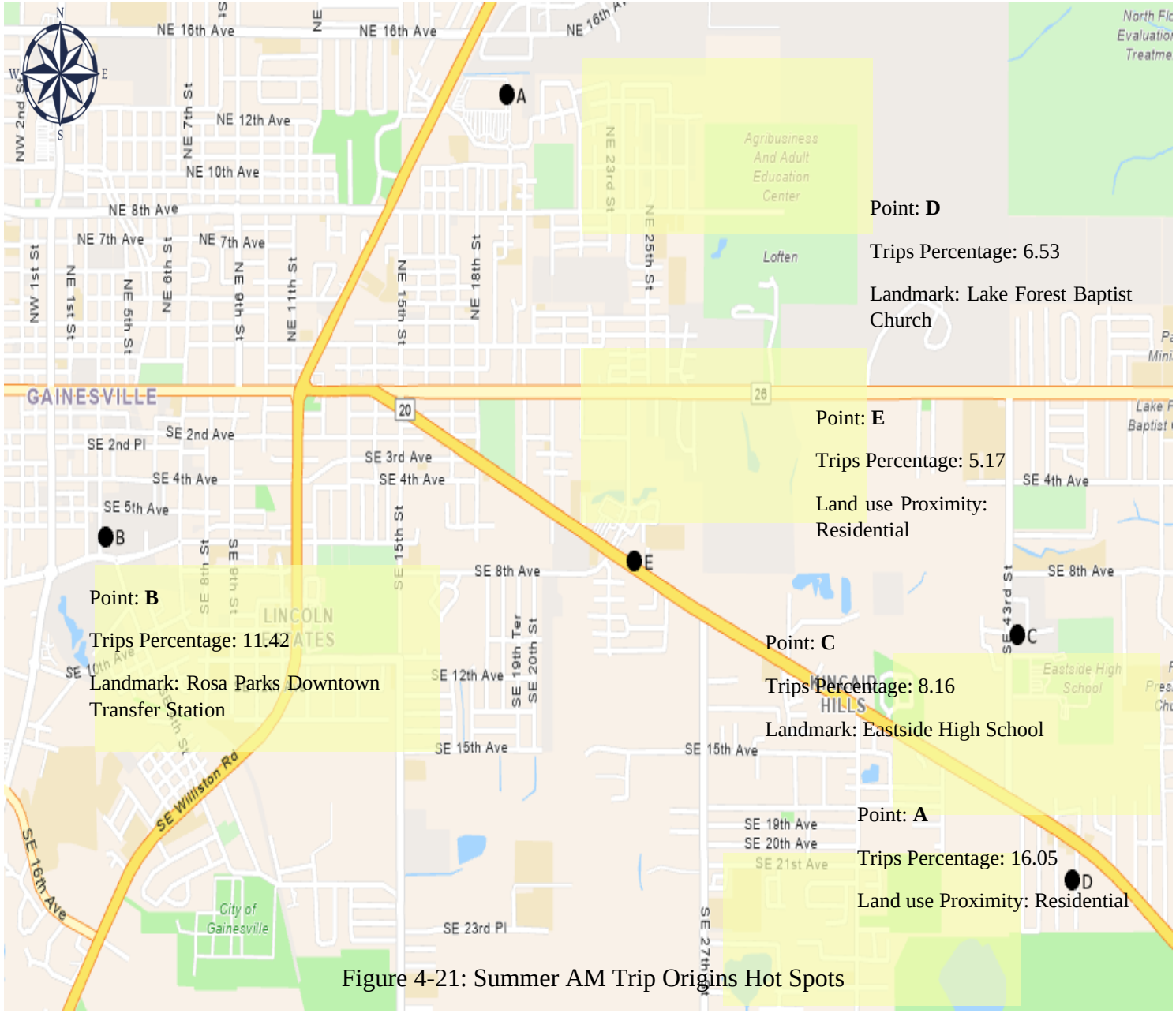


Figure 4-20: Spring PM Trips Origins Hot Spots



Point: **D**

Trips Percentage: 6.53

Landmark: Lake Forest Baptist Church

Point: **E**

Trips Percentage: 5.17

Land use Proximity: Residential

Point: **B**

Trips Percentage: 11.42

Landmark: Rosa Parks Downtown Transfer Station

Point: **C**

Trips Percentage: 8.16

Landmark: Eastside High School

Point: **A**

Trips Percentage: 16.05

Land use Proximity: Residential

Figure 4-21: Summer AM Trip Origins Hot Spots

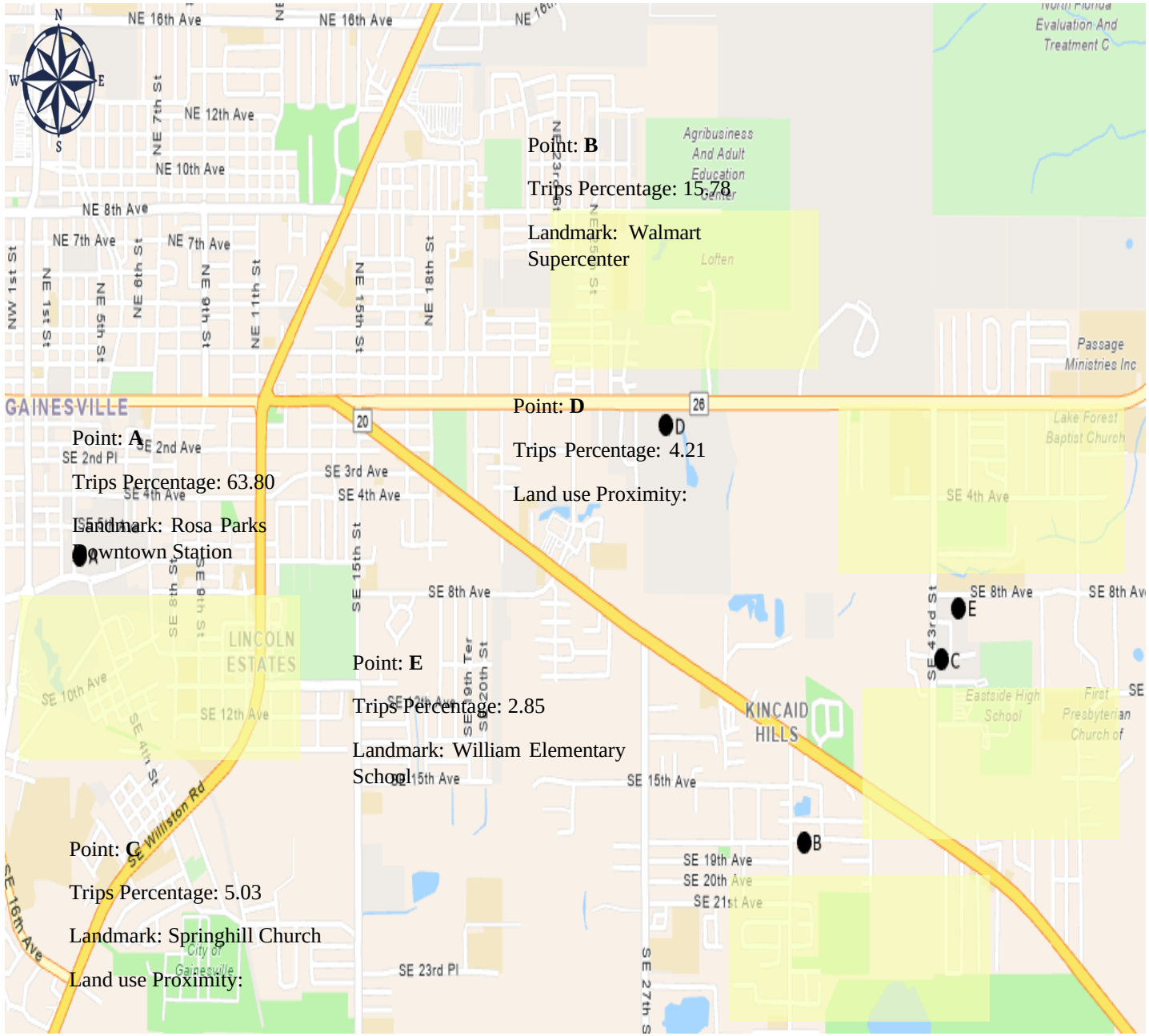


Figure 4-22: Summer AM Trip Destinations Hot Spots

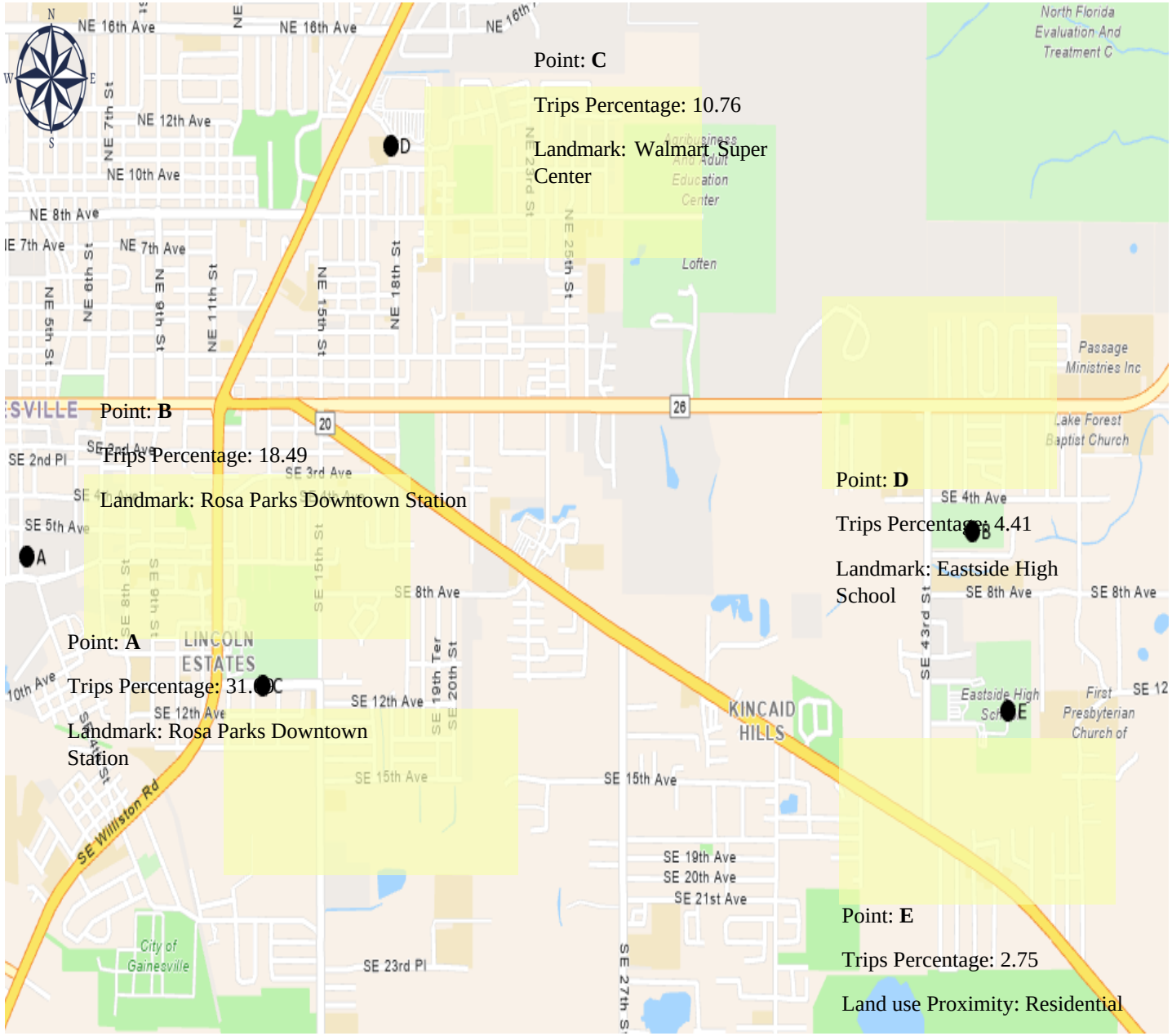


Figure 4-23: Summer PM Trip Origins Hot Spots

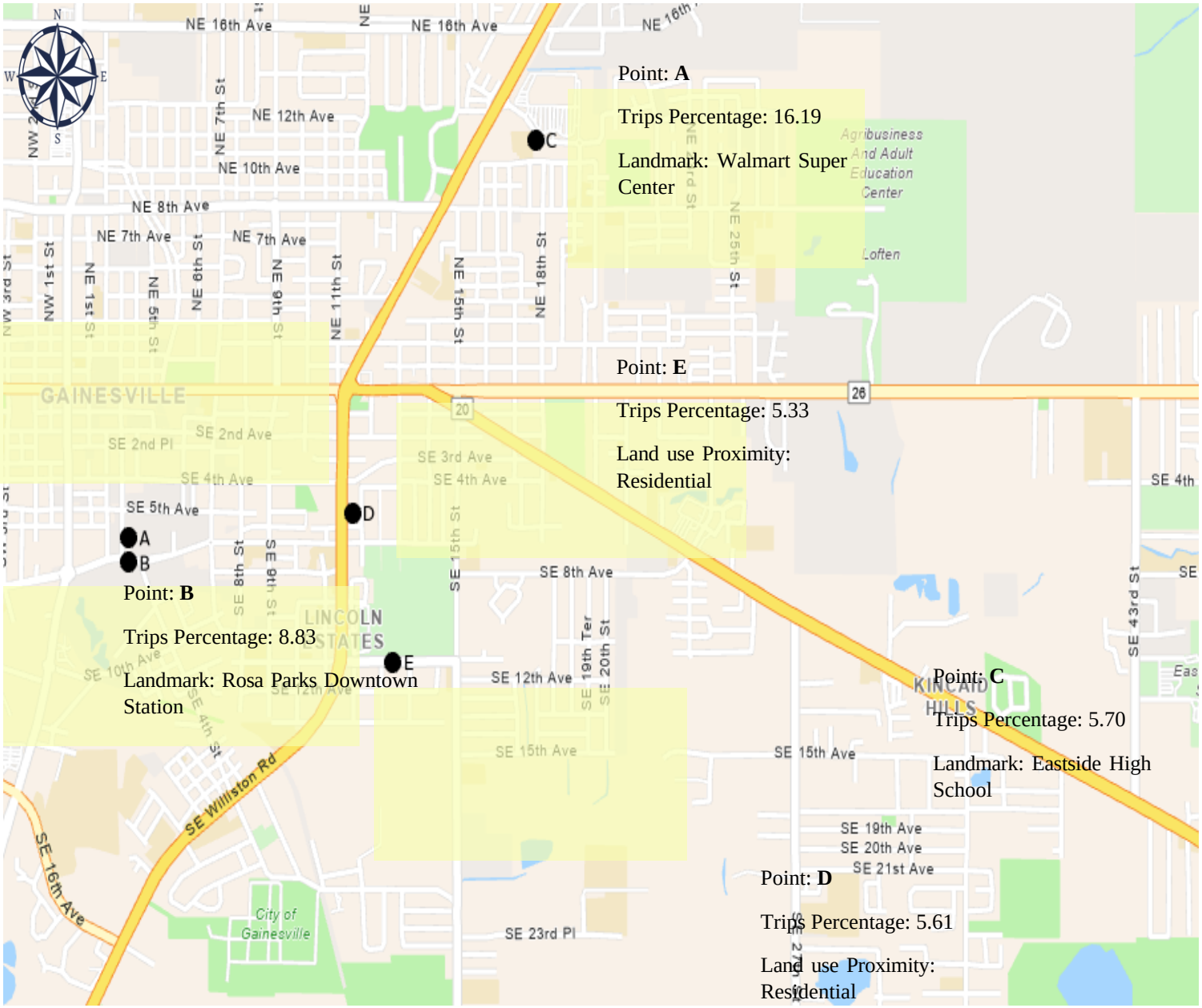


Figure 4-24: Summer PM Trip Destinations Hot Spots

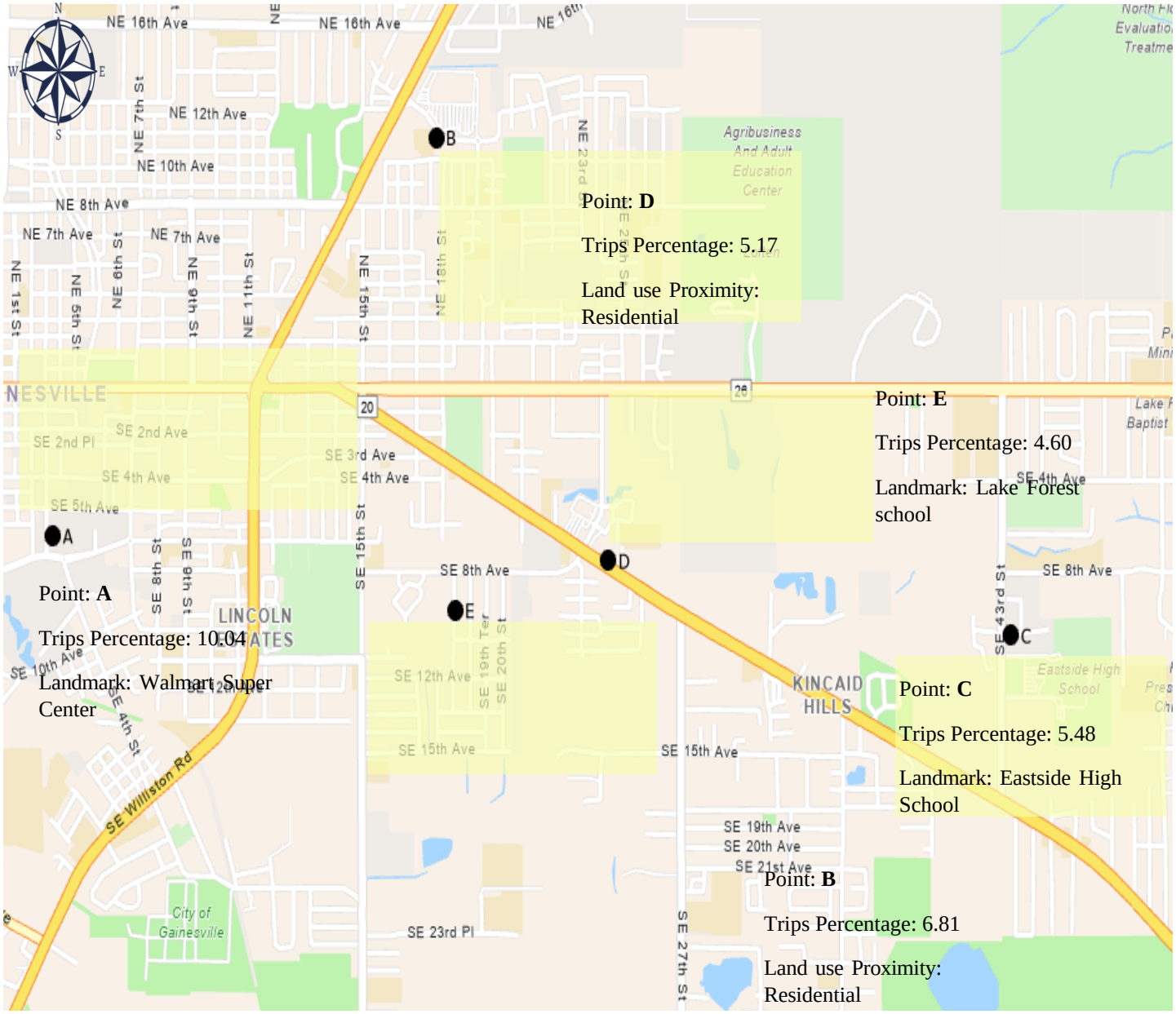


Figure 4-25: Fall AM Trip Origins Hot Spots

Point: **D**

Trips Percentage: 8.23

Landmark: Walmart Super Center

Point: **B**

Trips Percentage: 9.25

Landmark: Lake Forest School

Point: **A**

Trips Percentage: 38.72

Landmark: Rosa Parks Downtown Station

Point: **C**

Trips Percentage: 9.07

Landmark: Lincoln Middle School

Point: **E**

Trips Percentage: 4.91

Landmark: Eastside High School

Figure 4-26: Fall AM Trip Destinations Hot Spots

Point: **C**

Trips Percentage: 10.12

Landmark: Walmart Super Center

Point: **A**

Trips Percentage: 24.42

Landmark: Rosa Parks Downtown Station

Point: **D**

Trips Percentage: 4.07

Landmark: William Elementary School

Point: **B**

Trips Percentage: 12.13

Landmark: Rosa Parks Downtown Station

Point: **E**

Trips Percentage: 3.82

Landmark: Lincoln Middle School

Figure 4-27: Fall PM Trip Origins Hot Spots

Point: **B**

Trips Percentage: 11.13

Landmark: Walmart Super Center

Point: **A**

Trips Percentage: 13.65

Landmark: Rosa Parks Downtown Station

Point: **D**

Trips Percentage: 7.05

Land use Proximity: Residential

Point: **E**

Trips Percentage: 5.54

Land use Proximity: Residential

Point: **C**

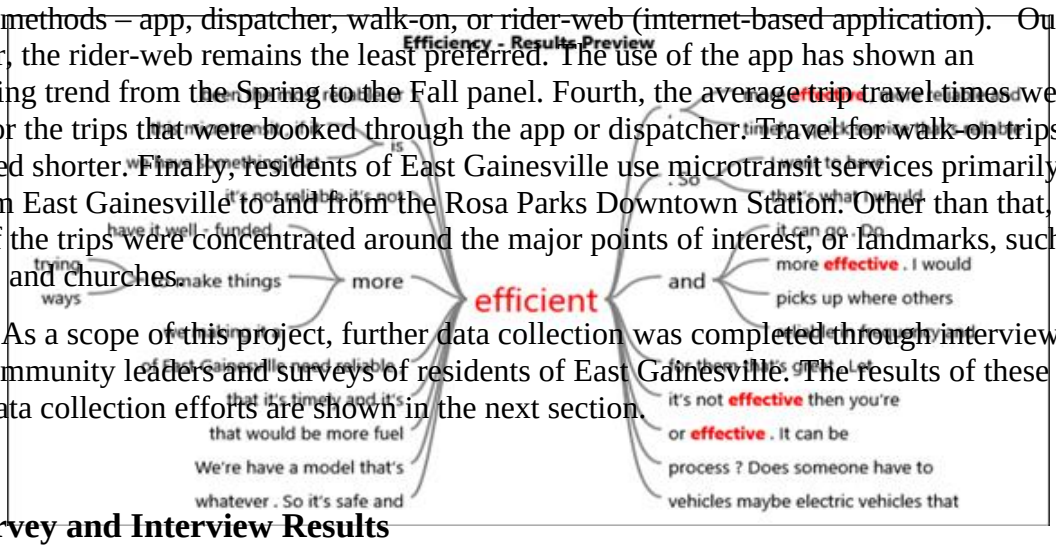
Trips Percentage: 10.27

Landmark: Eastside High School

Figure 4-28: Fall PM Trip Destinations Hot Spots

4.2.2 Conclusions from the Geospatial Analysis

Data collected and presented were obtained through secondary sources only. Key conclusions can be made about the use of these services based upon the spatial and temporal distribution of trips across the three panels. First, the COVID-19 pandemic resulted in a significant decrease in the ridership of the microtransit program. This impact began to show in March 2020 with a sustained decline until September 2020. The increased use of the services aligned with the opening of UF and Alachua County Public Schools that were more important during the Spring and Fall panel. Second, except for the summer panel, more trips were made in the morning than in the evening, in general. Third, users can book rides through one of four methods – app, dispatcher, walk-on, or rider-web (internet-based application). Out of the four, the rider-web remains the least preferred. The use of the app has shown an increasing trend from the Spring to the Fall panel. Fourth, the average trip travel times were more for the trips that were booked through the app or dispatcher. Travel for walk-on trips remained shorter. Finally, residents of East Gainesville use microtransit services primarily to get from East Gainesville to and from the Rosa Parks Downtown Station. Other than that, most of the trips were concentrated around the major points of interest, or landmarks, such as schools and churches.



As a scope of this project, further data collection was completed through interviews with community leaders and surveys of residents of East Gainesville. The results of these other data collection efforts are shown in the next section.

4.3 Survey and Interview Results

4.3.1 Summary of Interviews

4.3.1.1 Local Officials' & Community Leaders' Views on Microtransit

As the first phase of data collection for the project, the research team designed a semi-structured interview and eventually interviewed 14 local officials and community leaders to understand how they see the newly-provided services in East Gainesville (Appendix C). Several coding processes and line-by-line data analysis using NVivo resulted in extracting the following topics as constraints and limitations of public transit services and the microtransit pilot program in East Gainesville: reliability, efficiency, scheduling, accessibility, and infrastructure. A word count analysis was run and used to identify the context of the most frequently used words (Figure 4-29).

Figure 4-29: The Most Frequently Used words among Interviewees

4.3.1.2 Concerns about Microtransit Service

Based on interviews, most people were optimistic about the microtransit pilot program. However, both community leaders and public officials expressed their concerns about five main issues they see with existing public transportation and microtransit services in East Gainesville. Almost all interviewees expressed their concerns for the service sustainability, funding, and operations for existing public transportation and microtransit in East Gainesville. Considering that the five extracted topics based on interviews (e.g., reliability, efficiency, scheduling, accessibility, and infrastructure) are interwoven and interconnected, we summarize local officials' and community leaders' comments on the five main topics in the following paragraphs.

Reliability – which includes the availability of transportation, relevant stops, and timeliness – is the crucial component of a successful microtransit system. For this project, interviewees often used the word reliable in conjunction with efficiency and frequency. The majority of interviewees said that the microtransit program is filling in the reliability and predictability gap that has been so pervasive in East Gainesville. There were also scattered mentions of the value of public-private partnerships to improve the reliability of microtransit services: "...other factors include further public-private partnerships with mass transit to guarantee better service and better education for the public on the benefits of the microtransit program."

The reality that microtransit vehicles need to be well-coordinated with the real-time arrival of fixed-route buses at transit stations was a central theme during the interviews. Such partnerships would make the microtransit program more sustainable and maximize the frequency of transportation and the variety of available stops. Overall, it was more common among interviewees to mention reliability issues when referring to RTS's fixed-route service than when referring to the microtransit services. From the interviews, we learned that while fixed-route transit still plays an important role, the earlier-mentioned partnerships will capitalize on the strengths of both traditional and microtransit options.

Efficiency – which minimizes time, cost, and energy – is an essential component of a transportation system. Additionally, an efficient transportation system improves quality of life by decreasing traffic congestion and allowing us to spend more time on family, recreation, and personal experiences. Across the country, cities have started microtransit pilots to increase efficiency and to expand service hours. During the interviews, efficiency and reliability were used interchangeably by participants (Figure 4-3). Creating partnerships among key employers and public entities was widely mentioned as an opportunity to improve the efficiency of services. A local official talked about efficiency in balancing the demand of the microtransit system from K-12 students with the use of the public-school buses. They said that achieving actual efficiency may require merging the services or offering an alternative that satisfies everyone. Merging the systems instead of creating entirely new infrastructure could also reduce the amount of funding necessary, making this a more achievable solution. In addition to merging existing services, interviewees criticized the efficiency of current RTS services. To summarize, discussions around efficiency covered two main areas: efficiency of RTS's available public transit options and efficiency of microtransit as an alternative to filling the gap of the public transit system.

Scheduling – which includes the number of vehicles required and their fixed costs as well as labor costs (Hassold & Ceder, 2014). – is a means to minimize waiting times at transit hubs and to offer a reliable alternative mobility option. Almost all interviewees mentioned scheduling as being an issue in some capacity. There is an ongoing concern in East Gainesville about both the scheduling of the service times and the frequency of early and late routes. Specifically, participants stated that routes do not start early enough for shifts that are not the "traditional" 8-to-5, forcing workers to find alternative transportation or miss work. Interviewees agreed that transit needs general consistency, and one suggested solution is to have frequent transit options rather than strict schedules. Microtransit could bridge this gap without incurring the heavy costs of adding a fixed-route transit option.

On the other hand, there is the possibility that using the app or calling for a ride is overly complicating travel and preventing some people from using the service. One of the interviewees pointed out a benefit of the less restrictive on-call approach, saying it provides a useful alternative for those having to wait excessive amounts of time for the fixed-route RTS services. During the interviews, it became clear that scheduling is a potential barrier toward acceptance of on-demand services. It is a more significant barrier in areas where older adults and children are the primary riders, as they are less familiar with how to use the apps or less comfortable making calls for transportation. A microtransit partnership with fixed-route services could alleviate some of the scheduling issues, since microtransit can provide on-demand services rather than being tied to the limited schedule of public transit.

Accessibility – which is defined as the ease of getting to distinct destinations – is an ultimate goal for many transportation agencies (Venter, 2016). Limited access to alternative modes of transportation excludes individuals from social activities and destinations. This was seen throughout East Gainesville, where a lack of accessible community resources was one of the central concerns mentioned by interviewees. As a community leader said, "The less fortunate, the working-class people, are the ones that normally suffer… the resources aren't going to be allocated in their communities to improve the transportation access." Interviewees agreed that a sustainable microtransit system can resolve issues related to lack of access. In addition, many accessibility features need to be built into microtransit apps for people with all abilities. Transit agencies should also be in constant contact with their riders via phone, text, or

in-app notifications to provide them with timely information on their routine trips or new destinations added to the program. To sum up, interviews resulted in three main factors relating to accessibility: 1) ability to access information related to microtransit services; 2) access to microtransit services during the weekends and evening time; 3) physical access to essential resources such as health care, specifically for individuals with limited or no access to personal vehicles in their households.

Figure 4-30: The Word Tree for the Topic Efficiency

When politicians face fiscal constraints, infrastructure – which includes a wide range of fixed installations (such as roads) – is typically the first victim (Philipsen, 2021). In Gainesville specifically, population density and public transit infrastructure vary considerably by area. Most interviewees emphasized their concerns for physical infrastructure. The necessity for increasing the frequency of buses was frequently mentioned during interviews; however, interviewees recognized a disconnect between this need and the ability for the streets to sustain it, as some roads are not wide enough to accommodate bus stops. They also mentioned that there are concerns around dangerous behaviors from bus and personal car drivers if the streets were left at their current widths, such as drivers going left of center to pass a stopped bus. These conversations highlight how encompassing the term “infrastructure” is. From the width of the roads to the safety of the sidewalks, infrastructure must be trustworthy before citizens are willing to ride traditional or microtransit services.

In accordance with the general perspective on public transit routing, many interviewees discussed their perception of the unequal distribution of services between the residents of East Gainesville and UF students. To remedy the situation, they suggested integrating the transportation systems between UF and East Gainesville, which would also help identify (and resolve) gaps that transit-dependent UF employees face. Combining the university’s transportation system with that of the city will reduce the need for additional funding, but will better serve the community and offer a wider variety of stops. In summary, interviewees’ comments on infrastructure focused on: 1) the quality of physical infrastructure; and 2)

conceptual infrastructure integration between the city and the university. Interviewees also linked infrastructure improvements as one way to meet the current demand for transportation, and they agreed that the present infrastructure is not suited to the community's present transportation needs.

4.3.2 Summary of Survey Results

4.3.2.1 Responses to Survey of Residents of East Gainesville

In addition to the interviews of community leaders, the research team also conducted a survey for two sets of the population of East Gainesville — "microtransit users" and "non-users" of microtransit services. Surveys were distributed via email and paper. The full surveys can be found in Appendix D. In total, 20 surveys were completed by users and 37 surveys were completed by non-users. However, only those surveys that were compete (18 for users and 35 for non-users) were considered for further analysis. The respondents were validated for their age and residence. Only those respondents who were 18 years of age or older who have been living in Gainesville were eligible to participate in the survey.

4.3.2.1.1 Profile of Survey Respondents - Users and Non-Users

Travel demand of users and non-users was assessed through questions that had responses based on the usage frequency of different modes, time of travel and purpose of travel (Table 4-6). The "No response" category found in the descriptive summaries presents the percentage of responses that were not completed by respondents.

4.3.2.1.2 Modes and Frequency

Tables 4-7 and 4-8 below, show the percentage distribution of responses based on modes and frequency of usage for users and non-users, respectively. The user survey shows that 44.4% of respondents (Table 4-7) use microtransit services and 55.6% use bus services on a daily basis. A total of 66.7% and 55.6% of microtransit users never use personal car or carpool/ridesharing type options. In addition, biking and walking are generally not preferred mode choices among users, with 66.7% and 55.6% respondents choosing "never" as the response. Among non-users (Table 4-8), 11.4% respondents use a personal car and 31.4% walk on a daily basis. A total of 34.3% use bus services on a daily basis or a few times a week, while 57.1% and 65.7% of non-users never use a carpool or Uber/Lyft, respectively.

Table 4-6: Percentage distribution of respondents based on socio-economic characteristics.

Socio-Economic Attribute		User Survey (percentage of respondents)	Non-user Survey (percentage of respondents)
Gender	Male	16.7	42.9
	Female	55.6	42.9
	Non-Binary	0.0	2.9
	Prefer not to answer	11.1	5.7
	No Response	16.7	5.7
Age	18-29	16.7	22.9
	30-49	33.3	17.1
	50-64	22.2	31.4
	65 and older	0.0	22.9
	No Response	27.8	5.7
Race/Ethnicity	Hispanic or Latino	0.0	11.4
	White	5.6	20.0
	Black or African American	61.1	51.4
	Asian	0.0	0.0
	Other	5.6	11.4
	No Response	27.8	5.7
Annual Household Income	Below $15,000	38.9	45.7
	$15,000-$25,000	33.3	20.0
	$25,000-$35,000	0.0	2.9
	$35,000-$50,000	0.0	14.3
	Above $50,000	0.0	11.4
	No Response	27.8	5.7
Vehicle Ownership	Presence of Car in Household	38.9	45.7
Access to smart phone and internet		66.7	68.6

Table 4-7: Percentage distribution based on modes and frequency for microtransit users

Frequency	Personal Car	Carpool	Uber/ Lyft	Bus	Walk	Bike	Micro-transit
Daily	11.1	5.6	0.0	55.6	22.2	0.0	44.4
Few times a week	5.6	11.1	5.6	16.7	5.6	5.6	11.1
Once a week	5.6	11.1	11.1	5.6	0.0	5.6	0.0
Once/ twice per month	0.0	0.0	27.8	5.6	0.00	5.6	38.9
Never	66.7	55.6	38.9	0.0	55.6	66.7	0.0
No Response	11.1	16.7	16.7	16.7	16.7	16.7	5.6
TOTAL*	100.1	100.1	100.1	100.2	100.1	100.2	100
* - Total may not equal to 100% due to rounding.							

Table 4-8: Percentage distribution based on modes and frequency for Non-users of microtransit.

Frequency	Personal Car	Carpool	Uber/Lyft	Bus	Walk	Bike
Daily	11.4	2.9	0.0	34.3	31.4	8.6
Few times a week	11.4	5.7	0.0	34.3	20.0	2.9
Once a week	11.4	14.3	8.6	2.9	2.9	2.9
Once/twice per month	0.0	11.4	17.1	8.6	2.9	8.6
Never	60.0	57.1	65.7	17.1	37.1	65.7
No Response	5.7	8.6	8.6	2.9	5.7	11.4
TOTAL*	99.9	100	100	100.1	100	100.1
* - Total may not equal to 100% due to rounding.						

4.3.2.1.3 Modes and Time of Travel

Tables 4-9 and 4-10 below show the percentage distribution of responses based on modes and time of travel for users and non-users, respectively. It should be noted that other modes such as personal car, bike, carpool, and Uber/Lyft. have not been included in tables below because of the low response rate among users and non-users.

The use of buses among users (Table 4-9) was the highest in the afternoon hours. Half of the microtransit users indicate that they use buses in the afternoon. Another 44.4% of users also

use bus service during weekends, while 38.9% use buses in the morning hours. The lowest usage for buses is in the late night and early morning hours. For microtransit services, 33.3% of users use them during the afternoon hours, followed by morning and daytime hours with 27.8% and 11.1% respectively.

The usage of buses among non-users (Table 4-10) is highest in the daytime, with 57.1% of them using buses. A total of 48.6% non-users also use bus service in the morning. A substantial minority (45.7%) of non-users use buses in the afternoon. The lowest usage for buses for non-users is in the late night and early morning hours. About 31.4% of non-users walk for their trips in the morning.

Table 4-9: Percentage distribution based on modes and time of travel for microtransit users

Time of Travel	Bus	Microtransit
Early Morning (4 AM-7 AM)	11.1	0.0
Morning (7 AM-10 AM)	38.9	27.8
Daytime (10 AM-4 PM)	38.9	11.1
Afternoon (4 PM-8 PM)	50.0	33.3
Late Night (8 PM-4 AM)	0.0	0.0
Weekend	44.4	0.0
No Response	38.9	44.4
Note: Every respondent can choose multiple modes for each category of time of travel or single mode for multiple categories of time of travel as a survey response (Tables 4-7 and 4-8). Thus, the columns do not sum up to 100 percent.		

Table 4-10: Percentage distribution based on modes and time of travel for non-users of microtransit.

Time of Travel	Bus	Walk
Early Morning (4 AM-7 AM)	22.9	20.0
Morning (7 AM-10 AM)	48.6	31.4
Daytime (10 AM-4 PM)	57.1	28.6
Afternoon (4 PM-8 PM)	45.7	25.7
Late Night (8 PM-4 AM)	17.1	8.6
Weekend	34.3	31.4
No Response	28.6	51.4
Note: Every respondent can choose multiple modes for each category of time of travel or single mode for multiple categories of time of travel as a survey response (Tables 4-7 and 4-8). Thus, the columns do not sum up to 100 percent.		

4.3.2.1.4 Modes and Trip Purpose

Tables 4-11 and 4-12 below show the percentage distribution of responses based on modes and frequency of usage by users and non-users, respectively. The tables include responses only for bus and microtransit. This is due to the fact that the response rate from both users and non-users of microtransit show they did not use other modes, such as personal car, bike, carpool, or Uber/ Lyft for many trips. Both bus and microtransit services dominate for home-based trips, with 75.2% and 44.4% of users using them, respectively. About 65.7% and 51.4% of non-users of microtransit use buses for home-based trips and trips related to healthcare.

Table 4-11: Percentage distribution based on modes and trip purpose for microtransit users

Trip Purpose	Bus	Microtransit
Home	72.2	44.4
Work	50.0	38.9
Healthcare	50.0	22.2
School	38.9	27.8
Groceries	55.6	38.9
Shopping	55.6	38.9
No Response	22.2	22.2
Note: A single respondent can choose multiple trip purposes for each of the listed modes. Thus, the percentages don't sum up to 100.		

Table 4-12: Percentage distribution based on trip purpose and bus as mode for non-users of microtransit

Trip Purpose	Bus
Home	65.7
Work	22.9
Healthcare	51.4
School	14.3
Groceries	45.7
Shopping	45.7
No Response	22.9
Note: A single respondent can choose multiple trip purposes for each of the listed modes. Thus, the percentages don't sum up to 100	

4.3.2.2 User's Survey Response

This section highlights the overall interaction of users with the services, their way of booking the rides, willingness to pay for the services, and their satisfaction levels with respect to different attributes of the service.

4.3.2.2.1 Method of Booking Trip on Microtransit

Microtransit services are provided on an on-demand basis to the users. Users can book the microtransit service through one of four methods – calling a dispatcher, computer (web booking), phone app or walk-up. Table 4-13 below depicts different sources and percentage of respondents using them for accessing the services. About 55.6% of the users reported that they book a ride by making a phone call to a dispatcher. Just under 6% of the users make use of phone application or board the service through walk ups. The mode used to access the service differs from the mode split documented previously, which showed over 40% of trips being booked using the app. This suggests that the users of the phone app were either not captured in the survey or they use the microtransit service more frequently than other users.

Table 4-13: Source of booking

Source of Booking	Percentage of Response
Call (dispatcher)	55.6
Computer (web booking)	0.0
Phone App	5.6
Walk-Up	5.6
No Response	33.3
TOTAL	100.1

4.3.2.2.2 Willingness to Pay for Services

As of now, microtransit services come at no cost to the riders (users). Table 4-14 below summarizes the responses of users when they were asked how much they would be willing to pay for the services in the future. About 27.8% of the users agreed to pay $0.75 for the services. The percentage of users willing to pay decreased with an increase in the cost of the services, with only 5.6%, each, of participants willing to pay as high as $2.00 or $3.00.

Table 4-14: Willingness to pay for microtransit services.

Cost of services	Percentage of Response
$ .75	27.8
$ 1.00	16.7
$ 1.50	5.6

Cost of services	Percentage of Response
$ 2.00	5.6
$ 3.00	5.6
No Response	38.9
TOTAL	100.2
Note: Responses do not total to 100% due to rounding.	

4.3.2.2.3 Perception about Microtransit Services

Customer satisfaction holds utmost importance for sustenance of any service. Users of the microtransit services were asked about for their satisfaction levels with many aspects of the microtransit service based on a Likert Scale. The Likert scale used in this case had five rating levels: very satisfied (best rating) to very unsatisfied (worst rating). The third rating level was neutral, which corresponds to the average of Likert scale rating levels. Table 4-15 below shows the ratings of customer's satisfaction (users in this case) for different attributes of microtransit services.

When interpreting these results, it is important to recognize that between one third and 44.4% of respondents did not complete this section of the survey. In general, users showed a higher level of satisfaction than dissatisfaction with the characteristics of the microtransit. Users were most likely to indicate satisfaction with the safety of the shuttle, with 61.1 percent indicating that they were satisfied or very satisfied. They were also the next most likely to be satisfied with the bus driver's behavior and the ease of access for disabled, with 55.5% indicating they were satisfied or very satisfied. Half of the respondents were satisfied with the closeness of the drop-off to the destination and availability of service information.

The respondents were least likely to say they were satisfied with the navigation on the phone app, with 16.7% indicating they were satisfied; at the same time no one expressed dissatisfaction with the navigation app. For many other characteristics of the service – safety in shuttle, seat availability, bus driver's behavior, and ease of access for disabled – none of the microtransit users said they were dissatisfied with these characteristics. Users were the most dissatisfied with the coverage area of the microtransit services, with 16.7% indicating they were dissatisfied, and 5.6% indicating they were very dissatisfied. A slightly lower percentage of users were dissatisfied with the frequency of buses and the connections to city buses, with 11.1% indicating dissatisfaction with these characteristics.

Table 4-15: Attributes of Microtransit services and satisfaction ratings by Users.

Attributes	Very Satisfied	Satisfied	Neutral	Unsatisfied	Very Unsatisfied	No Response	TOTAL*
Safety in Shuttle	22.2	38.9	5.6	0.0	0.0	33.3	100
Phone app navigation	0.0	16.7	38.9	0.0	0.0	44.4	100

Attributes	Very Satisfied	Satisfied	Neutral	Unsatisfied	Very Unsatisfied	No Response	TOTAL*
Seat availability	33.3	16.7	11.1	0.0	0.0	38.9	100
Operation hours	5.6	22.2	16.7	11.1	5.6	38.9	100.1
Closeness of drop off to destination	33.3	16.7	0.0	11.1	5.6	33.3	100
Waiting time	11.1	33.3	16.7	5.6	0.0	33.3	100
Frequency of buses	16.7	27.8	11.1	11.1	0.0	33.3	100
Connections to city buses	22.2	22.2	0.0	11.1	0.0	44.4	99.9
Bus driver's behavior	33.3	22.2	11.1	0.0	0.0	33.3	99.9
Coverage area	16.7	16.7	11.1	16.7	5.6	33.3	100.1
Ease of access for disabled	22.2	33.3	5.6	0.0	0.0	38.9	100
Availability of service information	22.2	27.8	11.1	5.6	0.0	33.3	100
* Percentages do not always total to 100 percent due to rounding.							

4.3.2.2.4 Mode Choice in Absence of Microtransit

Table 4-16 below shows the responses of users when they were asked what their mode choice would be if microtransit services were unavailable. About 61.1% of the users indicate that they would use bus services, followed by 27.8% and 22.2% who say they would switch to walking and carpool, respectively.

Table 4-16: Mode choice if microtransit not present

Modes	Percentage Response
Personal Car	5.6
Carpool	22.2
Bus	61.1
Uber/Lyft	11.1

Walk	27.8
No Response	38.9
Note: Responses do not total 100% because respondents can use multiple responses.	

4.3.2.3 Microtransit Non-User Survey Responses

About 71.4% of non-users reported that they were not aware of the microtransit services. A lack of awareness about the services was one of the main reasons for not using the services. However, non-users reported that they would consider using the services if the services were more accessible, readily available, and connected them to their places of interest.

4.3.2.4 Analysis of Responses to Open-Ended Questions in Survey

Four questions from the users' surveys (8, 9, 10, and 12) and five questions from the non-users' surveys (5, 6, 7, 8, and 9) were separately examined to provide a descriptive analysis of users' and non-users' perspectives on the microtransit pilot program. Understanding non-users' views of microtransit services is essential to: (1) evaluate the level of access to information related to the services; and (2) to decipher whether technological literacy and internet access impact their willingness to take microtransit services. The latter hints at the significance of questions 5 and 7. Surprisingly, none of the participants answered the question regarding internet and smartphone access; therefore, there is not enough evidence to discuss the impact of internet access or technical literacy on non-users' approaches to microtransit services. However, the majority of respondents mentioned that they did not know such services exist, which demonstrates the importance of effective communication between stakeholders, the public, and key employers, who could benefit from, and help secure, the financial stability of microtransit services.

On the other hand, question 12 from the users' survey explores desirable changes users want to see for services. Based on NVivo analysis of this question, these are the most common themes: (1) expanding area of services (on both the east and west sides); and (2) extending hours of operations to meet users' needs. Participants highlighted three main issues with the existing services: 1) homogeneity of microtransit destinations; (2) lack of punctuality; and (3) inequitable distribution of services. Although the majority of users referenced the pilot program as a reliable service with fewer stops and more coverage, the aforementioned issues need to be thoroughly considered and addressed by transit authorities to make sure that microtransit services gain public support in the long term.

5 Use of Microtransit in Other Communities

5.1 Overview of Florida Transit Agencies

Microtransit service planning is all about trade-offs and finding a place for the service among other transportation options. Where are the right places to invest in microtransit? What are the priorities required to expand services? How do other shared mobility options impact microtransit services in the long term? How can we plan for long-term outcomes to effectively inform short-term decisions? These are only a few of the questions that need to be thoroughly considered in a broader public transit context. In this section, we focus on microtransit planning and what needs to be examined to make equitable investments.

Microtransit is defined as "shared public or private sector transportation services that offer fixed or dynamically allocated routes and schedules in response to individual or aggregate consumer demand, using smaller vehicles and capitalizing on widespread mobile GPS and interconnectivity" (Volinski, 2019, p. 90). Thus, transit agencies consider many factors to execute microtransit projects.

During the past seven years, transit agencies across the country have faced financial issues due to declines in ridership. At the national level, urban centers make up an overwhelming majority of ridership decline. From 2014 to 2017, the 40 largest urbanized areas represented 85.2% of total U.S. ridership decline. (Polzin & Godfrey, 2019). According to a recent FDOT report (2019), all of the 10 largest public transportation operators in Florida experienced a decline in the ridership using their services from 2013 to 2017. Even in the time frame after that report, public transit ridership continued to decline. From 2017 to 2018, ridership across the Sunshine State shrank by 8.5 percent (Polzin & Godfrey, 2019).

While transit has been on a nationwide decline, Florida has seen ridership declines two times greater than the average nationwide (Polzin & Godfrey, 2019, p. iv). At the same time, transit agencies are not necessarily eliminating services. Between 2013 and 2017, twenty-two Florida transit agencies expanded their services, but only five experienced a collective increase in ridership (Polzin & Godfrey, 2019). This means that most of the transit agencies have expanded operations but have experienced decreased ridership. Potentially influential factors may include an overall steady decrease in zero-vehicle households, while vehicle miles travelled in single occupancy vehicles increased between 1 and 5 percent annually (Polzin & Godfrey, 2019).

Florida must account for an ever-changing landscape of growth and development. As the state with the fourth largest economy and the third largest population in the country, with 21 million residents, Florida is expected to grow 1.7 million jobs and 5 million residents by 2030 (Florida Chamber Foundation, 2018). Increased job density and population density are factors that support public transportation. On the other hand, on-demand services, such as microtransit, are efficient and functional in areas with lower job and population densities than conventional fixed-route, fixed schedule transit options. As several North American cities continue to develop outward, the service area for microtransit might be most beneficial in areas with low density, high demand, and a need for expanded outreach (Mahtta, Mahendra & Seto, 2019). Florida, in particular, has developed outside of central business districts to include employment, residential areas and public services, which is a potential theory to explain lower ridership of public transit (Polzin & Godfrey, 2019, p. 42).

Some Florida transit agencies have begun experimenting with on-demand transit and mobility as a service. For example, St. Lucie County experienced a 31 percent growth in both service and ridership from 2013 to 2017 (St. Lucie County Public Transit, 2018). The *Direct Connect After Hours* program is an impactful initiative in St. Lucie County, one that resulted in alleviating the cost burden of paratransit trips for those requiring access to education, employment, and healthcare (St. Lucie County Public Transit, 2018). Investing in bus shelter improvements, fixed route services, and community outreach (including the creation of a marketing guide) were helpful steps towards increasing the ridership. The agency is now developing microtransit services for the entire county, as well as fare-free transit options (St. Lucie County Public Transit, 2018). In 2020, the Treasure Coast Connector On-Demand microtransit service deployed 3,415 passenger trips for 358 registered users in the southwestern part of the city of St. Lucie. In early analysis, the number one drop-off spot was a Walmart and Sam's Club shopping center, and a bus stop outside of a CVS was the next highest drop off spot. This indicates opportunities for both supplementary and replacement services for microtransit (All Things Treasure Coast, 2020). St. Lucie County shows that Florida transit agencies can provide flexible transit options, specifically microtransit services, and that a demand exists for them.

Additionally, other Florida cities have created new transportation programs as well. Seminole County experimented with an Uber partnership that provided discounted services for all in connection to five cities (Schwieterman et al., 2018). Royal Palm Beach created a partnership with Lyft to increase mobility for older adults within city limits (Webb, 2018). Cities across the state have invested in addressing existing mobility issues and future needs. The efficiency of transportation systems is affected by numerous factors such as "accessibility, adaptability, availability, and acceptability" (Cervallos, 2020, p. 11). Therefore, transit agencies need to have a multidisciplinary approach to mobility issues, while creating a platform for conversations about equitable transportation within the community.

American cities are experiencing simultaneous paradigm shifts that affect ridership of transportation: outward shifting development and demand for flexible transportation. Public transportation generally serves to benefit urban cores, but as demand for suburban and exurban housing increases, public transit may represent an increasing challenge for those communities. There is a negative relationship between coverage and ridership, which is to say that as coverage increases, the yield in ridership often decreases. Microtransit represents a trade-off between density and ridership. Microtransit may be a beneficial expansion to areas where public transit is declining altogether (e.g., discontinued fixed route lines in areas where transit is needed), and in areas of outward growth with low density.

Several metropolitan regions in Florida are developing in vast areas of low density, which makes the point relevant. An example of a region that may benefit from microtransit for these reasons is the Lakeland-Winter Haven metropolitan region. Between July 2019 and 2020, the Lakeland-Winter Haven metropolitan area was the second fastest growing metropolitan region in the country. As the county sits halfway between Tampa and Orlando, it is transitioning from a small-town exurb to a grander suburb, with an annual growth rate above 3 percent. As the Lakeland area transit has seen a decrease in ridership of 17 percent, one of the largest decreases among any Florida transit agency, microtransit may be a beneficial service for such a community (Polzin & Godfrey, 2019). Lakeland has one terminal and one transit stop for the entire city, and twelve transit lines for the entire county that spans over 2,000 square miles. Most bus routes take

around 90 to 120 minutes to cycle from the start to the end of the route; with a route of this length, it can be difficult to provide enough buses to support reasonable headways. Considering that Lakeland area transit has also seen a 33 percent increase in demand for responsive transit, microtransit could help supplement inconvenient fixed route transit from outer development areas into core parts of the metropolitan area (Polzin & Godfrey, 2019).

However, it is important that ridership is still maximized and provides optionality and flexibility of transport. Defining the corridors of development is useful to strategizing the best possible places to equalize coverage and ridership. Density measurements usually entail a combination of dwelling units per acre and building floor-area ratio. Coverage measurements usually include block sizes, intersections, and density of intersections, sidewalk coverage and other pedestrian-related forms of measure. When designing microtransit pilots, it may be better to design by starting with the corridor in which the microtransit will operate, assessing demographic differences within the corridor, and then creating sub-corridors based on density and coverage measurement tools, and ridership trends within the demographics (Liu, Zhang & Xu, 2020). Two districts, Triangle Research Park in North Carolina and Centennial, Colorado exercised similar methods of demand-responsive transit.

5.2 Case Studies of Other Microtransit Systems

A growing consensus has formed on the need to integrate on-demand microtransit services into a conventional fixed-route, fixed-schedule transit system. Indeed, many transportation agencies in the U.S. have experimented with pilot programs of microtransit services. In this section, we provide a detailed review of these programs and summarize the key lessons learned from these experiments.

Microtransit can play a role in formulating multi-modal transportation. The convenience of microtransit and other on-demand services can appeal to various market sectors dependent on the transit agency's objectives and business model. Additionally, several pilot programs have aimed to increase public transit equity. Since microtransit services provide a flexible option for underserved areas, transit agencies often deploy them to improve cost-effectiveness of transit-service provision and to expand services to underserved areas (e.g., low-density areas). Implications of these initiatives include meeting transportation demand in underserved geographic areas, reducing roadway congestion of single occupancy vehicles, improving operational efficiency, and reducing costs for users and transit agencies.

Microtransit pilot projects range across their geographic and demographic context. While some aim to delineate inequity in urban centers, others may provide connectivity in suburban, underserved low-density areas. These distinctions are important as they may create a variation in business models, operational budgets and outreach strategies. 5.2.1

5.2.1 TNC Partnerships and Examples

Microtransit, MOD, and other similar transportation services are often made opportune through partnerships between TNCs and transit agencies. While Uber and Lyft are the two most known TNCs that operate within the U.S., private microtransit-specialized companies, such as Bridj, Chariot, and Via, have also tested pilot programs with varying degrees of success. Funding models also vary depending on the source of the funding.

Bridj initially tested its first pilot with the Kansas City Area Transportation Authority (KCATA) in 2016. As one of the pioneers of microtransit pilots, KCATA was not entirely focused on the success of the pilot, but rather on the use of technology to create an on-demand type of service. However, at the end of the yearlong pilot, only 1,480 rides in total were given, costing the agency $1,000 per ride. Bridj has since collapsed. The KCATA/Bridj partnership failed for two main reasons: because midday transportation needs were not met, and because of limited payment options. Other limitations included lack of marketing and underdeveloped technology (Westervelt et al., 2018).

Regional Transport District (RTD) and the City of Centennial in Colorado joined Via and Lyft as microtransit partners. Lyft had prior experience with call center technology for those who do not own a smartphone and hailing ADA-compliant vehicles. Via provided ADA-compliant vehicles and Via drivers could easily transfer to the Lyft platform (Centennial Innovation Team & Fehr & Peers, 2017). Via drivers also helped market in areas with individuals who had low mobility, such as at physical therapy centers. Overall, this cross-integrated partnership proved to be effective and reduced the expected costs of a similar service for RTD.

The city of Gainesville, Florida enacted the Freedom in Motion program, a partnership with Uber and the city of Gainesville that was funded by the city. It provides need-based, co-pay transportation for elders in two assisted living facilities (and eventually was expanded to all seniors within the Gainesville city limits). While it costs the city $10 per ride, the unique program allows for dynamic mobility for an underserved population at off peak hours (Blodgett, Khani, Negoescu & Benjaafar, 2017). The funding model proved to be unsustainable, as funding options were not fully developed. However, it could serve as a foundational framework for a service that could accommodate underserved populations.

5.2.2 Business Models

Table 5-1 summarizes several major business models of microtransit type of services and presents a few examples for each business model. Key characteristics of each business model are described.

Table 5-1: Summary of Business Models and Their Key Characteristics

Business Model	Examples	Key Characteristics
FMLM services	Pinellas County, Florida Centennial, Colorado Santa Clara, California	Help alleviate barriers for riders who may use other modes of transportation to get to or from transit stop, partnerships with private sectors to direct to main transit spots. (Blodgett et al., 2017)
Suburban mobility and general transit	Contra Costa and Alameda, California; Monrovia, California; Boston, Massachusetts	Otherwise general transit, helps with low ridership in low density areas, usually offering fare reduced TNC trips. (Blodgett et al., 2017).
Out-of-span services	Pinellas County, Florida	Targets low-income populations and social equity issues by providing services when general transit is not in service, such as for late night workers.

Business Model	Examples	Key Characteristics
Peak-hour services	Dayton, Ohio Kansas City, Missouri Summit, New Jersey	Partnerships are established to help alleviate stress during times of high demand and to relieve parking congestion.
Smart phone applications	West Salem, Oregon Austin, Texas	Applications are created to showcase multiple modes of transportation to maximize ridership convenience.
Meeting monetary goals	Research Triangle Park, North Carolina San Clemente, California Dublin, California	Due to low ridership of various fixed transit systems, agencies will completely replace fixed route systems to increase ridership and lower costs. (Blodgett et al., 2017)

5.2.2.1 FMLM Services

A discrepancy occurs when travelers can use public transit for the majority of their trip but may require another mode of transit to get to or leave a public transit stop. This is often referred to as the "first-mile/last-mile" problem of public transportation. Some transit agencies have sought to address this issue by providing microtransit or other ride-hailing or sharing services. They have created subsidized services to encourage multi-modal transportation. An individual may have to walk a few blocks from her home, be picked up and taken to a transit stop, take public transit to a designated stop, and then hail microtransit to take the individual directly or close to their destination without having to pay for the full cost. This type of service has great potential to foster transit ridership by filling the geographic gaps of existing transit services.

Pinellas County, Florida started a microtransit pilot in February 2016 where an individual can hail an Uber or local taxi service, but rides had to go to or from a fixed location within the Pinellas Park Transit Center. The PSTA would pay for the first $5 of the ride. As of April 2018, PSTA had established 24 points where riders could be picked up or dropped off. They had 41 microtransit routes running every 15 minutes; it would take the individual directly to transit, alleviating the first or last mile problem at an affordable price. This pilot program has been regarded as a huge success and one of the pioneers of incorporating new mobility options into the service suite of public transportation (Jaffe, 2018).

GoCentennial in Centennial, Colorado, about 15 miles outside of Denver, aimed to improve connectivity to the Dry Creek Light Rail Station, the main light rail station that connects to the Denver business and shopping districts within Centennial city limits. RTD provided an on-demand, flexible and accessible service where an individual could hail a Lyft or Via vehicle to take them directly to the station at a subsidized cost. Ridership to the Dry Creek Light Rail Station increased 11.6 percent during the six-month pilot. About 68 percent of the surveyed users had never been exposed to FMLM services prior to GoCentennial, which suggest that first-/last-mile services can tap into new markets if accessible and convenient (Centennial Innovation Team & Fehr & Peers, 2017).

Valley Transit Authority in Santa Clara, Calif. identified five regions in Santa Clara County with high demand but low access to public transit. The creation of a microtransit service helped provide first-/last-mile services to technology campuses and housing clusters. The pilot project accumulated 2,471 total rides, with an average of 16 rides a day during the first three

months, and 41 rides a day in the latter three months. Thirty-five percent of the rides were traveling to or from the transit stations. While 84 percent of users were satisfied with the service, the vehicles were too large, marketing was not adequate, the service area was too small, and the algorithm did not prioritize efficiency, which caused the pilot to be not entirely successful (Westervelt et al., 2018).

5.2.2.2 Suburban Mobility and General Transit

Smaller to mid-sized suburbs can often be inaccessible to public transportation due to the pattern of low-density neighborhoods supported by low frequency transit routes. Microtransit can provide a dynamic and flexible routing system that accesses multiple stops without compromising too much on travel time. This is beneficial for low-density suburbs. As mentioned in the last section, a microtransit service may ask for a person to walk a few blocks to a designated pick-up location. Each microtransit technology differentiates in its algorithm and routing system, but it is effective in finding middle ground between the distance to a transit stop and hailing a ride directly from home, which is a useful system in some suburbs.

In California's Contra Costa and Alameda Counties (AC Transit), a demand responsive bus service called Flex was enacted to accommodate two low density and low demand areas that had an ineffective, low frequency bus route. The pilot initially served 45 rides a day in the Castro Valley and saw a greater increase in ridership over time. Bus line 275 was later discontinued, which was a cost-neutral solution due to lower maintenance costs of smaller vehicles and increased ridership (Westervelt et al., 2018). The previous services required wait times between 45 and 60 minutes, but the Flex program fed into the routes to create a more webbed network and greater transit opportunity. Flex is still in operation as we write the report. GoMonrovia in Monrovia, California subsidized bike sharing and ride-hailing services with Lime Bike and Lyft. Monrovia's fixed route transit became an issue for social and economic development. If the ride stayed within Monrovia city limits, a Lyft would cost $0.50 and Lime Bike would cost $1 every 30 minutes. Demand was very high, and little investment was needed due to existing infrastructure. This can be an effective strategy for social empowerment in the suburbs (Blodgett et al., 2017), but Monrovia struggled with such high demand.

Additionally, general transit pilots aim to provide fare reduced TNC services to increase equity by better serving underserved population groups. The Massachusetts Bay Transportation Authority (MBTA) started an on-demand paratransit service for 45,000 eligible users in the Boston area with Uber and Lyft. This on-demand service replaced an advanced booking system called "The Ride" due to the inefficiency of time-sensitive bookings. About 40,000 residents were eligible for the service. MBTA provides a maximum subsidy of $40 for each trip: Users who choose pooled services pay $1 and anything over a $41 total trip cost, and users who choose other types of TNC services pay $2 for each trip and anything over a $42 total trip cost. The partnership costs MBTA $9/ride, compared to $31/ride for "The Ride." The expansion of service witnessed a 28% increase in ridership with a cost reduction of 6% to MBTA (Blodgett et al., 2017).

Ride hailing services can be more efficient, convenient, and can reduce costs for both the user and provider. In Gainesville, the program Freedom in Motion took a unique approach. Using data from Meals on Wheels, it determined income levels of seniors and created a co-pay system to hail an Uber. Seniors may have to pay anywhere from $0 to $5, but the average was around $0 to $1 (Blodgett et al., 2017). The service was effective as it was accessible for an

underserved population; seniors could be mobile whenever they needed to be without paying typical Uber prices (Leistner & Steiner, 2017). However, as will be discussed in a later section, funding constraints can limit the success of the project.

5.2.2.3 Out-of-span Services

Microtransit is an opportunity to provide public transportation at hours when public transportation is not actively happening. This may be beneficial to early or late shift workers and students, and often can be another method used to provide transit equity for low income and underserved individuals. Increasing options for public transit times can be beneficial to transit agencies too, as long as the operational costs do not exceed the actual use of out-of-span transit.

In addition to Direct Connect, Pinellas County also implemented TD Late Shift, which provides free paratransit services from point to point for workers who travel to and from jobs that start and end between 10 PM and 6 AM (Jaffe, 2018). Requirements include purchasing an $11 monthly bus pass and meeting certain income qualifications. An individual can then take 23 trips per month, as well as one daytime Uber trip for $3 per month. This program experienced 50,000 rides in a 15-month span and helped relieve significant transit barriers for low-income individuals who worked late shifts.

5.2.2.4 Peak-hour Services

Peak-hour microtransit services boosts public transportation by reducing the use of SOVs. With the highest roadway congestion happening during rush hours, offering ride-hailing services during high demand hours can alleviate some of the roadway traffic. This business model may also be effective during temporary instances with high roadway demand, such as for sporting events or festivals.

For Dayton, Ohio, the reduction of bus service frequency for several routes resulted in lower ridership during peak hours. In response, free Lyft rides were offered to reach several bus stops along transit corridors to help encourage using public transit despite the decreased availability during peak hours (Schwieterman et al., 2018). KCATA's Bridj pilot operated only during peak hours. While potentially useful during these hours, 31% of the survey respondents stated the timing options were inconvenient, indicating that services may need to accommodate off-peak times (Westervelt et al., 2018).

TNC partnerships can also alleviate parking in high density areas through incentivizing single occupant vehicle users to hail rides to transit stops. In October 2016, the Resident Commuter Ridesharing Program in Summit, New Jersey, partnered with Uber to begin a pilot project to alleviate high-use parking infrastructure at the Summit Station. The limited program allowed for free Ubers if the commuter had purchased an $80 monthly parking pass and hailed an Uber to or from the Summit Station, or a $2 flat rate for an Uber if the commuter had purchased a $4 daily parking pass. Over the first six months, thirty spaces opened up, enabling more cars to park for shopping and business within Summit. The success and satisfaction led to an extension of six months to the pilot program (Lader & Klein, 2018).

5.2.2.5 Smart Phone Applications for Ride Planning

Similar to hailing a ride from Uber and Lyft, technologies such as Bridj and Chariot can create applications for ride hailing. Every transit agency may have different approaches to the algorithm

development and the applicability of its partner's software. Some applications cross-integrate TNC software with other public transit discounts and some allow riders to book public transit and first-/last-mile connections with one transaction (Lader & Klein, 2018).

Austin, Texas designed a service called Pickup that used Via's technology to provide on-demand ride services in a geofenced area. This partnership was at no cost for Austin as Via tested the program to see if the platform could demonstrate relevance to transit agencies (Lader & Klein, 2018). West Salem, Oregon and DemandTrans Solutions also partnered to provide software for customer trip planning and service deployment to provide a general paratransit service to users. The user would reserve a trip online, and the software would provide drivers with routes based on the reservations. Denver, Colorado partnered with Xerox to create an app that incorporates Lyft, public transit, and other ride hailing services into one application to show varied options dependent on the user's needs (i.e., reduced carbon emissions, walk speed, most efficient). This helps encourage multi-modal transportation as the application optimizes the needs of the user (Schwieterman et al., 2018).

5.2.2.6 Replacement for Fixed Route Systems

While several microtransit projects may aim to increase public transit access, other projects want to eliminate any use of fixed route systems. This may be due to low ridership and high fixed costs associated with operation. Public transit ridership has rapidly decreased nationwide over the last decade and some agencies look towards dynamic ride-hailing services as an entire replacement to fixed route systems. On the flip side, ride-hailing services may unintentionally create competition with transit, or the programs may encourage the use of ride-hailing services over transit.

In Triangle Research Park, North Carolina, fixed route systems were not accommodating several suburban areas, and ridership was decreasing on fixed shuttles. One of the objectives of the project was to get rid of four shuttle routes that were underperforming. A goal outlined in the pilot was to have 200 rides a day on the new service, with 75 percent of those not requiring a stop at a transit station. While the metric was improved, it was not met. The more dynamic system provides greater access to disconnected regions, so the GoTriangle routes are slowly being phased out (Lang, 2018).

San Clemente, California had an unsuccessful pilot with its program, FLEX. Its buses were too large, the algorithm prioritized pick up over drop off and the geofenced area was too small; in addition, the operating costs were high, but the ridership was low. Data suggests that rides were replacing walking and TNC trips. Without integration into transit and fare systems, the program decreased transit ridership (Lader & Klein, 2018). Livermore Transit Authority (LAVTA) in Dublin, California subsidized 50% of a carpool ride or up to $5 of a ride from a TNC service as long as the ride started and ended in Dublin city limits. This was a response to underperforming LAVTA transit lines carrying 5-6 passengers/hour and costing the agency $20 for a fare of only $2. While it was used to assess shuttle access, the program further discouraged use of already underperforming transit (Lader & Klein, 2018).

5.2.3 Financial Models

Table 5-2 summarizes the financial models of various pilot projects. This includes TNC or technological partnerships, where and how much funding was available and the eventual cost for

users, and the length of the program. This table provides insight into potential costs and funding necessary for microtransit pilots as they correlate to the length and extensiveness of the pilot program. Funding may be dependent on several factors, such as the extra costs associated with ADA accessible vehicles, length of project, training for vehicle operators, service area or improved, safe infrastructure.

Table 5-2: Funding Mechanisms for the Partnerships

Pilot Area	**Partnership**	**Funding**	**User Cost**	**Operational Period**
Alameda-Contra Costa, California	DemandTrans Solutions, retired fleet	$100,000 grant from Alameda County, $100,000 grant from Livermore Transit Authority	$2.10, same as AC Transit fare	2016 – March 2018
Austin, Texas	Via, existing paratransit	Via's technology was at no cost to Capital Metro, pilot itself cost about $50,000	N/A	June 2017 – June 2018
Boston, Massachusetts	Uber, Lyft, local taxis	---	$2, MBTA covers up to $13/trip for 20 rides a month	October 2016 – present
Centennial, Colorado	Lyft, Via	$129,717 of $400,000 funding used: split 50/50 between Centennial and Southeast Public Improvement Metropolitan District	Average cost of Lyft Line ride: $4.70	August 2016 – February 2017
Dublin, California	Lyft, Uber	---	50% of carpool ride, up to $5	January 2017 – June 2018
Durham-Raleigh-Chapel Hill, North Carolina	Existing shuttles	Grants from Congestion Mitigation and Air Quality Improvement and Federal Highway Administration	First six months: free fare, later increased to $2.25 with free transfers to non-express routes	January 2018 – June 2018
Gainesville, Florida	Uber	---	Co-pay, users pay average $0 to $1, maxes out at $5	September 2016 – March 2017
Kansas City, Missouri	Bridj	$1.5 million from leftover sales tax	$1.50, equivalent to bus fare	March 2016 – March 2017

Pilot Area	**Partnership**	**Funding**	**User Cost**	**Operational Period**
Monrovia, California	Lime Bike, Lyft	$1 million annually	$0.50/Lyft ride; $1/30 minutes Lime Bike in Monrovia city limits	March 2018 – present
Pinellas County, Florida (Direct Connect)	Uber, local transit	Initial pilot acquired $40,000 investment	Agency subsidized $3/ trip; extension of pilot allowed subsidy of $5/ trip	2016 – present
Pinellas County, Florida (TD Late Shift)	Uber	$300,000 state grant, secured $500,500 grant after success of pilot	23 free rides a month	August 2016 – present
San Clemente, California	Lyft	$900,000 grant from Orange County Transportation Authority	$2 minimum with a subsidy up to $9	November 2016 – November 2-017
Santa Clara, California	Retired fleet	---	$2 off-peak, $3 on-peak hours	Six months
Summit, New Jersey	Uber	---	Monthly parking pass: Uber was free Daily parking pass: $2/ride	October 2016 – October 2017
West Salem, Oregon	DemandTrans Solutions	Connector program cost $234,000 to operate, software cost $15,000	N/A	June 2015 – March 2017

Constraints on Funding

Financial sustainability of microtransit pilots can be difficult as pilots may have a limited budget while complying with federal funding standards. Pilot partnerships with TNCs are often discontinued due to budgetary concerns. Transit services aim to reduce ridership and potentially lower operational costs, but low ridership and budget constraints can limit the impact of the project, and in turn, increase costs. Microtransit projects are modelled to create more dynamic, public systems of transit. Since there is more nuance and unpredictability in microtransit systems, the operation costs are naturally going to be higher. If not executed correctly, the agency may incur more costs than anticipated.

However, it is difficult to determine how to correctly execute a pilot project, as different business models may require different systems of operation. For example, first- and last-mile services may focus more on targeting underserved areas, whereas general transit may focus on marketing strategies and accessibility compliance. Other factors such as supply and demand, density, accessibility issues, and technology services can play a role in the effectiveness of a project.

Another constraint is complying with federal standards. Under the Americans with Disabilities Act, transit agencies must provide paratransit services that are wheelchair accessible. If pilot projects are not ADA compliant, it will not receive federal funding. ADA-compliant vehicles are most expensive, so agencies must consider this trade-off, especially if their budget is small.

5.2.4 Impact on Public Transit

If executed correctly, microtransit can be supplementary to public transit infrastructure. If microtransit aims to be a step in a multimodal trip, it can ensure that public transportation will be used with greater convenience and flexibility. Microtransit convenience can additionally convince single occupancy vehicle users to switch to public transit systems, which can reduce congestion. This also has environmental benefits with the reduction of greenhouse gases. Additionally, general paratransit systems aim to be on a par with or lower than existing transit systems, which increases equity among underserved, low-income populations.

On the other hand, microtransit can interfere with existing fixed transportation. Because of the convenience of microtransit services, some may take a ride with microtransit that would otherwise be taken on public transportation. Additionally, some microtransit pilots aim to completely replace public transit altogether, which may encourage congestion. While the benefits of convenience exist, inequity may still exist if the services do not aim to target underserved areas or provide varied multi-modal options.

There are some potential challenges when creating a microtransit project. One of the most obvious is microtransit competing with fixed route transit. If pilot programs do not try to encourage multi-modal transportation, microtransit vehicles will only discourage the use of existing fixed route systems, which will worsen road congestion and greenhouse gas emissions. Agencies must be cognizant of the scope and impact of a microtransit project. In major urban corridors with high frequency and ridership, microtransit will not have as strong an impact, as microtransit vehicles do not serve as many people nor operate as often.

The idea of “elite projection” can make it difficult for microtransit projects to target underserved populations. Microtransit should be implemented for the benefit of the greater good. Cost, capacity, and efficiency are vital factors that need to be evaluate to reach underserved populations. Additionally, technologies that show multiple modes of transportation, seat reservation, and payment methods create more convenience, but it is important to address the digital divide. While options like this can benefit several users, providing accommodations for technology-insecure individuals helps continue to encourage microtransit for the greater society.

Case Study – East Queens, New York

A study of East Queens' historical commuter vans exemplifies the social benefits of transit systems, but also outline some of the potential shortcomings that can exist if not integrated into existing public transit. The region has high density and a low-income population with a high dependence on public transit. The three-month study incorporated on-board surveys including demographics, such as immigration status and gender, and reasons for transit use, such as car ownership and availability of a MetroCard. The findings show that the Metropolitan Transportation Authority (MTA) receives most of the fare revenue while only providing half of the feeder buses. Yet passengers are pleased with accessibility, affordability and convenience, and van drivers can make a living as members of the community. This indicates a win-win-win situation as it provides efficiency and affordability for the agency, the user, and generates income for the local economy.

Overall, there is a net positive impact on MTA. The split between commuter van use and bus routes that run parallel is almost equally distributed; thus, the elimination of commuter vans would require MTA to accommodate a doubling of ridership on buses while only receiving an increase of 40% of fare revenue. The study concludes that the vans are beneficial to MTA because they represent a high-quality feeder route system for other transit systems, and they help offset increased ridership at peak hours. However, in the surveys, 78% of users identify MTA transit systems as an alternative mode of transport which suggests potential competition. While the study finds evidence for multi-modal transportation, vans still pose a threat to public transit. Additionally, the increased number of vans competing with buses could potentially create more unneeded congestion. Microtransit services can help increase equity while lowering costs for the agency, but they may decrease ridership on fixed route transit. Agencies need to concentrate on improving equity with a rising use of private vehicles while encouraging multi-modal transportation too. (Musili & Salon, 2019).

5.2.5 User Characteristics and User Experiences

5.2.5.1 User Characteristics

To understand how user perception impacts microtransit pilot studies, it is important to address who uses transit and microtransit, and how this plays a role in user experience and ridership. This can also be an important tool in understanding why non-users do not use transit and how microtransit programs can help reach demographics that may not typically use transit. The American Public Transportation Association identified key demographics of American transit users and their key travel characteristics (Clark, 2017). The main findings are summarized in Table 5-3.

Table 5-3: Demographic and Travel Characteristics of American Transit Users.

Demographic characteristics	Key travel characteristics
79% aged 25 to 54 40% white, 60% minority 24% black – the largest minority represented 31% two-person household 71% employed, 7% students 55% women	44% use transit for convenience, 40% have no other alternative, 16% use transit for economic reasons 50% use transit five days a week, 13% use six or seven days a week 69% walk to their stop or station, 76% walk to their destination

Demographic characteristics	Key travel characteristics
13% household income under $15,000 65% have a driver's license 51% hold a bachelor's degree	57% would use an alternate to public transit if the current transit system was unavailable 50% require a transfer to another trip 53% of riders have been using transit for five or more years

Several studies have indicated that demand-responsive transit can target several groups that are already highly represented in public transit demographics, as well as continuously targeting underserved populations. In East Melbourne, Australia, younger populations (15-24), older populations (55+), and women are more highly represented in demand-responsive transit than public transit systems. In addition, San Francisco suburbanites state that they have a moderate willingness to use demand-responsive transit and are even more willing to pay higher fares and are accommodating to increased wait times. In a study of the OmniLink demand-responsive transit (DRT) service in Prince William County, Virginia, 61% of users are women, and 64% of users make less than $25,000 (Jain, Ronald, Thompson & Winter, 2017).

Public transit users seem to be quite diverse in socioeconomic status, race, age and gender, and microtransit services seem to target underserved populations. A greater representation of transport disadvantaged groups in the user groups of microtransit services suggests that microtransit has the opportunity to provide access to people and regions that are not as highly served in public transit. However, strategies to ensure that diverse and underrepresented demographics will be essential to the success of these projects.

5.2.5.2 User Experiences

User perception varies across the pilot projects. Users tend to favor a pilot project that is convenient, accessible and affordable. In general, rider satisfaction is higher if people can be picked up and dropped off closer to their destination, if they can ride during off-peak hours, wait a minimal amount of time, and enjoy more flexible services.

Another way to analyze user perception is to see how changes in pilot projects manifested higher ridership. Since not a lot of information is available on how to make projects successful, listening to users throughout the pilot and making necessary adaptations can increase ridership and improve ridership satisfaction. For example, in Santa Clara County, California, the initial service area for the pilot project was 3.25 square miles for the first three months. Users complained that the service needed expansion, so the agency expanded from 3.25 to 5.5 square miles. The pilot program experienced a three-fold increase in ridership. By the end of the project, 84% of users said the service was good or excellent (Westervelt et al., 2018).

User perception may also be due to lack of understanding about the project. In Centennial, 37% of non-users did not use GoCentennial because they did not understand how it worked. Other issues included the need for a car between trips from work to a light rail station, enjoying current travel habits, and lack of time (Centennial Innovation Team & Fehr & Peers, 2017). It is important for transit agencies to ensure that clear instructions are provided on service operation and how it can be a beneficial option for transit users or non-users. Perception can only change if potential or current users want to use the service, so doing more outreach services to appeal to various demographics could assist in ridership and satisfaction.

Microtransit services may provide an opportunity to improve transit systems while serving underrepresented populations that may be impacted by decreased demand for public transit. In this section, we identify additional concerns and considerations to ensure that microtransit pilots are successful and to provide improved connection between agencies and users.

5.2.5.3 Marketing Initiatives

Marketing is an essential to the success of microtransit initiatives. One of the greatest appeals of microtransit services is equity in public transportation. Marketing strategies that reach out to lower income and minority individuals help create equity. However, a limited marketing budget or marketing towards the wrong demographic or geographic region can result in an unsuccessful microtransit experiment.

In Alameda and Contra Costa Counties (AC Transit), during a partnership with the technology vendor, MobilityDR, the initial marketing strategy was only a website and a brochure. Access to the internet was the main method used to educate participants about the program. However, with the discontinuation of a low-frequency bus line, a substantial marketing budget provided 11,000 direct mailings to businesses and residences in the service area as well as brochures, seat drops, ads on busses and light rail stations, and bilingual brand ambassadors. AC Transit reports that the marketing helped substantially increase ridership (Westervelt et al., 2018). Using traditional marketing strategies and ones that appeal to transit-dependent individuals (i.e., advertisements on the bus for transit-dependent individuals, bilingual ambassadors for minority populations) helped to encourage equal access and usage.

5.2.5.4 Unionization

Since TNC drivers are independent contractors, transitioning from a non-unionized work force to a unionized one can be challenging. Some partnerships were formulated where unionized workers performed work on behalf of the TNCs, whereas other partnerships have reallocated labor and resources so that existing staff are transferred to other services and routes; the structure of the labor relationship depends on what the agency and partnership think is feasible from a legal standpoint. (Lader & Klein, 2018). In Kansas City, to alleviate potential competition with the Amalgamated Transit Union (ATU), KCATA and ATU created a partnership to eliminate competition and job loss in core ATU services and to increase overall productivity (Westervelt et al., 2018).

5.2.5.5 Data Inaccessibility

TNCs acquire several layers of data from their operations. Transit agencies should find ways to use this data to their advantage to make meaningful changes in programs and policy. Data can include information about demographics, geography, and ridership time. 0Applying these data to an agency’s business model is crucial to understanding the impact of its projects, and the opportunities to create additional partnerships and projects.

Nevertheless, TNCs have generally been reluctant to share data (Lader & Klein, 2018). Thus, transit agencies can have difficulty understanding the impacts of TNCs even though they are in a partnership. Ridership and demographic data can be essential in understanding the success of pilot projects, especially if the business model is encouraging equity for underserved populations or improving metrics of low rider transit.

5.2.5.6 Accessibility

Providing adequate service to people with disabilities is a major concern for agencies and partnerships. Since the approval of the Americans with Disabilities Act, transit agencies must operate ADA-accessible paratransit services. However, TNCs are not subject to ADA standards. Thus, most vehicles are not ADA compliant. Ensuring all TNCs have ADA-compliant vehicles becomes a cost burden to the TNC. Moreover, TNC trips are variable in cost, whereas fixed-route and paratransit services are provided at a fixed cost. Cost sensitivity is an important issue to address, because making the service accessible to all is foundational to pilot projects (Lader & Klein, 2018).

DRT, including microtransit, provides public transit services in areas with low demand and serves individuals outside of a fixed-route system or in conjunction with one. Microtransit vehicles can either provide direct pickups and drop-offs or serve passengers through several ideally placed points (Miah, Naz, Hyun, Mattingly, Cronley & Fields, 2020). DRT has a long history of successes and failures. From the 1970s to 2010, almost 50% of microtransit projects did not succeed (Currie, 2010). This was before the wide availability of new mobile technologies that have made these programs relatively accessible for a sizable part of the population. At the same time, the cost of rides has been a difficult hurdle for many transit agencies.

In 2019, the RTS started the two-year microtransit pilot program using funds from the local gas tax (Voleer, 2019). Presently, three microtransit routes serve the Gainesville metropolitan area: Routes 600, 601 and 602 (along East University Avenue, Hawthorne Road and SW 15th Avenue) (GUA-MTPO, 2020). Although there is no long-term assurance for funding of microtransit services in the RTS TDP, it is estimated that the ridership will increase by twenty percent between 2019-2029. The microtransit service is only guaranteed for the three-year pilot from 2019-2021, but microtransit expansion is a part of the desire for general expansion of the FMLM infrastructure. The TDP includes a recommendation for Route 7 service to be supplemented with microtransit service during peak morning and afternoon hours. The report recommends that this be extended to reflect the success of the East Gainesville pilot (City of Gainesville, 2019). Microtransit services currently provide similar supplementation for Routes 2, 3 and 11.

The microtransit program serves East Gainesville free of charge and there are no private partnerships between RTS and other organizations. The UF and Santa Fe College have collected fees from students for enhanced transit service for almost two decades. According to the 2019 Transit Development Plan, the development of microtransit services will cost approximately $275,853 a year during the three-year pilot (City of Gainesville, 2019).

5.2.6 Microtransit Service in Comparable Cities

Below are some samples of microtransit service in cities of comparable size to Gainesville.

5.2.6.1 Albany, New York

Albany, New York has a population of 96,460 (United States Census Bureau, 2019a). Their transportation system, the Capital District Transportation Authority (CDTA), has over fifty fixed-route buses serving the area. An additional Bus Rapid Transit program, called BusPlus, provides limited-stop services along 17 miles of one of their routes (Discover Albany, 2021). In January 2020, CDTA partnered with TransLoc to create FLEX, which is a microtransit service

that uses smaller vehicles to combine a ride-hailing approach with a more traditional bus approach. TransLoc is a subsidiary of Ford Smart Mobility and has partnerships with about forty cities nationwide.

While TransLoc covered nearly 90% of the costs involved with software development, CDTA contributed an additional $25,000 to the creation of the program. CDTA was individually responsible for supplying the vans and the operation of services (De Socio, 2020). FLEX charges three dollars per trip or 25 dollars for a ten-trip pass. Since the 2020 introduction of the program, the University of Albany has partnered with CDTA to provide students with free rides to certain destinations. Students can request rides through the TransLoc app just as other customers can, but the fare is limited to students who swipe their student IDs. This is part of a previously established partnership between the university and the transit system. The free fare is limited to students. No other group can use the service free of charge (Capital District Transportation Authority, 2020).

5.2.6.2 Worcester, Massachusetts

Worcester, Massachusetts has a population of 185,428 (United States Census Bureau, 2019d). The Worcester Regional Transit Authority (WRTA) is the second-largest transit service in Massachusetts. It offers 24 fixed routes and three shuttle routes serving the city of Worcester and 36 other communities in the Central Massachusetts area (Worcester Regional Transit Authority, 2021). WRTA launched its on-demand microtransit services through a partnership with Via. Via is a company that works with transit companies, universities, private companies, or schools to seamlessly integrate microtransit into existing infrastructure. Via has had over 140 partnerships with cities around the world, including Los Angeles, London, New South Wales, and Berlin (Allen, 2020).

The WRTA received a $460,000 award from the Massachusetts Department of Transportation for on-demand commuter services. The cost is two dollars per ride, with all rides to and from MBTA stations costing one dollar (Via Mobility Services, 2020). In March 2021, the WRTA was awarded an additional $527,986 from the Massachusetts Department of Transportation for the expansion and continuation of their on-demand services such as microtransit (WRTA, 2021). Their services are not free, and they continue to charge $1 - $2 dollars depending on the location and distance traveled.

5.2.6.3 Carlsbad, California:

Carlsbad, California has a population of 115,382 (United States Census Bureau, 2019b). The North County Transit District (NCTD) and the Breeze bus system provide transportation services for Carlsbad through 30 routes that cover of the majority of North San Diego County. The Carlsbad Connector is a bookable shuttle service that runs from the Carlsbad Poinsettia COASTER Station to business parks and around the Palomar McClellan Airport. The Carlsbad Connector was launched in August of 2019 as a pilot program, that created a partnership between the NCTD, the San Diego Association of Governments, and the City of Carlsbad (FACT, 2019). The smartphone app for the services was developed by RideCo and the shuttles were operated by WeDriveU (Sklar, 2019). RideCo is a company that develops mobile applications for transit services like microtransit, underperforming fixed routes, employee commuting, long-distance commuting, and paratransit services. Their applications are being used in major cities such as Los Angeles, Houston, and San Antonio (RideCo, n.d.). WeDriveU implements shuttle services

mainly for corporations, universities, and hospitals, though they have also other managed transit services such as the Carlsbad Connector.

Carlsbad's microtransit service was considered costly. The pilot program was suspended in July of 2020 due to the pandemic and consistently elevated prices. While the service operated in 2020, before its July suspension, the operating costs were at $35.61 per customer. The fare was $2.50 for a one-way trip or $1.25 for a one-way trip for passengers with a Senior, Disabled, or Medicare card. The service was free to those who purchased a monthly COASTER pass at $182 per adult, or a RegionPlus day pass at six dollars per adult. Considering the small portion of the cost that the fare covered, the rest was supplemented through tax revenue from the state and federal government (Diehl, 2020). The NCTD Executive Director, Matt Tucker, referred to the Carlsbad Connector as "proof of concept" and explained that it demonstrated the demand for a similar service in the community. The peak of ridership occurred in February 2020, but the pandemic brought numbers down significantly, and reduced the ability to connect to fixed routes, which were also canceled. The project was temporarily suspended in July 2020 due to that shrunken demand and the high cost of ridership. However, given a resurgence in transportation demand, NCTD has plans to expand on-demand transit programs with the start of a new pilot in May of 2021 (Diehl, 2020).

5.2.6.4 Antioch, California:

Antioch, California has a population of 111,502 (United States Census Bureau, 2019b). Tri Delta Transit (formerly the Eastern Contra Costa Transit Authority) covers the Antioch area with fourteen weekday routes and 5 weekend routes. The Tri Delta Transit started a six-month pilot program with TransLoc in June of 2019 called Tri MyRide. The ride fare was two dollars each. For this price, riders could be delivered anywhere within the Bay Area Rapid Transit (BART) service area in either the Hillcrest or Antioch area, or further to the San Marco to Pittsburgh Bay Point area. The service specifically advertises that all rides are two dollars. A mobile application is required to check the eligibility of the area for pick-up or drop-off as that fare only applies within a certain range of services. During the pandemic, the services continued to cost two dollars and users could be dropped off or picked up from anywhere within the service area.

After expanding the pilot for an additional six months, in June of 2020, Tri Delta Transit restructured the system to work under Via. The reasoning behind the switch is unclear. Their report only stated that it was a result of the TransLoc contract expiring on June 17th of 2020. The partnership with Via may have originated from a desire for better branding of the app and a clearer mobile payment platform for fares. (Tri Delta Transit, 2020). Despite the transition, the fare remained at two dollars per ride within the same service area.

5.2.6.5 Pinellas County, Florida:

Pinellas County has a population of 975,280, including the city of St. Petersburg with a population of 265,351, and Clearwater with a population of 116,946 (United States Census Bureau, 2019c). The PSTA has 210 vehicles, 40 routes, and 4,382 stops covering the entire county. Two routes go into neighboring Hillsborough County (PSTA, 2021).

Pinellas County's microtransit system differs from the other systems in the sample by the scope of services offered, but also because of the partnerships it has created. In February of 2016, Pinellas County introduced Direct Connect, a service that allowed users to call an Uber, local taxi, or paratransit provider to take them to a couple of fixed locations. PSTA covers half

the fare for this ride, up to three dollars for any user. In 2017, after receiving positive feedback on that program, they extended the services to cover up to five dollars of the fare. Such an extension in the Direct Connect services was considered a small cost compared to what the inefficient and unreliable fixed routes were spending. The pilot program switched to featured zones, where passengers had to board in one of the eight zones. Passengers had to board and exit Direct Connect in the same zone, which created significant confusion (Jaffe, 2018). In April 2018, the zones were extended from eight to 24 zones and the partnerships were expanded to include Lyft.

In 2020, PSTA budgeted $150,000 for upfront deployment, operation management, and transit app development for the integration of Direct Connect. This cost is budgeted to go down every year during the next five years while maintaining consistent service. The funds for the upfront deployment and operation management were provided by FTA Accelerating Innovative Mobility (AIM) grants (PSTA, 2020).

Direct Connect is available from 5:00 AM to 12:00 AM at 26 locations across Pinellas County. Uber, Lyft, and United Taxi users are all provided five dollars for their trips if they board the vehicle within 800 feet of one of these locations. Wheelchair Transport users receive a $25 voucher to use with the same guidelines for pick-ups and drop-offs. Uber and Lyft rides are logged via voucher codes typed into mobile applications for the individual companies. United Taxi and Wheelchair Transport require that users call and request the Direct Connect service.

6 Discussion and Final Remarks

6.1 Synthesis of Project

This research has attempted to gather an understanding of microtransit as an emerging mobility mode and as a service that is being evaluated for its place in the field of transportation. Throughout the research, there has been a constant reminder of the essence of microtransit and what it is meant to achieve. Microtransit is essentially a service that aims to connect users to numerous destinations, generally without a predetermined route. It is frequently used as a first-mile, last-mile service. This service has been discussed as ideal in addressing the challenges that fixed-route transit has in connecting users in low-density, highly residential areas. The microtransit service implemented in East Gainesville plays the role of a different type of service that can potentially address longstanding transit challenges in the area.

6.1.1 Role of Microtransit in East Gainesville

Within the context of East Gainesville, it has been noted before that the neighborhood experiences low levels of transit ridership. In several discussions and interviews during this research, participants have said that this is due to low service frequency. This, in turn, is due to the challenge of creating a transit route that could cover East Gainesville, effectively, since it is a low-density, highly residential neighborhood with an unconnected street grid on the periphery of Gainesville. In addition to the demographics previously discussed about East Gainesville, the implementation of a microtransit in this area made sense. Mostly, the perceived role of microtransit in East Gainesville has been related to its capacity to provide more frequent service during peak hours, by serving either early in the morning or late in the afternoons when workers depart or return to the neighborhood. The assessment of close to three years of service in East Gainesville has further led to an understanding that microtransit can add a mobility dynamic not previously experienced by fixed-route transit. This has led to a discussion as to whether microtransit functions as a replacement or a complement to transit.

6.1.2 Summary of Findings

What we have found in this work is that microtransit can function as both a replacement and a supplement for transit. The question of the success of microtransit has been said to hinge upon its ability to address first mile last mile issues while reducing operations cost. However, it is challenging to conceptualize ways that microtransit can reduce operations cost given the figures presented. In various inquiries, this research has found that the operational cost of services similar to microtransit run at about $55 per hour, and the inclusion of capital costs into the equation results in cost near to $72 per hour. With low levels of ridership and the niche market it serves, microtransit challenges the question of operational cost previously assumed. Therefore, since cost is a challenging measure of success for such a service. This research has finds is that microtransit's success is better measured as a replacement or complement to public transit. In both cases, however, the consideration is not to be made swiftly because the cost of implementing the service raises the need to assess how and where microtransit will be effective. While microtransit may be far from offering a widespread solution, the microtransit service is capable of addressing the specific challenge of operational efficiencies for fixed-route buses by replacing fixed routes that seriously underperform, and that are not serving their catchment area as adequately as possible.

Moreover, microtransit supports demand in areas that need the extra support. The Gainesville TDP recommends that microtransit more closely follow the Route 7 alignment in East Gainesville, which has essentially expanded the coverage area and hours of operations in that particular catchment area in a dynamic manner. This is supported by literature previously discussed that concludes that the purpose of trips being made on ridesourcing mobility modes such as microtransit are distinct from the purpose of trips on fixed-route buses. As such, it would be wrong to consider that microtransit is being used in place of fixed-route buses such as Route 7, but rather that they are being used to complement these routes. On the other hand, Routes 24 and 27 seem to be undergoing a change in Gainesville in that they will be replaced by microtransit. This research team learned that these routes severely underperformed in operational efficiency, and microtransit may better serve their respective catchment areas with more flexible and frequent service. The implementation of service into those areas would effectively solidify microtransit's capacity to address underperforming routes, not for the sake of operations cost, but for the sake of operational efficiency.

Although we were able to collect information on how the service is used, we were not able to develop a profile of the users of the service to understand the how many riders benefit from the service. For example, the data we collected shows users were equally likely to access microtransit via the app as by calls made to the dispatcher. However, microtransit users who responded to the survey overwhelmingly indicated that they access microtransit via calls to the dispatcher. Either the microtransit users who access the service via the app are under-represented in the survey, or a small number of app users take a large number of trips on the service. We could not verify this with RTS.

6.2 Discussion of Microtransit Sustainability Goals

The main focus of analysis for a service such as microtransit needs to be sustainability. In the various interviews and discussions that took place during the process of this research, the main concern among participants was how sustainable microtransit can prove to be. In a recently published research article, Buenk, Grobbelaar and Meyer (2019) developed a list of 12 Areas of Sustainability (AoS) based on their relevance to microtransit systems and their importance in the consideration of the concept of microtransit systems. The 12 AoS are subdivided into a total of 50 indicators, which we will consider and discuss in the coming sections when evaluating Gainesville's microtransit system.

Five of the AoS are found to be most associated with this research and will be discussed thoroughly: accessibility and availability, mobility, financial perspective, socio-economic, and economic productivity of the system.

6.2.1 Accessibility and Availability of Microtransit Services

Four indicators help assess accessibility and availability: customer accessibility to transport system, transport system accessibility to other locations, social equity and inclusion, and availability.

Residents of East Gainesville have been able to access microtransit since it began operating in January 2019. The service has undergone several shifts in accessibility. Initially, users could only access the service by calling the dispatcher to request a ride, and they could only get a ride to the Rosa Parks Downtown Station. Now, users can call in, or request the

service online or via a phone app to request a trip between a greater diversity of origins and destinations. Users were allowed to access the microbuses by walking up, but this option has been suspended since February 2021. Additionally, while requesting the service online is an option, it was not frequently used, leaving call-in and in-app request as the main methods of service request. While several avenues of customer accessibility exist, this evaluation should also look at how effective marketing has been at making residents aware of these choices on how to request a ride. Among non-users of microtransit, survey respondents broadly answered that they were not aware that this service existed.

Most iterations of microtransit generally connect residents to local transit hubs, effectively acting as a hub and spoke system. In terms of system accessibility to other locations, Gainesville's microtransit performs well, because it effectively connects residents of East Gainesville to 16 different destination points. In addition to this, Gainesville's microtransit system operates similar to a transit circulator in that it connects neighborhood residents to neighborhood amenities. The main complaint, however, is that the microtransit does not reach out beyond the neighborhood. The question that results is how sustainable an expansive microtransit network can be.

In terms of social-equity and inclusion, RTS has been effective in being first to bring this kind of service to a community most in need of equity in transportation to all of Gainesville. A vast majority of microtransit users identify as Black or African American and they indicate their income levels as below $35,000, and for many, not above $15,000. Microtransit operates in a historically under-resourced community in Gainesville and connects people living in low-density residential zones to a variety of nearby amenities and to the broader transit network through the Rosa Parks Downtown Station.

The question of service availability has been more contentious than the previous indicators of accessibility and availability. In many surveys, respondents expressed the need to expand hours of service, especially late at night. In interviews with microtransit service drivers and community leaders, and in response to the survey, the concern about late night service availability came from a lack of fixed-route service availability later than 8 PM throughout East Gainesville. The lack of late-night service means that transit users from East Gainesville make lengthy walks when returning from work late at night, and they make these trips at a risk to their personal safety. Low service demand is the source of these conditions, with no fixed-route services late at night. Microtransit, or a similar service, could be a viable alternative for late night services in this area.

6.2.2 Evaluation of Microtransit's Mobility

Five indicators are listed under the mobility AoS category (Buenk et al., 2019) that can be discussed briefly: time, speed, distance, transit integration, and general mobility.

In terms of time, many users of microtransit experienced on average anywhere between 15 and 20 minutes of trip travel time. The average speed or distance traveled by users of the service was not calculated as part of this research.

When evaluating transit integration, one of the more solid indicators of microtransit service's role in complementing fixed-route services is that nearly 33% of all rides requested have an origin or destination to the Rosa Parks Downtown Station, which indicates that a third of

all trips are helping people connect to the broader transit network. The project team is still working on an evaluation of the number of trips that are completed using microtransit that could be completed using the fixed-route public transit system.

General mobility may perhaps be most indicated by the number and variety of microtransit destinations available. As previously mentioned, the service is available at 16 destination points aside from the three residential zones. The destinations are mostly schools and daycare centers, general stores such as Walmart or Dollar General, and several other public services.

6.2.3 Financial Perspective of Microtransit Services

Four indicators are listed under the financial perspective category of evaluation: affordability to customer, costs to company, governmental costs, and financial security.

Currently the service operates free of charge for users of the service, however, it is unlikely that this service would remain at such a price. Survey respondents generally indicated that they would not pay more than $1.00 for services such as microtransit. The current fare for the fixed-route transit service is capped at $3 per day or $56 per month. Maintaining this service affordable to customers without a significant subsidy would lead to a heavy cost to customers in the long run since most inquiries made about similar services priced the hourly cost of operation between $55 and $75. Farebox recovery rate would be very low, even if the service operated at full capacity by charging $1.00 per trip. Moreover, an excess in demand also results in challenges to managing the algorithm and routing multiple trips at once, leading to a lower operational efficiency. The question of customer affordability is perhaps the greatest challenge to widespread service implementation, but methods such as partnerships with local employers could prove to create a more financially feasible model.

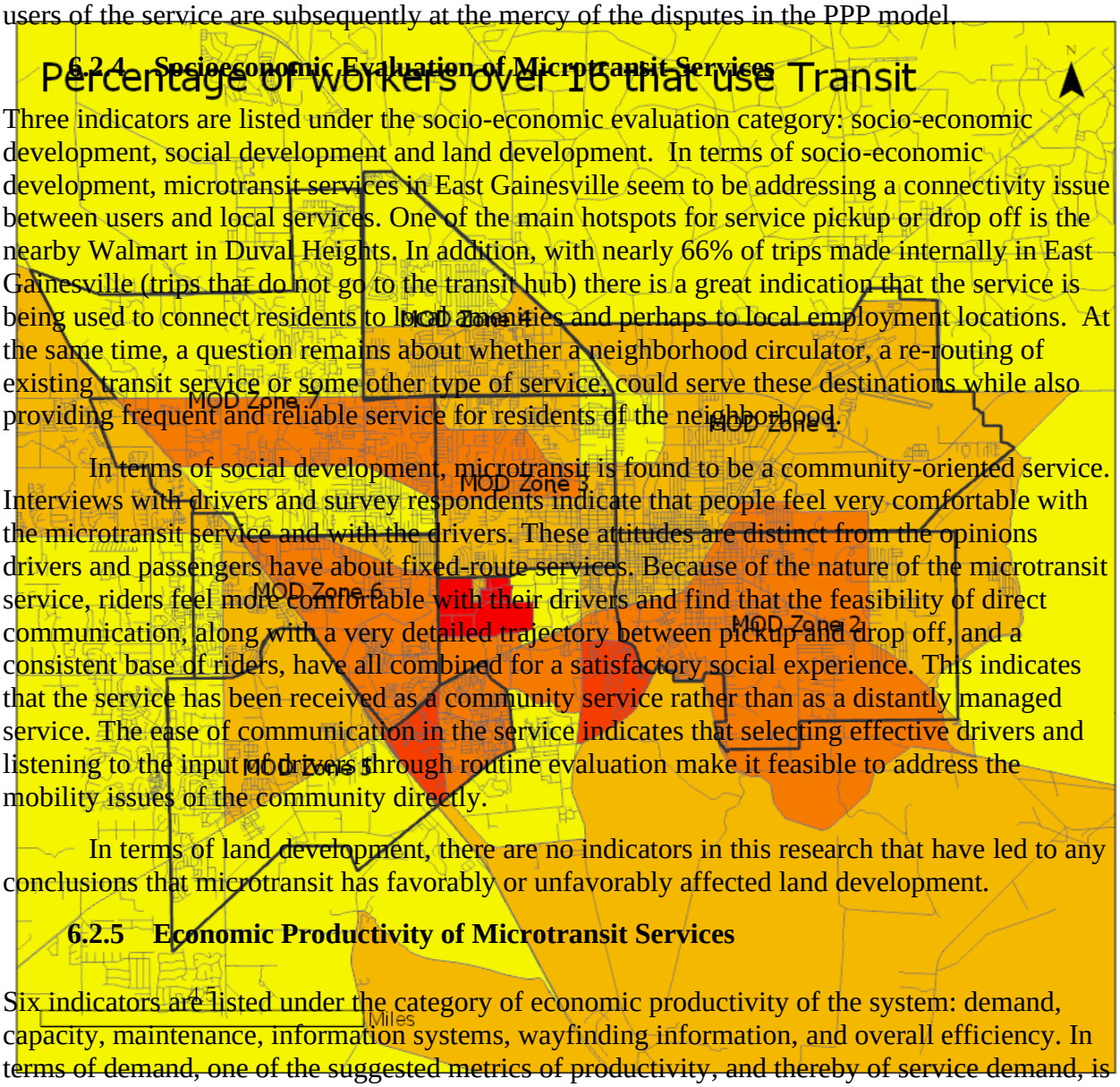
As such, when we talk about costs to company or governmental costs, it would be very challenging for RTS as a single operating agency to manage the entire cost of the service. Rather the cost could be split among employers whose workers use this service. RTS already has partnerships with the UF and Santa Fe College for fixed-route service for students and employees, and with Alachua County for a few routes that serve residents in the unincorporated part of the county. Expanding that partnership could be challenging for RTS because it may create inequities in the provision of service. In this sense then, splitting the hourly cost among various employers could help to maintain the service in operation more feasibly. However, neither public nor private entities can fully take on the burden of service cost in the long-term, but a public-private partnership (PPP) would be more effective in managing the financial aspect of the service.

Financial security has proven to be the single most contentious indicator for the success of microtransit. Gainesville's Microtransit service currently operates on a three years' worth of funding for a pilot operation of the service. At the end of three years, a financial model that ensures financial security needs to be pursued. This research finds that the PPP model could be a model for financial security. However, a PPP model could prove to have its own drawbacks depending on the way this arrangement is managed. Multiple discussions and deals would lead the PPP to be susceptible to changes, modifications and collapse from disputes or challenges from employers and all parties involved in the partnership. This results in two challenges: (1)

financial security could be lost or constantly challenged due to disputes and challenges, and (2) users of the service are subsequently at the mercy of the disputes in the PPP model.

6.2.4 Socioeconomic Evaluation of Microtransit Services

Three indicators are listed under the socio-economic evaluation category: socio-economic development, social development and land development. In terms of socio-economic development, microtransit services in East Gainesville seem to be addressing a connectivity issue between users and local services. One of the main hotspots for service pickup or drop off is the nearby Walmart in Duval Heights. In addition, with nearly 66% of trips made internally in East Gainesville (trips that do not go to the transit hub) there is a great indication that the service is being used to connect residents to local amenities and perhaps to local employment locations. At the same time, a question remains about whether a neighborhood circulator, a re-routing of existing transit service or some other type of service, could serve these destinations while also providing frequent and reliable service for residents of the neighborhood.



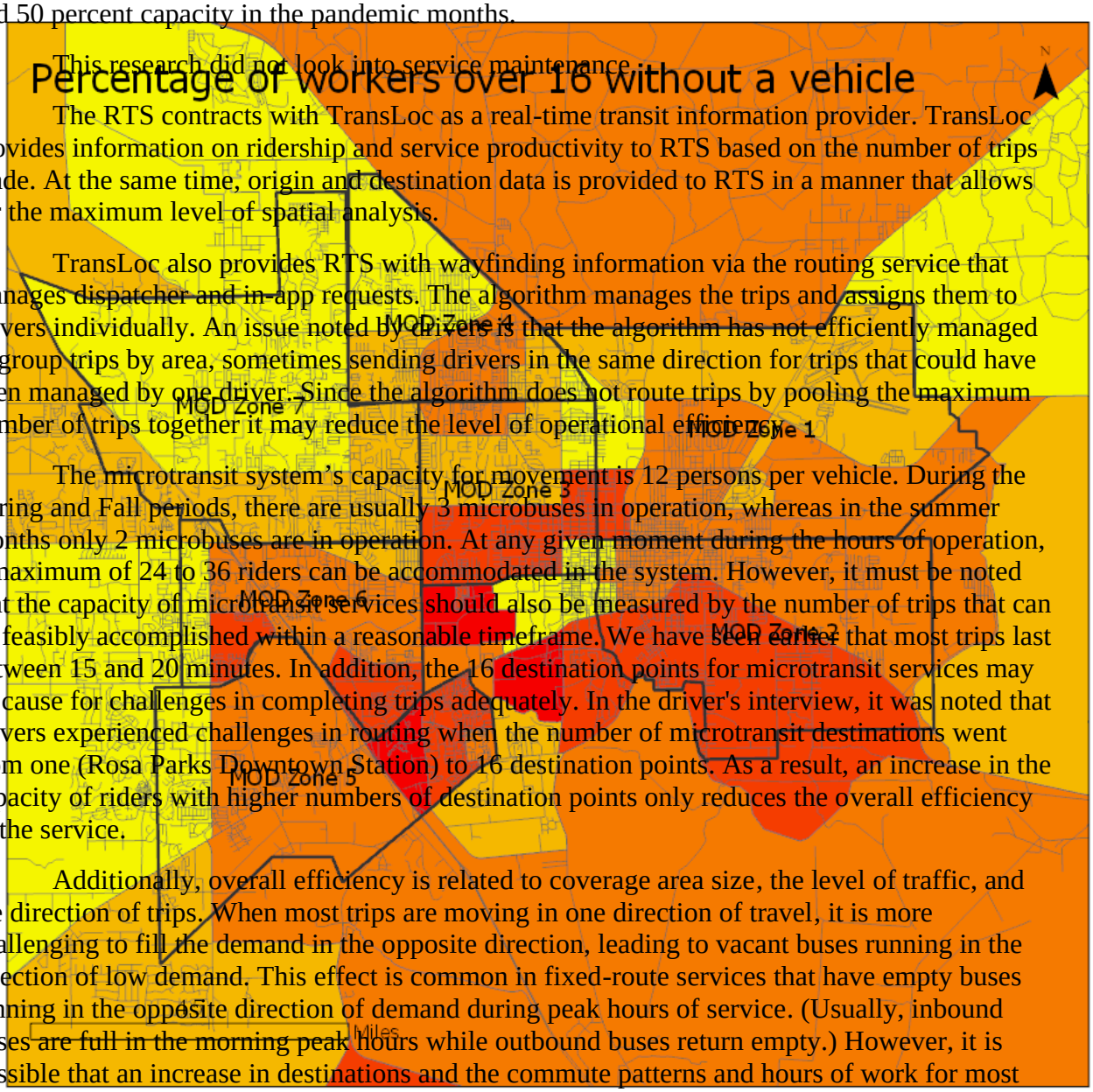
In terms of social development, microtransit is found to be a community-oriented service. Interviews with drivers and survey respondents indicate that people feel very comfortable with the microtransit service and with the drivers. These attitudes are distinct from the opinions drivers and passengers have about fixed-route services. Because of the nature of the microtransit service, riders feel more comfortable with their drivers and find that the feasibility of direct communication, along with a very detailed trajectory between pickup and drop off, and a consistent base of riders, have all combined for a satisfactory social experience. This indicates that the service has been received as a community service rather than as a distantly managed service. The ease of communication in the service indicates that selecting effective drivers and listening to the input of drivers through routine evaluation make it feasible to address the mobility issues of the community directly.

In terms of land development, there are no indicators in this research that have led to any conclusions that microtransit has favorably or unfavorably affected land development.

6.2.5 Economic Productivity of Microtransit Services

Six indicators are listed under the category of economic productivity of the system: demand, capacity, maintenance, information systems, wayfinding information, and overall efficiency. In terms of demand, one of the suggested metrics of productivity, and thereby of service demand, is a passenger per hour metric. RTS Ridership Reports (City of Gainesville, 2020) from Fiscal Year 2020 show that ridership on microtransit was about 719 passengers per vehicle per month, and ranged between 4 and 5 passengers per hours per vehicle in the months preceding the COVID-19 pandemic. During the pandemic months, the demand dropped to 287 passengers per vehicle per month and ranged between 2 and 4 passengers per hour per vehicle. By comparison, transit ridership numbers on the least and best performing routes in East Gainesville show that Route 2 averaged 13 passengers per hour and Route 7 averaged 19 passengers per hour in the pre-pandemic months. In the pandemic period, these numbers declined slightly to 12 passengers per hour and 16 passengers per hour, respectively. Evaluating these by their respective capacities (12 on the microbus, and 32 on the transit bus), microtransit vehicles in the pre-pandemic period were operating between 42 and 46 percent of capacity and then dropped to between 12 and 33 percent of capacity during the pandemic period. The fixed-route transit service operated between

40 and 60 percent of capacity in the pre-pandemic period before dropping to a range between 37 and 50 percent capacity in the pandemic months.



This research did not look into service maintenance.

The RTS contracts with TransLoc as a real-time transit information provider. TransLoc provides information on ridership and service productivity to RTS based on the number of trips made. At the same time, origin and destination data is provided to RTS in a manner that allows for the maximum level of spatial analysis.

TransLoc also provides RTS with wayfinding information via the routing service that manages dispatcher and in-app requests. The algorithm manages the trips and assigns them to drivers individually. An issue noted by drivers is that the algorithm has not efficiently managed to group trips by area, sometimes sending drivers in the same direction for trips that could have been managed by one driver. Since the algorithm does not route trips by pooling the maximum number of trips together it may reduce the level of operational efficiency.

The microtransit system's capacity for movement is 12 persons per vehicle. During the Spring and Fall periods, there are usually 3 microbuses in operation, whereas in the summer months only 2 microbuses are in operation. At any given moment during the hours of operation, a maximum of 24 to 36 riders can be accommodated in the system. However, it must be noted that the capacity of microtransit services should also be measured by the number of trips that can be feasibly accomplished within a reasonable timeframe. We have seen earlier that most trips last between 15 and 20 minutes. In addition, the 16 destination points for microtransit services may be cause for challenges in completing trips adequately. In the driver's interview, it was noted that drivers experienced challenges in routing when the number of microtransit destinations went from one (Rosa Parks Downtown Station) to 16 destination points. As a result, an increase in the capacity of riders with higher numbers of destination points only reduces the overall efficiency of the service.

Additionally, overall efficiency is related to coverage area size, the level of traffic, and the direction of trips. When most trips are moving in one direction of travel, it is more challenging to fill the demand in the opposite direction, leading to vacant buses running in the direction of low demand. This effect is common in fixed-route services that have empty buses running in the opposite direction of demand during peak hours of service. (Usually, inbound buses are full in the morning peak hours while outbound buses return empty.) However, it is possible that an increase in destinations and the commute patterns and hours of work for most people in East Gainesville have allowed for this issue not to be a challenge, with trips in all directions being used. The issue remains excessive destination points and finding the threshold of destination points that can help the system manage trips effectively. This could also be tied to the coverage area size, which would be the determinant in length of trip time and distance. After thresholds of satisfaction are established (such as satisfactory average trip times, satisfactory revenue miles, and other such indicators that can indicate adequate microtransit service performance), the number of destinations and size of coverage area can be adjusted adequately to aim for said performance indicators.

7 Recommendations

7.1 Recommendations on Existing Service

The most recent GFS TDP emphasizes the need to evaluate the implementation of transportation alternatives. The existing microtransit services are grouped under those alternatives. The discussion is framed within the context of MOD, which are transportation alternatives that can be requested on demand using the methods previously described. Further-more, the plan suggests that the implementation of mobility on demand can be evaluated in each of seven MOD zones. A spatial analysis was conducted using GIS to evaluate the mobility zones and the areas that would most benefit from the use of microtransit in Gainesville, including the spatial and demographic characteristics that would support such expansion.

In earlier sections, we evaluate the demographic attributes and travel characteristics of populations in Gainesville by census tract. The following series of maps use data from the American Community Survey Data 5-year estimates from 2013-2018 to understand the commute patterns of people in each census tract. Overlaid on these maps are the boundaries that the City has defined in their TDP as individual MOD zones. MOD Zone 2 is where the microtransit service currently operates. However, consideration of the attributes of residents and their travel in Gainesville includes Zone 2 in the analysis.

Figures 7-1 and 7-2 show two key attributes of the commute patterns of workers over age 16 in Gainesville: the percentage of workers that use transit and workers without a vehicle. These attributes are used as indicators of populations that are most likely to depend upon modes other than the automobile for travel. For both attributes, these populations were found in high levels in MOD Zones 2, 3, 5 and 6. It is important to note that the large population of university students in Zone 3 is associated with low vehicle ownership and higher transit use.

Figures 7-3 and 7-4 show the percentage of workers over 16 who bike or use alternative commute methods and carpool by census tract, respectively. Considering the small numbers of people using these mobility options, these patterns were found to be less significant and are not used in the final analysis. Biking as a mobility option is most significant in areas close to the UF and the Downtown. However, these modes are used less frequently in areas outside of the city center. Carpooling as a mobility choice is found to be more important in areas outside of the University and downtown areas, especially in MOD Zone 1, closer to the airport.

Figure 7-5 shows the distribution of transit routes in Gainesville. Routes that consistently provide late-night operations, weekend operations, and frequencies of 20 minutes or less during the peak hours are highlighted in green. The rest of the routes, highlighted in red, provide less consistent levels of service. Consistent routes are found mostly in the area of UF, and in the eastern portions of MOD Zones 5 and 6, although the west side of Interstate 75 is underserved. Zones 4 and 7, in the northwest, follow the same pattern. Zones 1 and 2 have greater route coverage; however, most routes do not provide late-night/weekend operations or high frequency service.

An evaluation of individual transit routes that are less consistent can give us a better understanding of the impacts microtransit services may have on individuals' mobility patterns in each zone. The first measure of route evaluation is ridership. Not surprisingly, the most consistent routes also happen to have the highest levels of ridership.

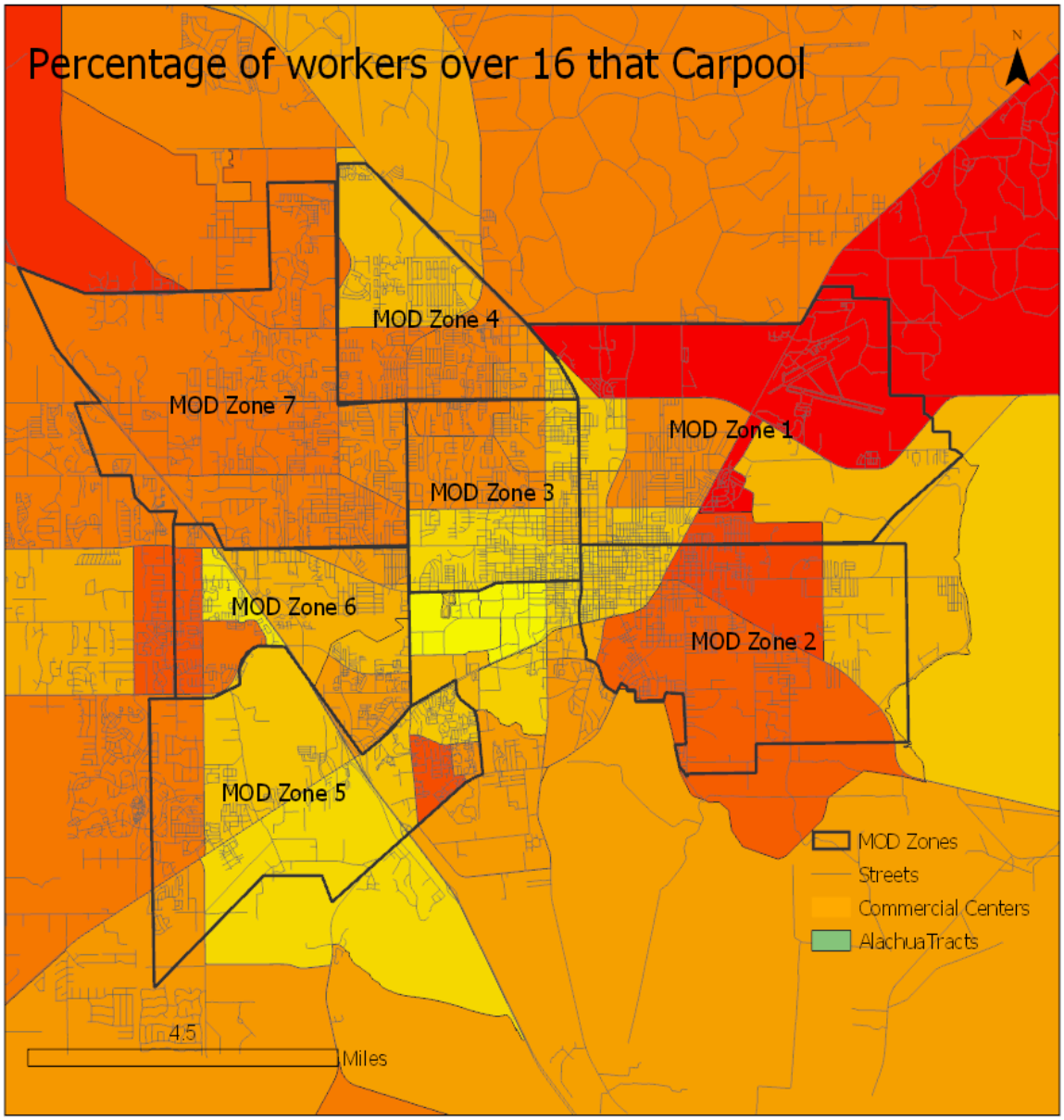


Figure 7-1: Percentage of Workers over 16 That Use Transit. Source: American Community Survey, 2013-2018, U.S. Census Bureau

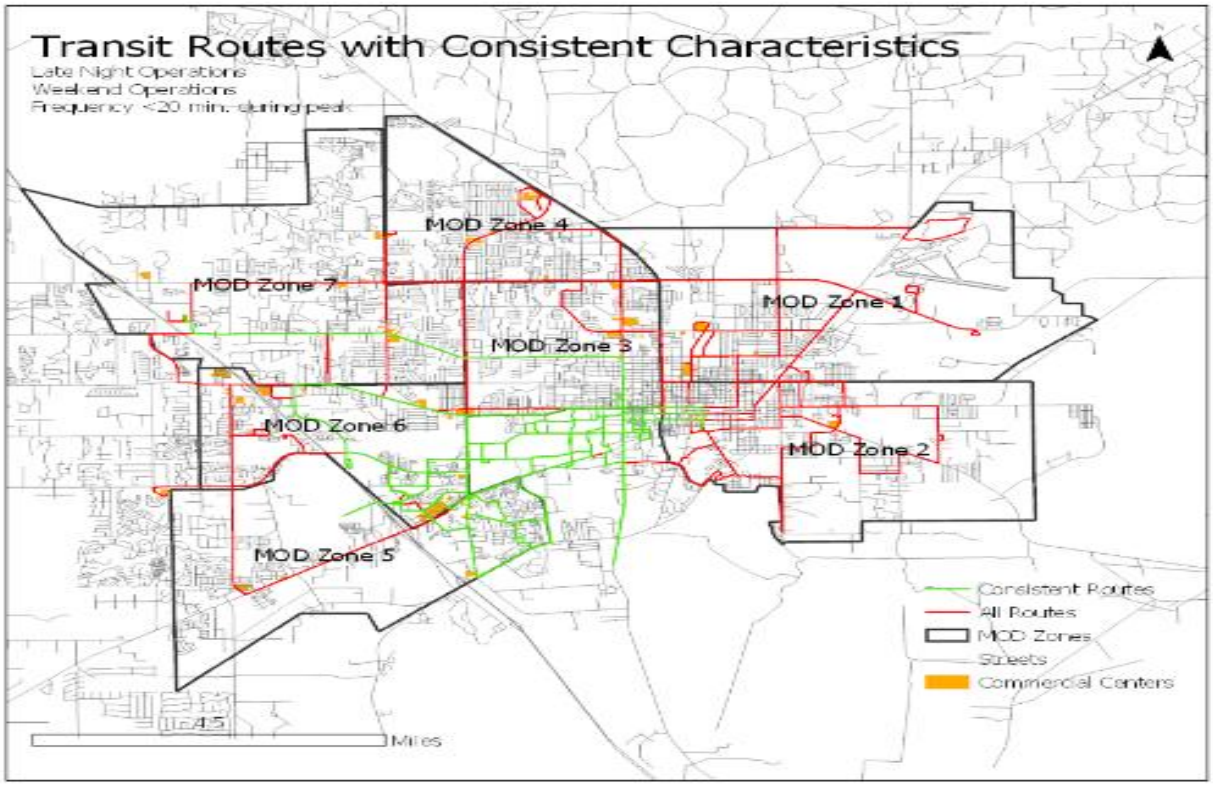


Figure 7-2: Percentage of Workers over 16 Without a Vehicle. Source: American Community Survey, 2013-2018, U.S. Census Bureau

Figure 7-3: Percentage of Workers over 16 Who Bike or Use Alternative Commute Methods.
Source: American Community Survey, 2013-2018, U.S. Census Bureau

Figure 7-4: Percentage of Workers over 16 Who Carpool. Source: American Community Survey, 2013-2018, U.S. Census Bureau.

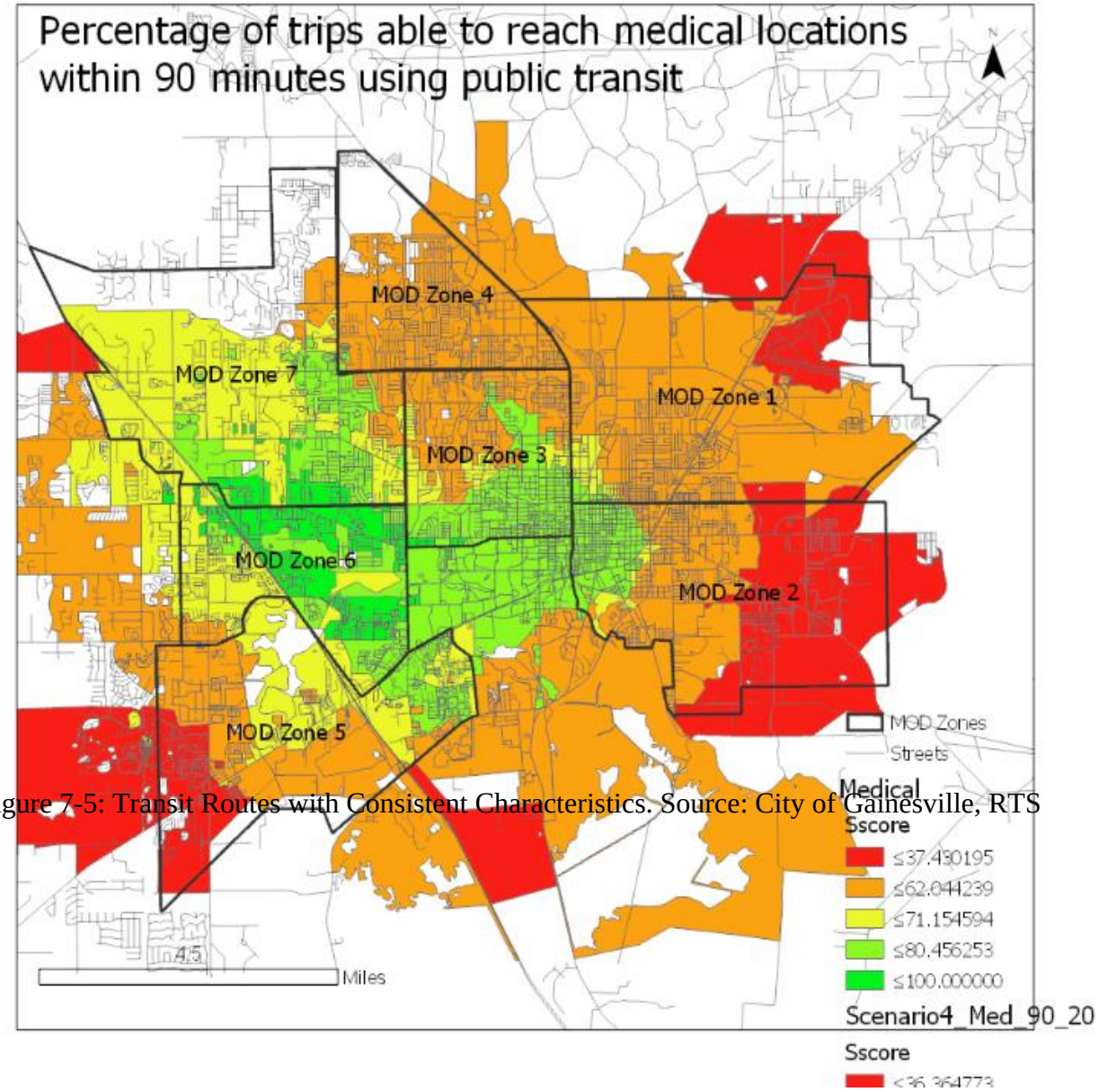
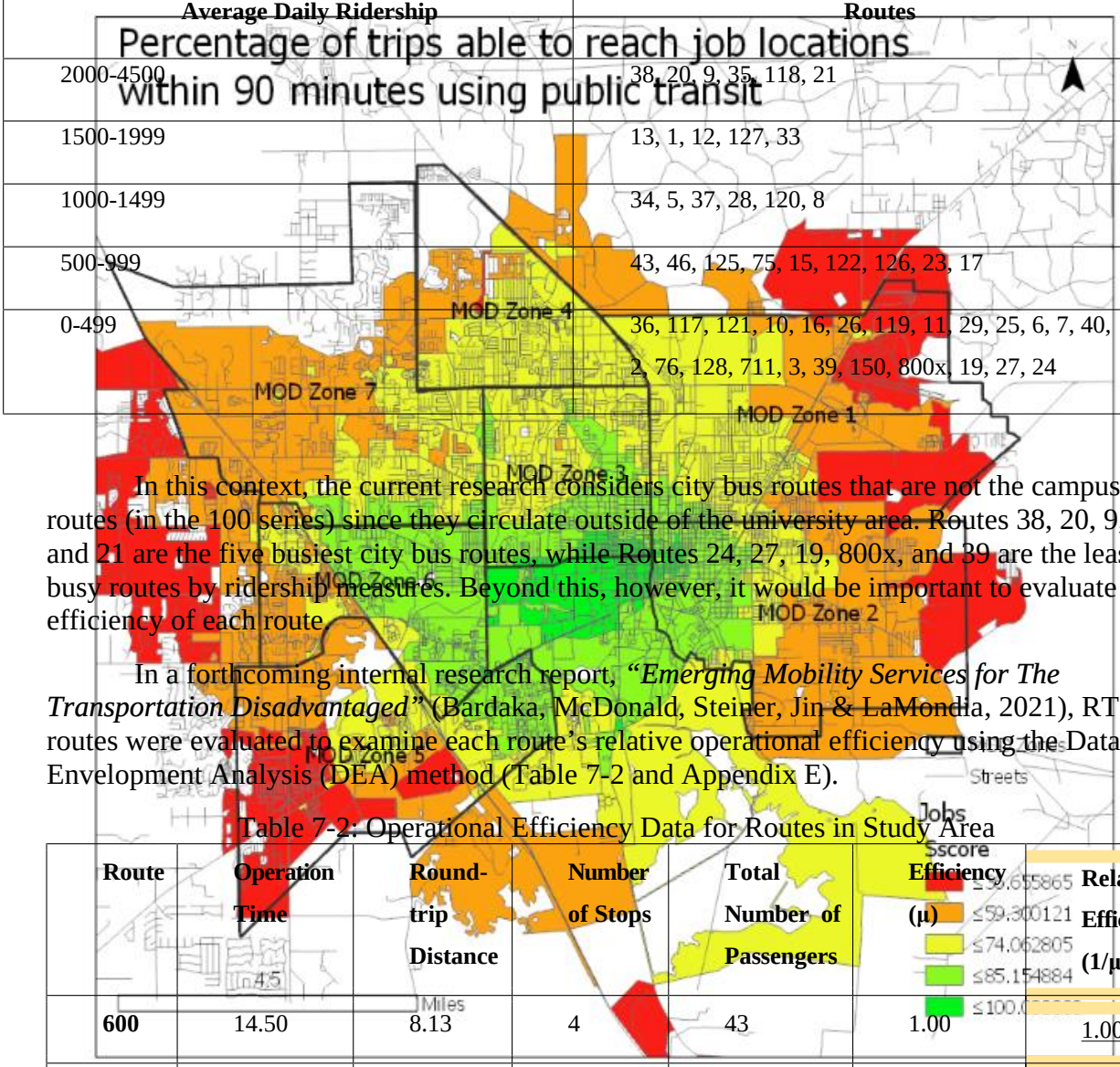


Figure 7-5: Transit Routes with Consistent Characteristics. Source: City of Gainesville, RTS

Table 7-1: Routes organized by bins in increments of 500 average daily riders per route

Average Daily Ridership	Routes
2000-4500	38, 20, 9, 35, 118, 21
1500-1999	13, 1, 12, 127, 33
1000-1499	34, 5, 37, 28, 120, 8
500-999	43, 46, 125, 75, 15, 122, 126, 23, 17
0-499	36, 117, 121, 10, 16, 26, 119, 11, 29, 25, 6, 7, 40, 2, 76, 128, 711, 3, 39, 150, 800x, 19, 27, 24



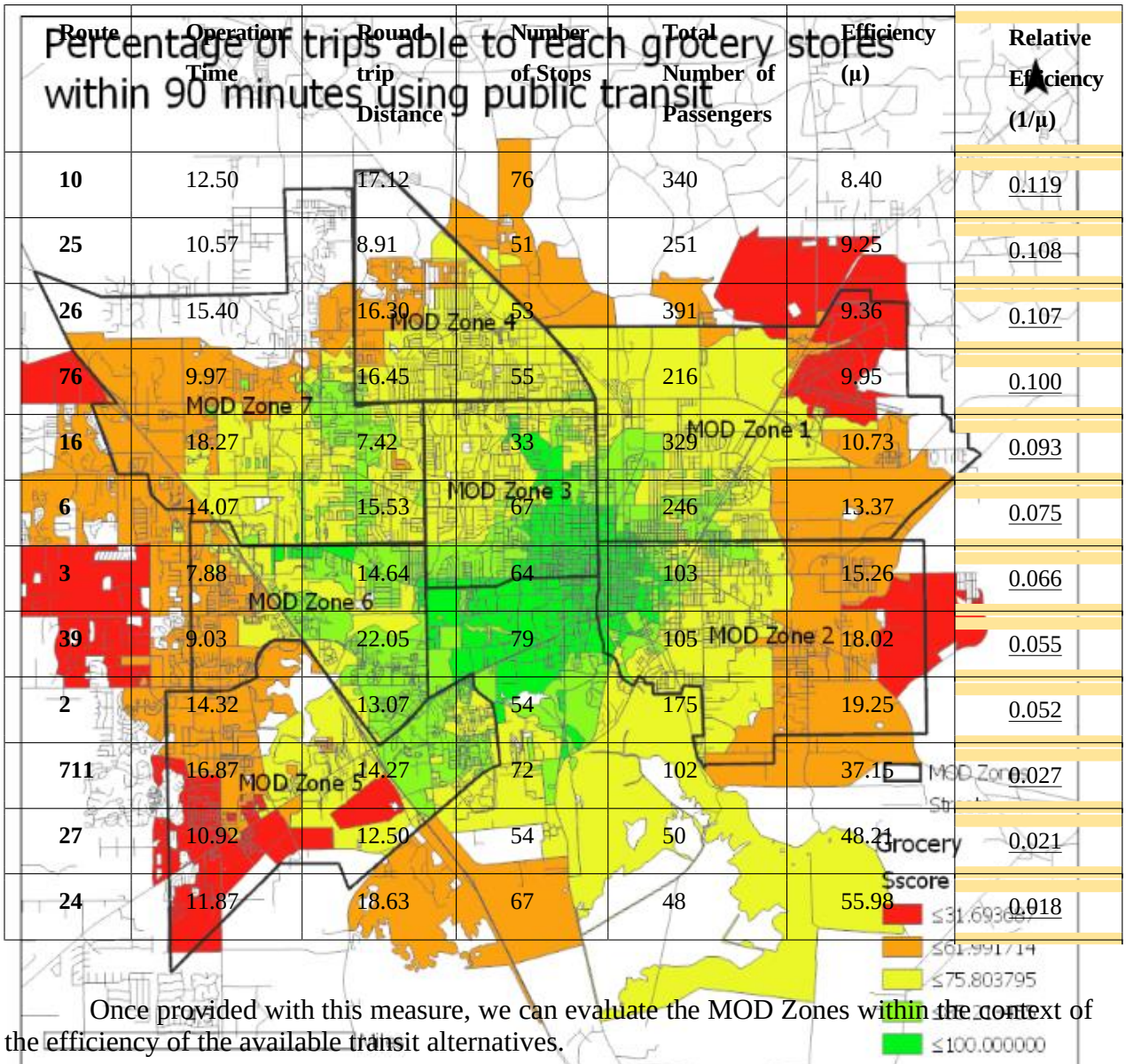
In this context, the current research considers city bus routes that are not the campus routes (in the 100 series) since they circulate outside of the university area. Routes 38, 20, 9, 35, and 21 are the five busiest city bus routes, while Routes 24, 27, 19, 800x, and 39 are the least busy routes by ridership measures. Beyond this, however, it would be important to evaluate the efficiency of each route.

In a forthcoming internal research report, *"Emerging Mobility Services for The Transportation Disadvantaged"* (Bardaka, McDonald, Steiner, Jin & LaMondia, 2021), RTS routes were evaluated to examine each route's relative operational efficiency using the Data Envelopment Analysis (DEA) method (Table 7-2 and Appendix E).

Table 7-2: Operational Efficiency Data for Routes in Study Area

Route	Operation Time	Round-trip Distance	Number of Stops	Total Number of Passengers	Efficiency (μ)	Relative Efficiency (1/μ)
600	14.50	8.13	4	43	1.00	1.000
601	14.50	7.93	4	32	1.00	1.000
20	19.90	11.46	51	2477	1.52	0.657
5	20.38	12.77	65	1000	3.77	0.265
43	13.58	20.60	95	795	3.97	0.252
8	17.40	17.91	92	823	4.58	0.218
15	17.48	14.34	74	666	5.67	0.176
75	16.72	28.80	122	656	5.75	0.174

Route	Operation Time	Round trip Distance	Number of Stops	Total Number of Passengers	Efficiency (μ)	Relative Efficiency (1/μ)
10	12.50	17.12	76	340	8.40	0.119
25	10.57	8.91	51	251	9.25	0.108
26	15.40	16.30	53	391	9.36	0.107
76	9.97	16.45	55	216	9.95	0.100
16	18.27	7.42	33	329	10.73	0.093
6	14.07	15.53	67	246	13.37	0.075
3	7.88	14.64	64	103	15.26	0.066
39	9.03	22.05	79	105	18.02	0.055
2	14.32	13.07	54	175	19.25	0.052
711	16.87	14.27	72	102	37.15	0.027
27	10.92	12.50	54	50	48.21	0.021
24	11.87	18.63	67	48	55.98	0.018



Once provided with this measure, we can evaluate the MOD Zones within the context of the efficiency of the available transit alternatives.

Bardaka et al. (2021) examines the percentage of transit trips that could be made for five trip purposes: Employment, Education, Grocery, Medical, and Social. The gap model that was developed to perform the described analysis considers the number of trips that could be made within a 90-minute timeframe on public transit for each of the five trip purposes. For the present research, we exclude the scenario that considers social trips. The model does not take into consideration demographic attributes or mobility attributes particular to each unit of evaluation (which are census blocks in this case). The results of this evaluation are found in the following maps (Figures 7-6 to 7-9).

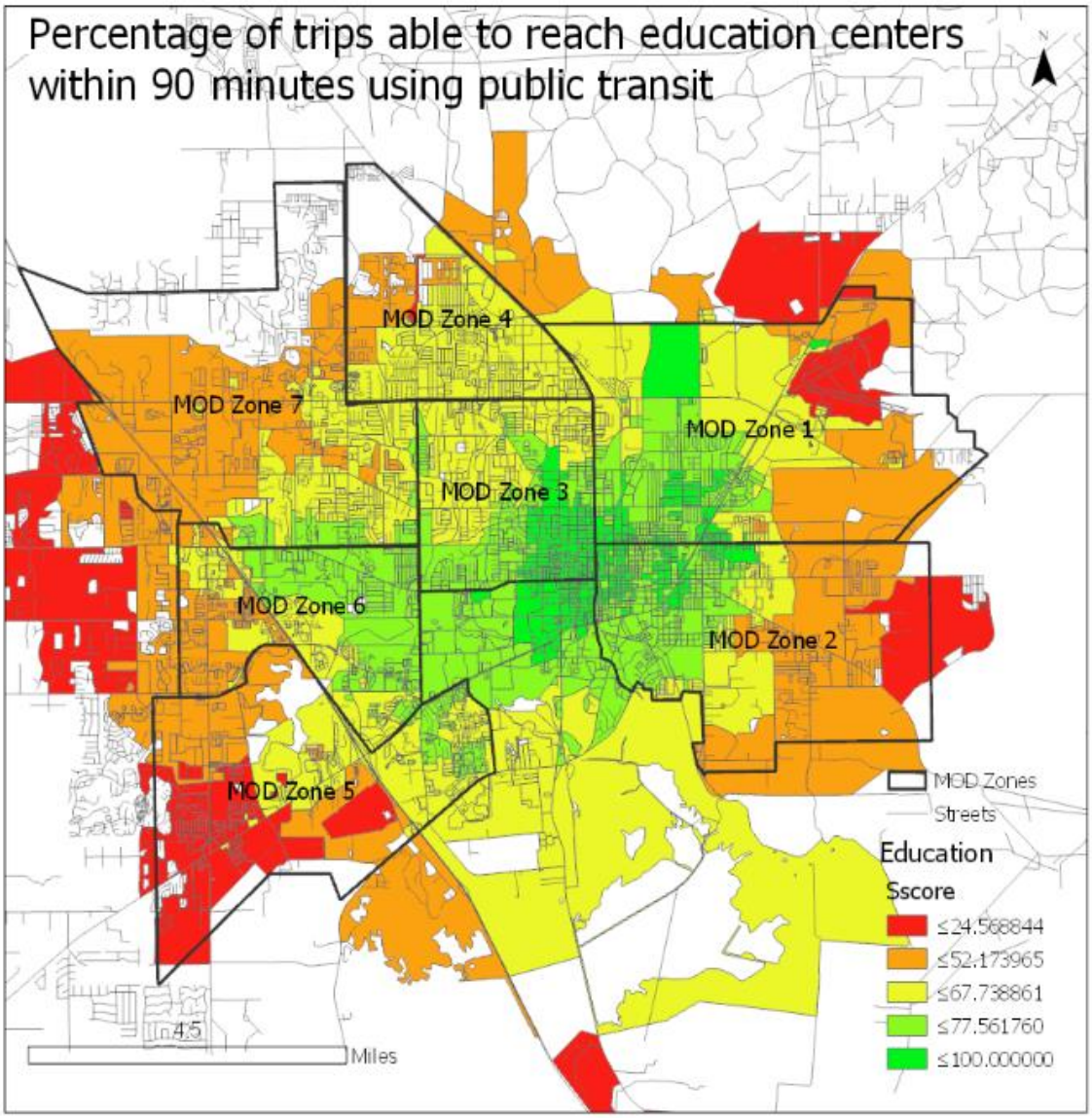


Figure 7-6: Percentage of Trips Able to Reach Medical Locations Within 90 Minutes Using Public Transit. Source: Bardaka et al. (2021)

Figure 7-7: Percentage of Trips Able to Reach Job Locations Within 90 Minutes Using Public Transit. Source: Bardaka et al. (2021)

Figure 7-8: Percentage of Trips Able to Reach Grocery Stores Within 90 Minutes Using Public Transit. Source: Bardaka et al. (2021)

Figure 7-9: Percentage of Trips Able to Reach Education Centers Within 90 Minutes Using Public Transit. Source: Bardaka et al. (2021)

Transit-dependent residents on the east side of Gainesville have needed reliable transportation for a long time. Throughout this project, we learned that the pilot microtransit services provided an opportunity for transit-dependent individuals to have more frequent service, to overcome the lack of public transit options for certain destinations, and to expand their access to other parts of the city. The Gainesville microtransit program has been operating for just over two years of service. As such, it is still not a mature service, and it still needs to provide a more economical solution than the current fixed-route service. Currently, the cost of microtransit services are estimated at $35.63 a ride, with an annual inflation rate of 1.6% (City of Gainesville, 2019). The research team was not able to independently confirm this estimated cost. This exceeds the standard investment made in transit services in the area and should be reconsidered in the scope of available alternatives in funding as outlined in this section.

Two main recommendations are provided to ensure long-term financial stability and equitable access and availability. Through evaluation of AoS introduced by Buenk et al. (2019), five specific areas will be touched upon: *financial perspective*, *accessibility and availability*, *mobility*, *socioeconomic*, and *economic productivity of the system.*

7.1.1 Financial Stability

Microtransit can be quantified on a financial level by balancing its affordability with associated costs for private companies or the government. In the city of Gainesville, the microtransit program is operated by RTS and provided to the citizens of East Gainesville for free. Based upon the activities of peer cities, mentioned in the previous sections, accessing diverse funding sources and collaborating with major employers helps to improve the economic aspects of the microtransit system and to ensure long-term sustainability.

Historically, most microtransit programs have been piloted and then failed after about three years of operation due to their inability to secure long-term funding. Cities that continue microtransit services after the pilot have built a partnership with private entities or other public sector agencies. While potentially damaging to user satisfaction, the public nonetheless expressed a willingness to pay fares for reliable services. If the city of Gainesville were to partner with major employers, they would have an opportunity to create a service that blends different sectors. Fares could be paid by the individual, or fares could be provided by the companies who want more reliable transportation for their employees.

Guaranteeing partnerships with private and public employers in the area that have a continued need for transportation could guarantee the previously elusive financial security. Table 7-3 features a list of key employers in the Gainesville metro area according to the Gainesville Area Chamber of Commerce in 2016 (Gainesville Area Chamber, 2016). UF and Santa Fe College already have partnerships with RTS. Considering the density of demand, collaborating with key employers can maximize employees' access to jobs and create opportunities for additional riders, including transit-dependent communities, to use transit. Similar to case studies provided in this report, by just collaborating with a greater number of employers in Gainesville, RTS can (1) boost ridership through specific promotions, (2) ensure job access for transit-dependent communities, (3) secure funding for microtransit services in the long term, and (4) expand services and improve overall efficiency in the system's performance.

Table 7-3: Employment in the Gainesville Metropolitan Area

Corporation	Industry	Number of Employees
1 University of Florida	Education	27,567
2 UF Health Shands System	Healthcare	12,705
3 Veterans Affairs Medical Center	Healthcare	6,127
4 Alachua County School Board	Public education	3,904
5 City of Gainesville	Government	2,072
6 North Florida Regional Medical Center	Healthcare	2,000
7 Gator Dining Services	Food service	1,200
8 Nationwide Insurance Company	Insurance	960
9 Alachua County	Government	809
10 Publix Supermarkets	Grocery	780
12 Santa Fe Community College	Education	750
13 Wal-Mart Distribution Center	Grocery	738
11 Wal-Mart Stores	Grocery	312
14 Dollar General Distribution Center	Retail	600
15 RTI Surgical	Orthopedic/Cardio	518
	Total	60,524

Source: Gainesville Area Chamber (2016)

7.1.2 Accessibility and Availability

The current microtransit program is limited to origins and destinations in East Gainesville. The service could be expanded to cover greater geography both within and outside of East Gainesville. As seen in the analysis of Pinellas County, the financial balance of that system was guaranteed through the elimination of previously inefficient routes. The City of Gainesville could achieve comparable results through the analysis of the routes suggested in Section 5. If the City of Gainesville were to guarantee reliable transit to East Gainesville, it would increase social equity and inclusion in the area through connected infrastructure.

Microtransit is generally rated as a time-efficient solution for transportation that limits the waste that fixed-route programs experience. As a form of DRT, it reduces the number of stops that the vehicle makes and increases efficiency. Smaller vehicles are also more convenient in terms of maneuverability, making them ideal for navigating smaller and more crowded streets or areas with poor roadway infrastructure. The future success of the microtransit program in Gainesville will depend on merging the idea of smaller vehicles with the more fundamental components of a fixed route service. Costs should be cut through the elimination of ineffective RTS routes catering to small groups with larger vehicles. Reassessing the existing routing will guarantee both the affordability of the system to provide such services, and accessibility, as these smaller populations continue to receive support.

7.1.3 Value of Partnership

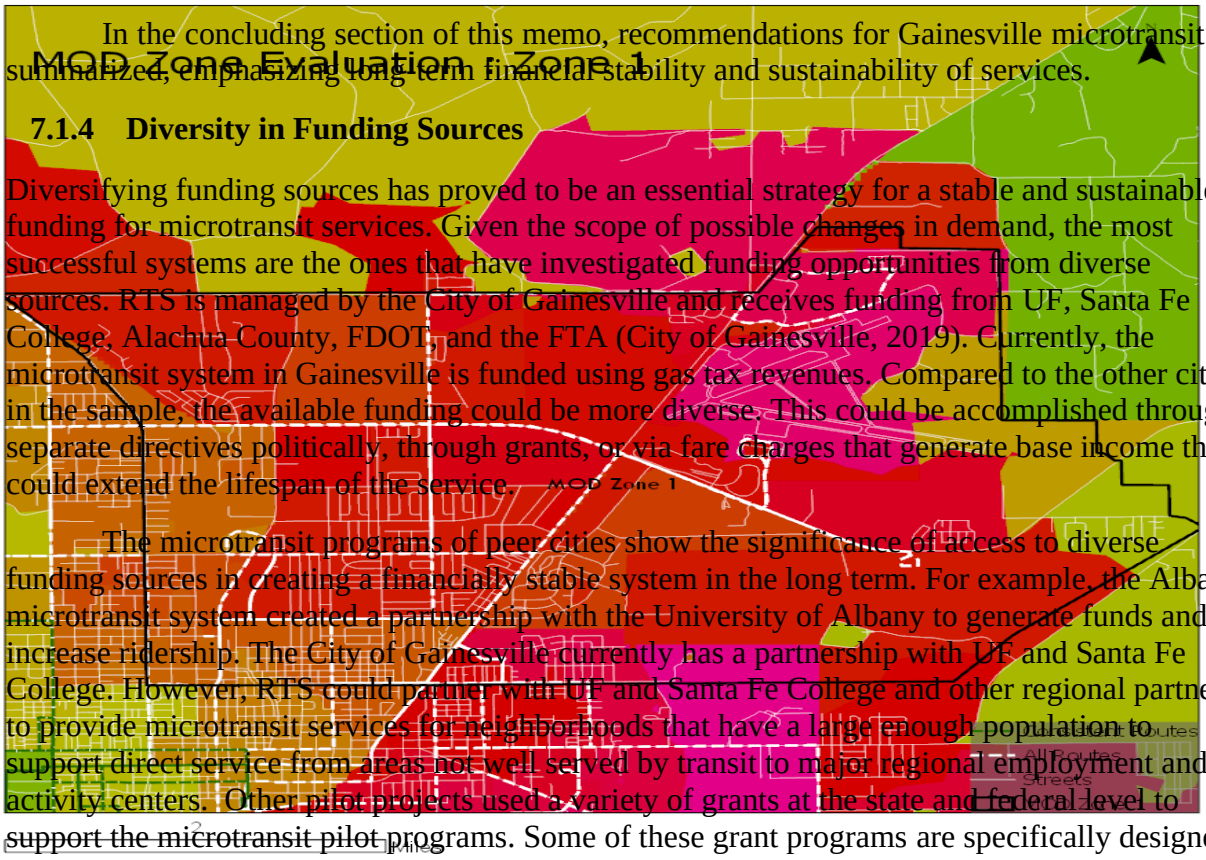
The cost per trip has been a major challenge for the existing pilot microtransit programs. The Gainesville TDP identifies a cost per trip as remarkably similar to the one in Carlsbad, California. In a similar context, Antioch, California, encountered similar issues and successfully switched to another program, building off the information they gathered during their pilot program to create a system that would continue to support the community.

Gainesville microtransit is currently a free service that operates without a public-private partnership. The physical services in East Gainesville are limited to specific times and destinations. Both in the TDP and in the initial scheduling for service, RTS indicates the necessity for service expansion. On the other hand, lessons from other microtransit programs suggest that expansion without additional financial support is unreasonable. For instance, other mid-sized cities introduced Via as a partner to provide microtransit service. Some private companies work with the government to maintain microtransit programs, but there are also companies that partner with the private sector to create low-cost microtransit.

Similarly, Transdev has microtransit pilot projects across the United States, and in France, the Netherlands, and Australia. In Detroit, Transdev partnered with two large employers, Detroit Chassis and FlexingGate, to provide FMLM service. They were also funded by a $1.4 million grant (Transdev, 2021). Using existing infrastructure provided by Via and TransLoc could limit start-up costs, especially in creating an app that is easier for customers to use. But it is not required.

Pinellas County presents a different picture; they partnered with several private entities to meet the needs of transit-dependent residents and to fill the gaps in existing fixed-route services. Their project required more upfront funding, but they were able to obtain FTA grants to develop it. Pinellas County did not build their project to increase ridership generally. Instead, they did so

to address perceived inefficiencies of transit routes that served smaller populations. Though it is a public-private partnership, it relies much less on support from the private sector compared to services like Via or TransLoc.



In the concluding section of this memo, recommendations for Gainesville microtransit are summarized, emphasizing long-term financial stability and sustainability of services.

7.1.4 Diversity in Funding Sources

Diversifying funding sources has proved to be an essential strategy for a stable and sustainable funding for microtransit services. Given the scope of possible changes in demand, the most successful systems are the ones that have investigated funding opportunities from diverse sources. RTS is managed by the City of Gainesville and receives funding from UF, Santa Fe College, Alachua County, FDOT, and the FTA (City of Gainesville, 2019). Currently, the microtransit system in Gainesville is funded using gas tax revenues. Compared to the other cities in the sample, the available funding could be more diverse. This could be accomplished through separate directives politically, through grants, or via fare charges that generate base income that could extend the lifespan of the service.

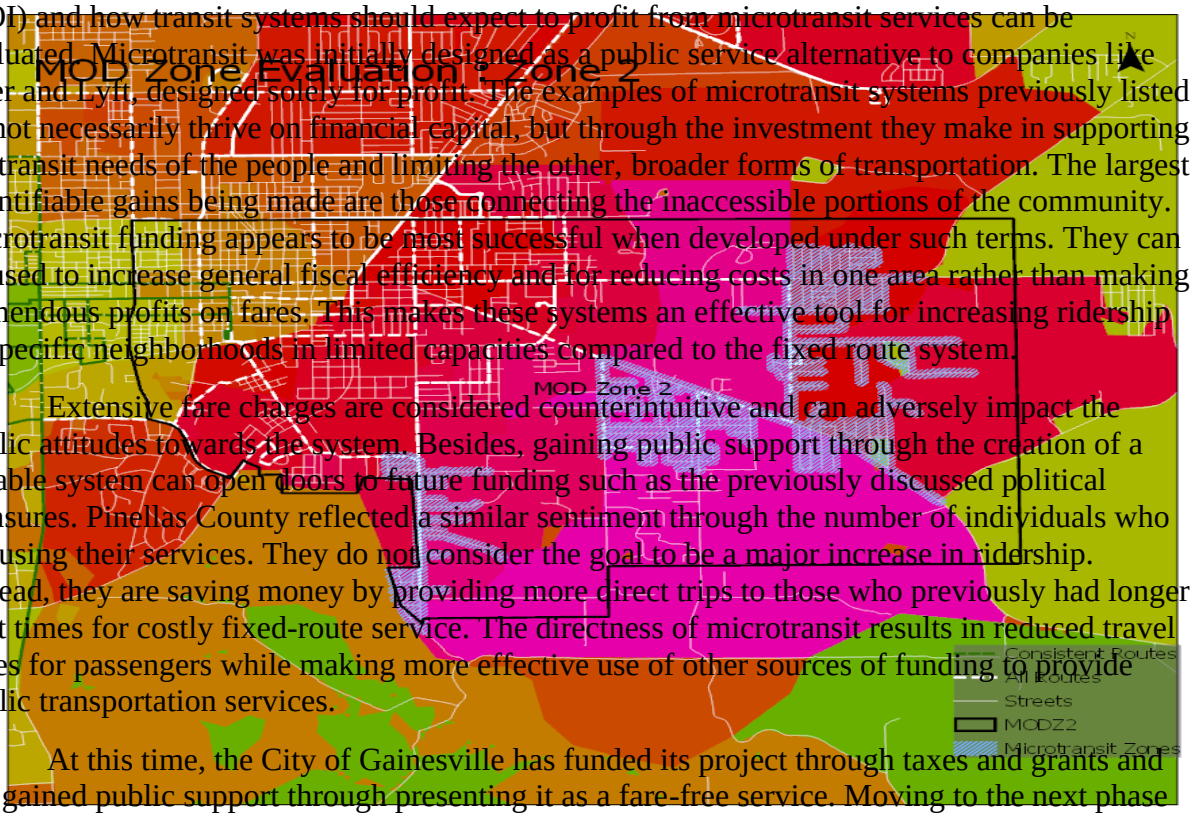
The microtransit programs of peer cities show the significance of access to diverse funding sources in creating a financially stable system in the long term. For example, the Albany microtransit system created a partnership with the University of Albany to generate funds and increase ridership. The City of Gainesville currently has a partnership with UF and Santa Fe College. However, RTS could partner with UF and Santa Fe College and other regional partners to provide microtransit services for neighborhoods that have a large enough population to support direct service from areas not well served by transit to major regional employment and activity centers. Other pilot projects used a variety of grants at the state and federal level to support the microtransit pilot programs. Some of these grant programs are specifically designed to be competitive, but the existing Gainesville microtransit service could qualify for them. Other grants are designed to match existing funding. Grants can exist on a one-time basis or can be difficult to renew; therefore, collaborating with key economic players at the local and regional level can open the door to new opportunities to access diverse funding sources.

7.1.5 Effective Outreach

Public engagement is an essential part of any transportation project. Many of the programs featured in this memo have begun with short initial pilot projects, and then transitioned to a more long-term service. Positive public feedback played a critical role in guaranteeing future financial security of services as success of a system is primarily dependent on the satisfaction of the riders. Via, one of the services that peer cities have used, suggests a variety of methods used to obtain the necessary funding for local governments.

Grants on any level are a common solution, as many exist to promote mobility. Alternatively, Via demonstrates solutions of a more political nature, such as ballot measures on a local level that could generate funding for a specific project such as microtransit. Citizens would vote for measures on ballots and funds would be generated through the implementation of concepts like state, local or regional congestion pricing, TNC fees, and tolling (Via Mobility Services, 2021). Several cities, such as Austin, Texas, have successfully introduced transportation ballots to completely fund their microtransit programs and to expand the existing service.

Measures such as this would not be possible without the public having faith in the viability of such approaches. Via further investigations, the concept of Return on Investment (ROI) and how transit systems should expect to profit from microtransit services can be evaluated. Microtransit was initially designed as a public service alternative to companies like Uber and Lyft, designed solely for profit. The examples of microtransit systems previously listed do not necessarily thrive on financial capital, but through the investment they make in supporting the transit needs of the people and limiting the other, broader forms of transportation. The largest quantifiable gains being made are those connecting the inaccessible portions of the community. Microtransit funding appears to be most successful when developed under such terms. They can be used to increase general fiscal efficiency and for reducing costs in one area rather than making tremendous profits on fares. This makes these systems an effective tool for increasing ridership of specific neighborhoods in limited capacities compared to the fixed route system.



Extensive fare charges are considered counterintuitive and can adversely impact the public attitudes towards the system. Besides, gaining public support through the creation of a reliable system can open doors to future funding such as the previously discussed political measures. Pinellas County reflected a similar sentiment through the number of individuals who are using their services. They do not consider the goal to be a major increase in ridership. Instead, they are saving money by providing more direct trips to those who previously had longer wait times for costly fixed-route service. The directness of microtransit results in reduced travel times for passengers while making more effective use of other sources of funding to provide public transportation services.

At this time, the City of Gainesville has funded its project through taxes and grants and has gained public support through presenting it as a fare-free service. Moving to the next phase beyond the pilot, it is important to consider the difference that public outreach has made in the other peer cities and how this can be better used to promote the goals of the Gainesville system.

7.1.6 Steps Forward

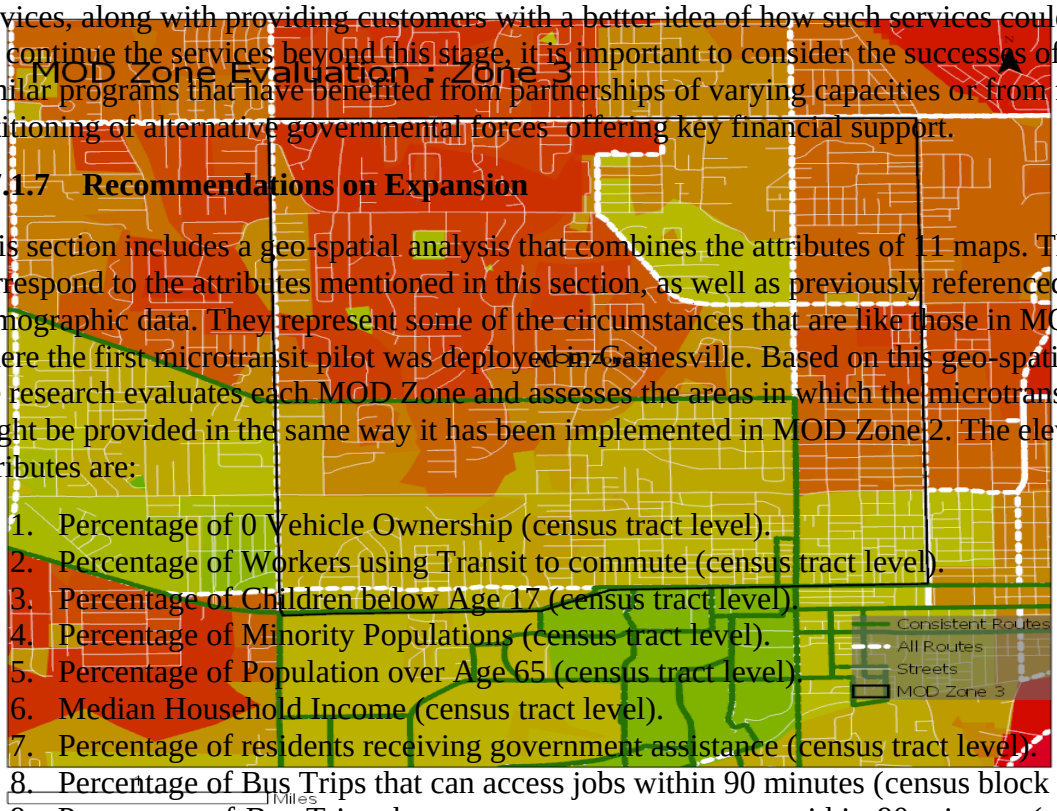
Several factors influence a microtransit system's ability to function fiscally. These include whether a partnership is secured with private entities, the degree to which the partnership facilitates governmental aid or funds, and the sources of funding that the transit agency can generate. The current Gainesville microtransit program could be much more interactive, either with the city or with a company specifically designed to boost microtransit services. The peer cities in this memo have presented examples of both. When other entities are involved, the system has more of an opportunity to sample different techniques. There are many ways in which this partnership could be secured, based on the technology or the vehicles, or other elements. If RTS wants to continue to control the program, they will need to consider both the costs and sources of revenue that are required to do so.

Several systems have secured federal, state, or local grants to continue their microtransit projects. This gives the transit department control over a greater part of the project. It also reduces the need for fare increases. For example, Pinellas County has been able to offer its services fare-free through their FTA AIM grant. Gainesville microtransit is currently fare-free, but this is not a strong trend seen in other microtransit services. Public opinion can change what funding is available. But installing a fare could weaken the reliance on microtransit and the basis upon which any possible political maneuvering can rely. In Gainesville from 2019 to its

completion in 2021, the pilot program has provided the baseline for future micromobility services, along with providing customers with a better idea of how such services could function. To continue the services beyond this stage, it is important to consider the successes of other similar programs that have benefited from partnerships of varying capacities or from further petitioning of alternative governmental forces offering key financial support.

7.1.7 Recommendations on Expansion

This section includes a geo-spatial analysis that combines the attributes of 11 maps. The 11 maps correspond to the attributes mentioned in this section, as well as previously referenced demographic data. They represent some of the circumstances that are like those in MOD Zone 2, where the first microtransit pilot was deployed in Gainesville. Based on this geo-spatial analysis, the research evaluates each MOD Zone and assesses the areas in which the microtransit service might be provided in the same way it has been implemented in MOD Zone 2. The eleven attributes are:



1. Percentage of 0 Vehicle Ownership (census tract level).
2. Percentage of Workers using Transit to commute (census tract level).
3. Percentage of Children below Age 17 (census tract level).
4. Percentage of Minority Populations (census tract level).
5. Percentage of Population over Age 65 (census tract level).
6. Median Household Income (census tract level).
7. Percentage of residents receiving government assistance (census tract level).
8. Percentage of Bus Trips that can access jobs within 90 minutes (census block level).
9. Percentage of Bus Trips that can access grocery stores within 90 minutes (census block level).
10. Percentage of Bus Trips that can access medical centers within 90 minutes (census Block level).
11. Percentage of Bus Trips that can access education centers within 90 minutes (census Block level

The overall results demonstrated that the current microtransit pick-up zone (MOD Zone 2) is the area in most need of such services. The peripheral areas of the city show higher levels of aggregated values, which is due to the challenges of completing trips via transit compared to the center of the city and the University area. In the following sections, we discuss the analysis of individual zones.

7.1.8 Evaluation of Potential for Microtransit Expansions in MOD Zone 1-7

Zone 1 is located in the northeasternmost sector of Gainesville. Points of interest include the airport, the Job Corps Park, the Tacachale Center, and numerous car dealerships along North Main Street. The area is not very dense, highly residential, and has several multi-family neighborhoods and trailer parks scattered throughout the zone. The areas in Zone 1 with the greatest potential for expansion include the Job Corps Park, the Lamplighter community, and most of the area along NE 15 Street. Routes 3, 15, 24, 25, 26, 27, and 39 serve this zone (Figure 7-10); among them, routes 24 and 27 are considered the least efficient city routes in terms of operational efficiency. Route 24 connects the Rosa Parks Downtown Station with the Job Corps Park along 15 Street, and Route 27 connects the Rosa Parks Station with Walmart along Main

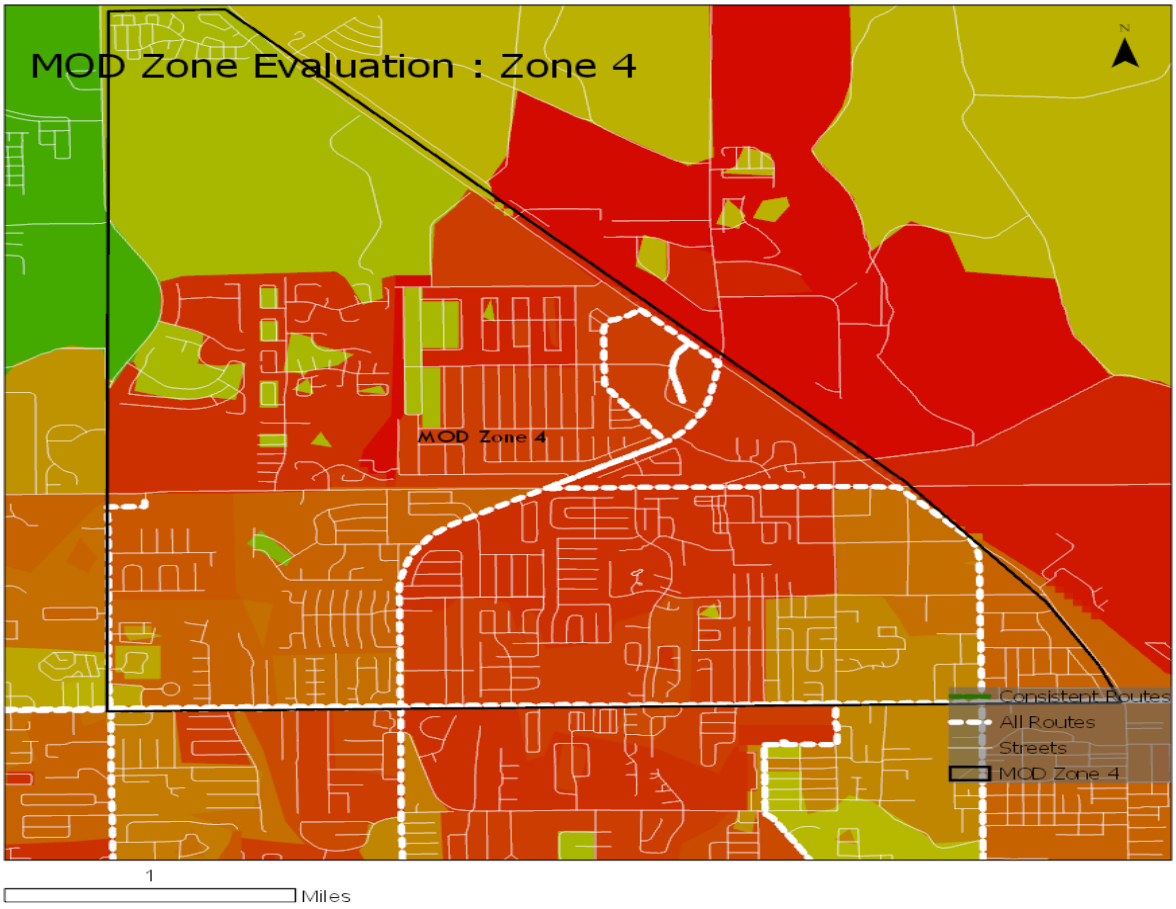


Figure 7-10: Potential for microtransit expansion in MOD Zone 1

Street. Implementation of a microtransit service in this zone would replace routes 24 and 27 with the purpose of: 1) covering Northeast Gainesville, 2) connecting the Job Corps Park with the Rosa Parks station via NE 15 Street, 3) supporting Routes 3 by providing residents access to the commercial center on North Main Street between NW 10th and NW 14th Avenues, as well as the Duval Heights Walmart, and 4) support Route 15 by providing service to residents along the NE 15 Street corridor.

In Zone 2, all the attributes were aggregated to the point of indicating the highest values for any given area in Gainesville, which verified the rationale behind the selection of Zone 2 as the first area of the city to receive microtransit (Figure 7-11). This research evaluates how the attribute values found in this area could be identified in other areas of Gainesville to provide the suggestions and recommendations found in this section. If microtransit service were to continue expanding in Zone 2, the areas that would most benefit from additional service would include the Sugarhill neighborhood and the Duval Heights neighborhood. A similar configuration to the existing microtransit system that connects residents to various destination points in this zone would be desirable.

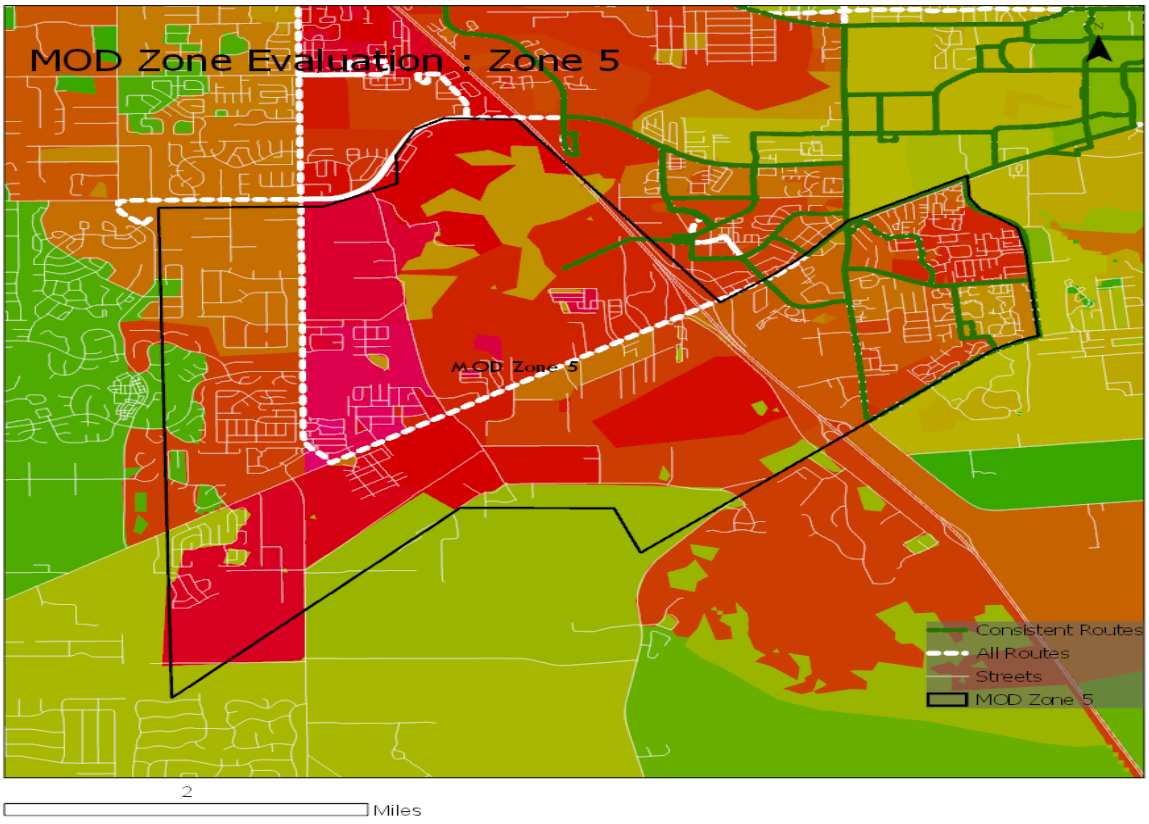


Figure 7-11: Potential for microtransit expansion in MOD Zone 2

Zone 3 is located north of UF and extends up to NW 39th Avenue. The area is mostly suburban, dominated by single family residential, and commercial and retail shops along the NW 13th Street corridor. The results indicate that the northwestern portion of the zone may benefit from a service such as microtransit, although this research recommends it stay on the lowest ranking since the levels of aggregated attributes are relatively low (Figure 7-12).

Additionally, the zone benefits from services on routes 6, 8, 10, and 15, all of which are recommended for service improvement in the TDP. It would seem that these improvements would be adequate for the area.

Zone 4 is located in the northernmost section of Gainesville. Points of interest include the North Gainesville Walmart, Northside Park, and a commercial center on NW 34th. Blvd. and 53rd Avenue. The area is mostly suburban, with a few multifamily dwellings, such as Pine Ridge, Deerwood, and Creekwood, in the area surrounding Walmart. Route 8 has a higher level of operational efficiency and route 6 has been identified as needing extended hours. However, these and Route 39 are the only routes in this zone. Therefore, the implementation of a microtransit service in this area would complement these three routes by connecting residents of Pine Ridge,

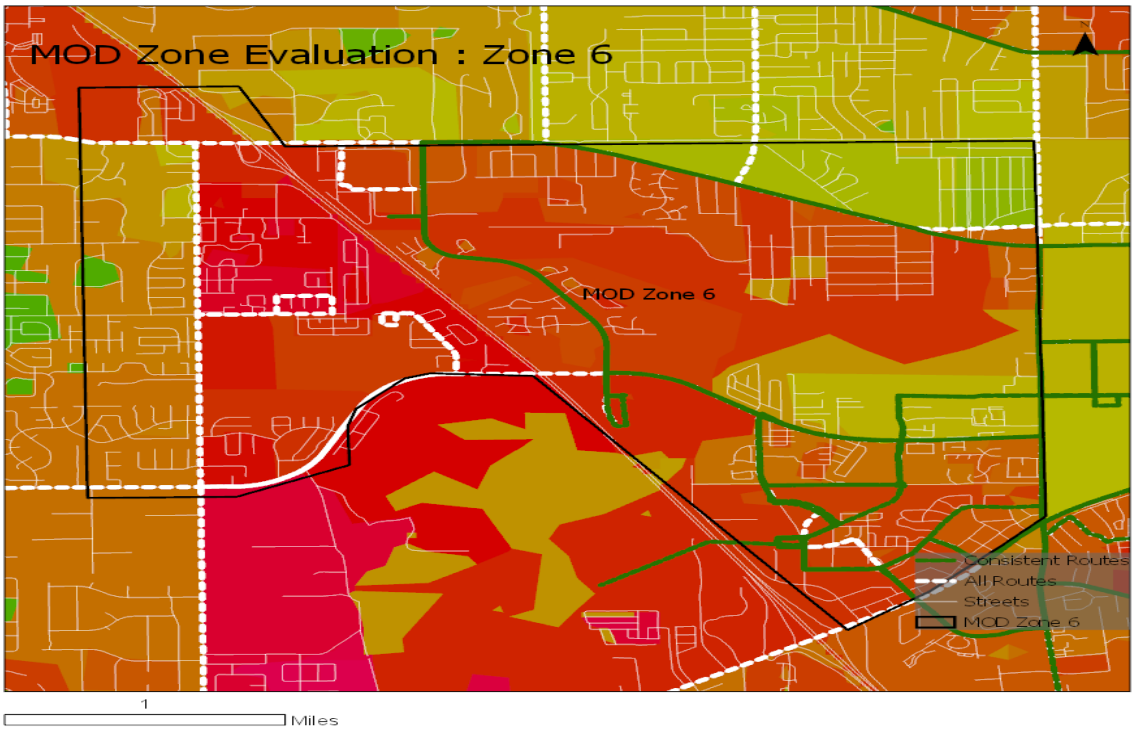


Figure 7-12: Potential for microtransit expansion in MOD Zone 3

Deerwood, and Creekwood and the residential area west of Pine Ridge with the local Walmart and the commercial center on NW 34th Blvd (Figure 7-13).

Zone 5 is located in the Southwestern-most sector of Gainesville and encompasses an area that is split by I-75 into two distinct sections. The eastern section is dominated by student housing developments and Butler Plaza, while the western section is mostly low density, with several trailer parks and multi-family units spread closer to 75th Street. The emerging Celebration Pointe activity center is also located in this area. The area surrounding the junction of Archer Road and 75th Street shows a high level of aggregated attributes. Served only by Route Interstate 75, which ranks at medium levels of operational efficiency, but has very inconsistent levels of service, this area demonstrates a demand for transit in an area that is isolated (Figure 7-14). The research found that the implementation of microtransit services in this area would connect various residential areas east of 75th Street, between Archer Road and SW 41st Place, including mobile homes such as Westgate, Oak Park, and the Palms of Archer; and multi-family apartments such as Madison Cove, as well as Kanapaha Middle School, Kimberly Wiles Elementary School, the commercial center at Tower Square, and the shops at Butler Plaza.

Zone 6 is located in the westernmost sector of Gainesville and has traits similar to those of Zone 5 in that it is split by Interstate 75 into west and east portions. The eastern portion is very

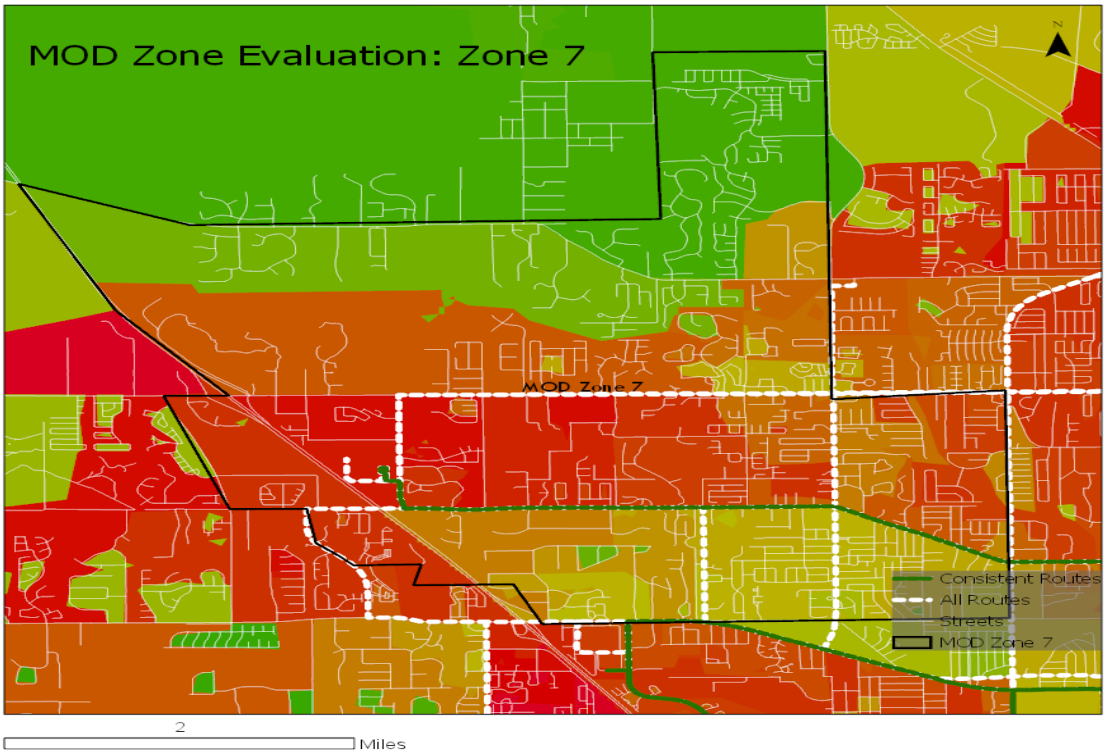


Figure 7-13: Potential for microtransit expansion in MOD Zone 4

diverse in context, ranging from dense student housing developments to single family suburban style residential areas, as well as dense commercial activity around the interchange of Newberry and I-75, most notably at Oaks Mall. The west is also very similar except that there are many multifamily and medium-density residential zones.

The eastern portion of Zone 6 benefits from routes 5, 20, and 21 which are some of the most operationally efficient routes in Gainesville. However, the western portion is served by routes 23, 75, and 76, which have lower operational efficiency. Based on this spatial analysis, the area surrounded by I-75 to the east, 75th Street to the west, Newberry Road to the north and 20th Avenue to the south, is another area with high levels of aggregated attributes (Figure 7-15). This area is composed of medium density residential areas and multi-family developments with low levels of transit accessibility, caused by the neighborhood's proximity to I-75, which acts as a spatial obstruction from nearby amenities. Although served by three routes at a medium level of operational efficiency, none of these routes possess the characteristics of a consistent transit route. This research recommends the aforementioned area for serious consideration of expansion for microtransit services. The microtransit services would help residents by making connections

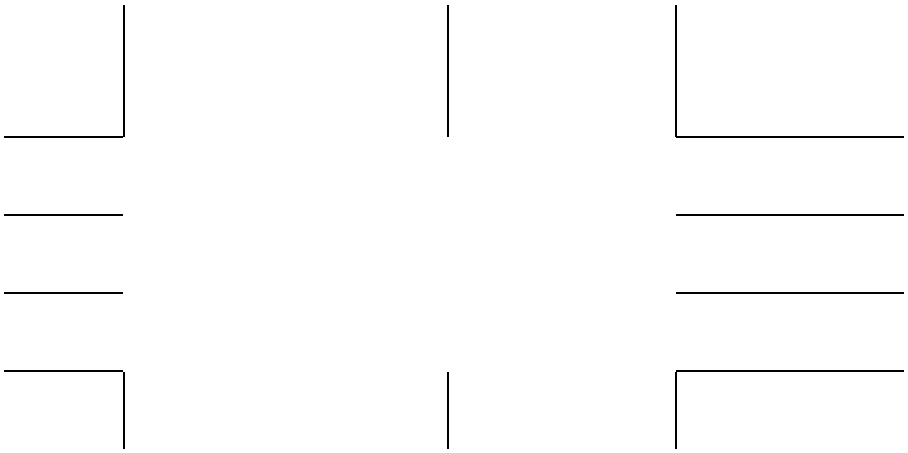


Figure 7-14: Potential for microtransit expansion in MOD Zone 5

to the northern commercial centers, North Florida Regional Hospital and surrounding medical complexes, and the Oaks Mall.

Zone 7 is located in the northwesternmost sector of Gainesville and is highly suburban and single family residential in character. Points of interest include Santa Fe College, UF Health Springhill, commercial activities along NW 39 Avenue and 43rd Street, the Millhopper and Thornebrook Shopping Centers at 43rd St. and 16th Blvd. and senior housing. Most of the area near Santa Fe is far from the city center and other activity centers. Routes 10, 23, 39, 43, and 76 circulate in the area. Most notably, however, is route 39, which has a low level of operational efficiency and spans multiple zones in the northern area of Gainesville. Because the area is very sparse, there is some consideration for the replacement of Route 39 with a microtransit service (Figure 7-16). However, much needs to be done to ensure that the service connects to other transit routes and the closest activity centers (such as Oaks Mall). While destinations are sparse, demand for this service needs to be carefully evaluated in this area to ensure support and long-term viability of microtransit services.

Figure 7-15: Potential for microtransit expansion in MOD Zone 6

Figure 7-16: Potential for microtransit expansion in MOD Zone 7

7.1.9 Summarizing Spatial Analysis

Based on spatial analysis, this research suggests the following ranking of areas of expansion summarized in Table 7-4. The results are evaluated according to the level of need evaluated, as the total area of these lands had more than 80% of aggregated attributes present in the residential areas within each MOD Zone.

Table 7-4: MOD Zone Rankings

Rank	Zone	Relative Location	Level of Need
1	MOD Zone 2	E	High
2	MOD Zone 5	SW	High
3	MOD Zone 1	NE	High

Rank	Zone	Relative Location	Level of Need
4	MOD Zone 6	W	Medium
5	MOD Zone 4	N	Medium
6	MOD Zone 7	NW	Low
7	MOD Zone 3	Central	Low

Created by research team

7.2 Recommendations for other Transit Systems

The following section will provide a set of recommendations based on the literature, discussion, and data that has been analyzed throughout this project.

7.2.1 Recommendations: Goals

Microtransit goals help provide context for the methods through which projects should be monitored. The following are recommended ways to monitor microtransit goals. While all the following methods may not be necessary, as goals for every agency may vary, it may be optimal to develop measurement and monitoring strategies.

7.2.1.1 Increased Multimodalism and Expanded Mobility

The efficiency of microtransit will result from the integration of the system into complex networks of fixed-route public transit systems. Whether the goal is to replace fixed-route systems or to complement them, microtransit is a useful strategy to simplify existing complexities or create integrative networks that provide greater access. Microtransit can reignite public transit by reaching underserved parts of the system where public transit may have been discontinued, or by developing new networks by increasing accessibility to transit. The goal of mobility expansion should be to create new nodes of development to maintain or increase levels of accessible mobility. This is especially necessary to maintain when compared to old levels of mobility if there has been a decrease in ridership.

Increasing mobility expansion may likely be something that progresses with the project. Initially, smaller service areas that support important demographics may be more pertinent to start with. Then, the service can be expanded as demand or needs increase. This may help shift mobility outward to more users. The Dallas Area Rapid Transit (DART) system used GoLink, an app-based microtransit service, intended to expand mobility and increase interconnectivity by addressing the first mile/last-mile problem. In late 2017, the service began in the outer suburbs to help connect them to fixed-route lines. Six months later it was expanded to the entire district to increase mobility in areas of high job density (Kang & Hamidi, 2019). This method ensures communities have the transportation necessary to gain access to transit, at a minimum. As projects deploy successfully, increases in services and accessibility are necessary.

7.2.1.2 Increased Ridership and Unique Usership

Ridership is an essential goal as it promotes the success and sustainability of microtransit. Several microtransit projects have been unsustainable due to low ridership. This may be due to various unsuccessful strategies, including poor marketing and outreach, inaccessible methods, and cost inefficiencies. For example, Kansas City, a pioneer in microtransit, discontinued their project after only dispatching just over 1,000 rides in six months, a goal they hoped to reach in about 2 weeks. Other agencies such as Hillsborough Area Regional Transportation Authority (HART) and the Alameda-Contra Costa Transit District in California, likewise, discontinued their projects due to low ridership and lack of funding. Ridership should be a foundational goal for all microtransit projects; other goals may be supplementary or beneficial to consider. Ridership and expansion of riders is a crucial component in the development of microtransit.

However, ridership will be a highly contested aspect of microtransit being successful. Suburban expansion of microtransit is a challenge because suburban development does not necessarily align with transit-oriented development. The allure of single-occupancy vehicle ownership and the flexibility of mobility on one's own terms, especially when located farther from jobs and other services, makes the concept of microtransit more difficult to incorporate.

In a study completed by the Transportation Research Board, the authors analyzed several different agencies ranging across land-use environments (residential suburbs, balanced mixed use suburbs, suburban campuses, edge cities, corridors and exurban enclaves). Each one poses unique challenges to development of any type of transit service. However, foundationally, each presents similar obstacles of lower ridership and inability to access riders. Considerations for ridership opportunities would be to develop microtransit service around focal points, particularly within the densest areas or multi-use regions of suburban development, and the service should continuously target traditional markets for transit development (TRB, 1999).

7.2.1.3 Decreased Travel and Wait Times

From a hierarchical approach to microtransit development, accessibility and connectivity are the core of microtransit sustainability. Convenience would likely be the next most important consideration, starting with decreasing wait time. Public ridership often decreases, especially in suburban, middle-class communities, because the benefits of driving are greater than using public transit, and the costs of vehicle ownership and use are not high enough for public transportation to be cost beneficial.

Transit travel and wait times are some of the greatest concerns of respondents to the transit user survey who used TNC trips instead of transit trips (Cervallos, 2020). Factoring in this aspect of the transit rider experience is important for mutual benefits between transit agencies and users. When budget cuts to public transit are made, the frequency of service is often decreased.

To combat issues of infrequent service, San Antonio implemented a microtransit pilot in a service area of about 83,000 people and 25,000 jobs, where three bus lines ran only once an hour (Cervallos, 2020). In this case, emphasizing the frequency and distance through which microtransit could alleviate wait times for users was pertinent. The microtransit service would run every 20 minutes, with 400+ stops along the route. Deviation services were provided in the area to ensure users would not have to walk more than four minutes to arrive at a stop, and the service would take five minutes at a maximum to arrive at the destination (RideCo, 2019). These

are all important methods through which microtransit can be useful and can match benefits provided by previous transit or single-occupant vehicle (SOV) ridership.

7.2.1.4 Maximize Operating Hours

Microtransit may start at a much smaller scale in terms of times of availability. Currently, several mobility on-demand services similar to microtransit are offered for special or differentiated audiences, such as Uber or Lyft partnerships offered to senior citizens during the day or for late-night employees. Microtransit may need to start on a small scale, prioritizing times such as rush hours or weekend services that can help to gauge maximum ridership. Transit agencies may choose to analyze data at those specific times, as the researchers at Arizona State University did. These researchers analyzed ridership behavior from 7 AM to 7 PM on weekend days (Musili & Salon, 2019) to see if the service could feasibly be expanded to other times. Starting at times when ridership was predicted to be at a maximum helped provide an understanding of the cost-benefit trade-off of expansion of hours and service.

One problem with microtransit, which has resulted in the failure of several projects, is high operational costs. Due to funding structures, lower hourly ridership, and fare rates (e.g., pilot testers starting with a free fare structure), expansion of operational hours may be unsuccessful in the initial stages. Microtransit should be started in micro-doses when it comes to key factors: service area, operational hours, and travel time. Over time, as data permit the expansion of these opportunities, authorities can gauge changes in demand based on the lengthening and expansion of microtransit, as these services could potentially become more inconvenient or less desirable. A final consideration is that the transit agency should provide the service in a manner consistent with the goal of the microtransit program. Microtransit service to low-density residential areas may be provided to serve new riders and increase overall ridership. In this situation, the microtransit may be designed to be replaced by fixed route service once it reaches a specific ridership threshold. By contrast, night-time microtransit service may be designed to provide job access to a smaller population.

7.2.1.5 Improved Job Accessibility

Transportation systems provide access to various destinations, such as employment, healthcare services, and shopping. However, as housing expands outward and job locations increasingly decentralize, job accessibility remains an important goal. This is especially the case for low-wage jobs where public transit may be necessary for transportation.

In a case study completed on the Dallas Area Rapid Transit system concerning impacts of job accessibility in first-mile/last-mile mobility, researchers compared data from 2014 and 2019. In 2014, before the introduction of on-demand mobility, users would walk nearly 34 minutes to get to a transit stop. By 2019, as the GoLink service was introduced, users were found to take an extra 10 minutes of riding time using microtransit to get to fixed route transit, but the walking required to get to the microtransit stop decreased to under 20 minutes for up to 91% of users (Kang & Hamidi, 2019). This expansion in service may increase on-board travel time, but it expanded job access from 250 to 1000 percent, especially to communities where job access was crucial and where transportation may have been a barrier in the past. Job access intermingles with equity concerns, as job access may be most pertinent for transportation-disadvantaged populations.

7.2.2 Recommendations: Implementation

Implementation entails multiple strategies including the implementation of microtransit itself and the processes to sustain microtransit, such as financial partnerships and data and technology considerations. When implementing microtransit, factors such as household income, vehicle ownership, commuting patterns, areas of service, job accessibility and distribution should be factored in (Volinski, 2018). Transit agencies likely have immediate knowledge of areas where microtransit may be necessary. Microtransit may not be useful in areas of high density and high availability of fixed-route transit. Areas of discontinued transit lines, and even areas that were originally not reached by transit, could be ideal for microtransit. Areas that did not have accessible fixed route transit may be harder to implement, as they are likely in more exurban/rural regions, and microtransit may only be located in certain small boundaries present within the region.

Next, the flexibility of the service should be considered. This is where factors of trade-offs must be considered: complementary service or replacement of service, service area coverage and regional density, and point or route deviation. From this, determination of the service area is important. Starting smaller may be the more beneficial strategy to recognize internal patterns at a simplified scale, but scaling outwards is a good strategy once those patterns are recognized. Additionally, flexibility of service should be altered if patterns change or reflect negative returns. For example, implementation of a complementary microtransit service using point deviation methods may reflect that users are not actually using microtransit to connect to a fixed route transit, which could reflect several factors. For instance, are the pick-up and drop-off requests too fixed? and do they need greater flexibility or an expanded radius? Are users being brought closer to public transit, or is microtransit just inhibiting them from getting closer to their destination? Do users even want demand-responsive transit to connect them to public transit, or are they searching for more flexibility, such as in replacement and route deviation strategies? Altering strategies based on patterns can provide more successful microtransit service.

Community engagement should also be considered when making these decisions. Transit agencies in Orlando and Houston proposed flex zones for demand-responsive transit where they sought to replace some fixed-route transit. However, when affected residents in the service zones were surveyed and showed disinterest in replacement strategies, the agency changed strategies (Volinski, 2018). This is not to say that changes are not viable in certain contexts, but it is important to engage community members, especially if equity is a goal and outcome of the microtransit pilot.

Another factor to consider is the use of outside third-party methods for data analysis and vehicle fleets. Work outside the agency is something that is prevalent with microtransit pilots, because several companies and partnerships have already developed the algorithmic technology necessary for microtransit services. While transit agencies can analyze their own ridership, and use their own financial and demographic data, outside companies can help estimate the demand, need and optimization for microtransit services (Volinski, 2018). This may be useful for transit agencies that are considering microtransit programs and have the economic ability to afford outside technological perspectives on microtransit optimization. Companies like Chariot, Via and Bridj also deploy the technological algorithms specific to microtransit. These types of companies provide great options necessary to understand the data algorithm needs of microtransit services, as deploying in-house data methods can be time consuming and costly. At the same time, the

transit agency staff needs to understand how to best apply the algorithm to the specific context of the transit agency.

When contracting for microtransit, there are several methods to consider. A transit agency can contract a third party for all needs (e.g., data collection, vehicle fleet), some of the needs (only the data) or they may keep everything internal to the transit agency. Oftentimes, contracting a third party is more cost effective due to lower hourly operational costs. However, it may be problematic if the contract does select proper data collection methods for microtransit. Since microtransit is an ever-developing topic in public transit, access to information is crucial not only to understand issues unique to the agency, but also issues encountered by agencies nationwide. Ensuring that contracting allows for data access is particularly important because it will allow for alterations to be made to the microtransit pilot that will be necessary to increase efficiency. Contractual procurements from third party agencies may be based out of transit agency experience and bidding power (Volinski, 2018).

Pilot projects themselves are generally a year or less in length, normally dependent on financial capabilities of the transit agency. However, it is recommended that pilot projects last between three and six months to obtain well-rounded data, and to allow flexibility in alterations to the microtransit program. Pilot projects must determine the time frame and required vehicular fleet. Vehicles for microtransit generally range from 12 to 26 passengers, though that may fluctuate based on density and demand. Capacity issues have never seemed to be a problem in previous microtransit pilots due to lower hourly demand. When microtransit is being deployed in areas with low density, larger vehicles may not be necessary. A similar consideration is how many trips a microbus can make within an acceptable timeframe.

Other considerations to make are the budgeting and fare structures of microtransit systems. Funding is an afterthought in microtransit, as determining service operation, contracts and model of transportation are selected. Financial and funding data for microtransit is quite limited, as demand-responsive transit in this capacity is still new, and there is no general range of funding to be expected as agency's needs and scopes fluctuate (KFH Group, 2019). Federal funding may be an option, but not all states permit it. New programs are being deployed to develop funding for innovative design in public transit, which represents an opportunity to seek new funding (KFH Group, 2019).

Fares can fluctuate based on contractual agreements and how the fare system will operate. For the sake of transit equity, fare boxes can be implemented into microtransit. But app integration fares, such as those with Uber and Lyft, can be more beneficial and efficient. Fare policy can match the fare of fixed route transit, or premium fare, at a rate that is less than 50 percent more than the price of fixed route transit (KFH Group, 2019). Additionally, reduced fare or even free fare in special fare programs may help encourage equity in microtransit. Options are really based on agency goals, although equity can be overshadowed by cost effectiveness for the agency, if they attempt to charge fares that disadvantaged populations cannot afford. In regions where transit is limited and microtransit connects to fixed route transit, charging reduced rates or similar rates may incentivize use of the program. However, when creating transit in areas that did not have transit already, charging similar or greater costs may provide estimations about how much community members value transit in their community. Fare and demand are intermingled in such a way that adapting to changes based on affordability may be necessary.

7.2.3 Recommendations: Performance Measures

Performance measurements in microtransit may be context-dependent and related to the length of the pilot project and goals of the transit agency. Performance measures should be rooted in measures that can be evaluated consistently over time, provide meaningful context to the transit service's role, exemplify progress within the goals, and showcase performance and its link to funding (FDOT, 2014).

Performance measures can be extensive, with several different sub-categories within broader measurements. The most essential aspects of measurement include availability, delivery, safety, economy, and administration (Rodier & Isaac, 2016). All performance measures will touch on these aspects of measurement in the context of microtransit.

7.2.3.1 Availability of Microtransit

The availability of microtransit is crucial to the success of the project. Several factors are incorporated into these decisions: service area, hours of operation, number of vehicles, and other operational considerations. Availability of service stems from the flexibility of funding and services defined by a transit agency. First, transit agencies must properly define service areas that are feasible for microtransit pilots. Defining a service area may be difficult due to the density of riders, demand for transit, and ridership patterns. Quantifying the exact square mileage of a service area may be necessary due to a variety of factors. For example, when setting up flexible zones for on-demand services, cities such as Orlando found 5 to 7 square miles to be sufficient. These areas followed natural and built borders such as roads, waterways, communities, and transit infrastructure as borders for the measurements (Volinski, 2018). For Denver's Call-n-Ride service, service areas ranged from just over one square mile to up to 30.1 square miles, but the average was 7.5 miles of service area (Volinski, 2018). Both Orlando and Denver have relatively similar rates of suburban sprawl, density, and transit operation, which makes these boundaries sufficient.

Availability of service intersects with goals of coverage, frequency, and operation. Some metrics to be used would include how much area is covered by microtransit, microtransit vehicles per hour, length of service per day, and how the service emulates fixed route transit (Rodier & Isaac, 2016). Total hours of service provided would need to be coordinated with the total hours needed to meet the demand for transportation. This information could also be used to determine how many days a week microtransit was available (FDOT, 2014). Correlations to population density, job density, and demographics are also necessary (FDOT, 2014).

Availability may also be linked to accessibility of service to various demographic groups. For example, if it is necessary to hail a ride via smartphone, availability of service may be hindered if users do not have a smartphone (Volinski, 2018). Other examples include ensuring that the vehicles are ADA accessible, and ensuring safety of infrastructure at pick-up and drop-off locations.

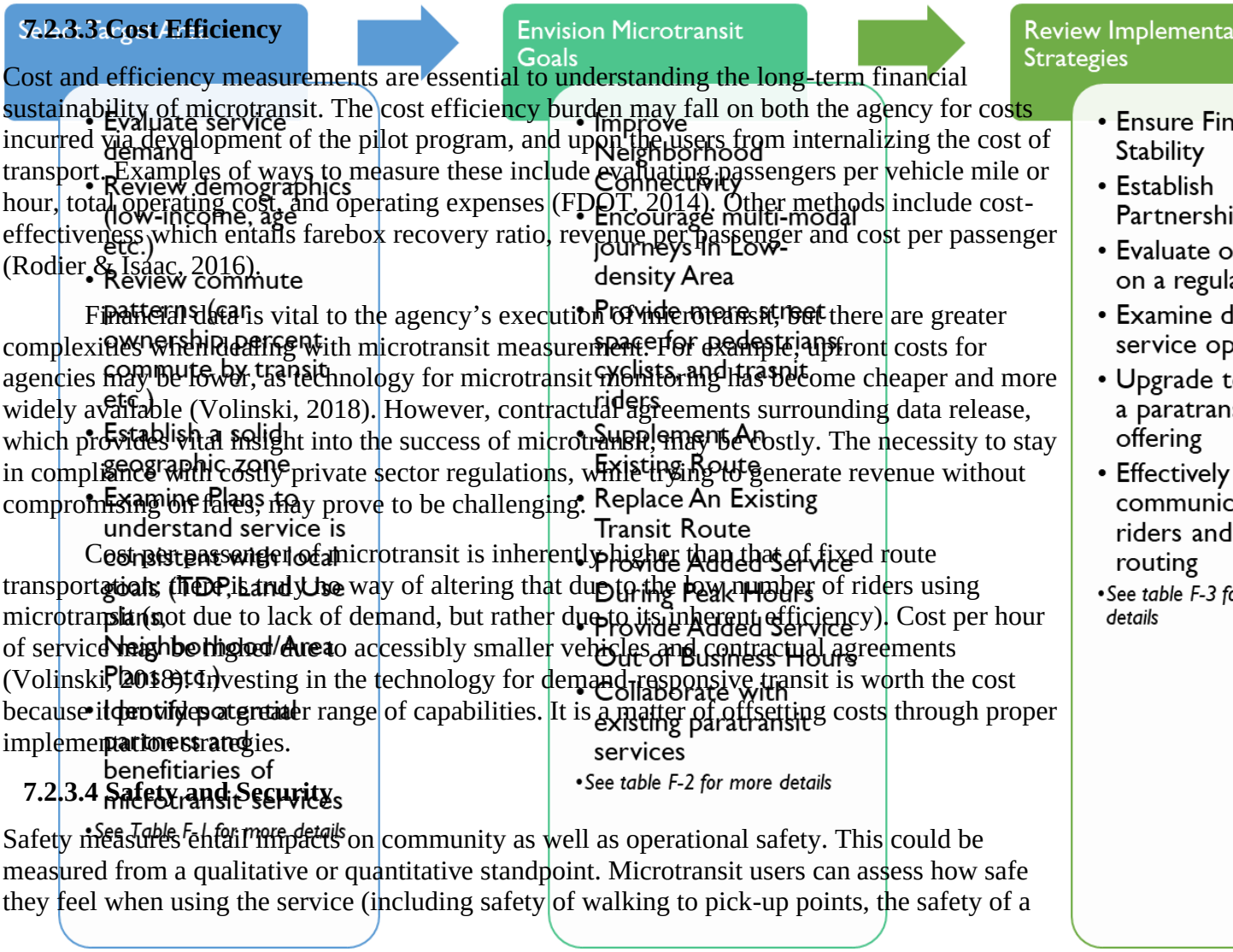
Availability of microtransit should be informed by available, ever-changing data for riders. If the service is unavailable due to factors such as a client outside of the service area or inflexible timing of service, users should be notified via denial of service or presented with other transportation options. This allows users to be aware of other available services outside of

microtransit, but this data can also inform decision making for the transit agency. If there is demand in an area that is not being met, the program may expand or alter service areas.

7.2.3.2 Demand and Service Delivery

Continuous success will be rooted in the availability of microtransit to sustain and increase demand and to remain cost-efficient. Programs should implement measures designed to survey and track usage to ensure demand is still within the range of original demand (Buenk et al., 2019). Surveying methods may include onboard surveys, satisfaction surveys, perception-based surveys, and accessibility surveys to gauge efficiency from an economic and social perspective. Tracking demand will entail geofencing and location, technological and algorithmic integration, and data deviations for microtransit services.

Measuring demand involves a variable process due to changes in user behavior. Microtransit often will change based on rider perception, peak ridership times and days, and marketing. Microtransit will likely be more variable than fixed route transit because demand can be ever shifting based on ridership patterns and enjoyment of service.



7.2.3.3 Cost Efficiency

Cost and efficiency measurements are essential to understanding the long-term financial sustainability of microtransit. The cost efficiency burden may fall on both the agency for costs incurred via development of the pilot program, and upon the users from internalizing the cost of transport. Examples of ways to measure these include evaluating passengers per vehicle mile or hour, total operating cost, and operating expenses (FDOT, 2014). Other methods include cost-effectiveness which entails farebox recovery ratio, revenue per passenger and cost per passenger (Rodier & Isaac, 2016).

Financial data is vital to the agency's execution of microtransit, but there are greater complexities when dealing with microtransit measurement. For example, upfront costs for agencies may be lower, as technology for microtransit monitoring has become cheaper and more widely available (Volinski, 2018). However, contractual agreements surrounding data release, which provides vital insight into the success of microtransit, may be costly. The necessity to stay in compliance with costly private sector regulations, while trying to generate revenue without compromising on fares, may prove to be challenging.

Cost per passenger of microtransit is inherently higher than that of fixed route transportation (not a bad way of altering that due to the low number of riders using microtransit (not due to lack of demand, but rather due to its inherent efficiency). Cost per hour of service may be higher due to accessibly smaller vehicles and contractual agreements (Volinski, 2018). Investing in the technology for demand-responsive transit is worth the cost because it provides a greater range of capabilities. It is a matter of offsetting costs through proper implementation strategies.

7.2.3.4 Safety and Security

Safety measures entail impacts on community as well as operational safety. This could be measured from a qualitative or quantitative standpoint. Microtransit users can assess how safe they feel when using the service (including safety of walking to pick-up points, the safety of a

ride, and other factors). This can also be measured via rate of injuries or accidents of microtransit vehicles and verifying that safety standards are followed.

Other ways to measure safety and security entail verifying the standards of operation for meeting customer satisfaction. This includes verifying whether passengers were picked up on-time, and whether they were comfortable about transportation and overall vehicular safety, which are important to maintain successful ridership. Microtransit measurements of safety may speak more to the broader safety of the public transit system in general, but this is still an important aspect necessary to ensure consumer satisfaction.

7.2.3.5 Community

Measurements involving community include tracking of demographic-based ridership. Some of the goals being measured by a transit agency should entail who is riding microtransit and how they are being affected by microtransit. Much of the data measurement will come from local census data, surveying, in-house data, and GIS measurement. Measurements may also entail investigating how microtransit is being marketed to communities.

Community measurements may be altered based on the goals of specific microtransit projects. Community goals align extensively with the goals surrounding issues of equity. Thus, if microtransit is bridging a gap in low ridership for underserved communities, measuring the number of riders without cars, number of riders with incomes under a certain level, and the financial impacts of fare rates, may be important factors to assess. Community goals should extend toward how microtransit systems affect the communities and whether the service is actually helping the populations it is intended to help.

7.2.4 Recommendations: Monitoring and Evaluation

Monitoring for microtransit may be difficult to evaluate and may entail qualitative assessments. Measurements based on goals and performance metrics are obviously necessary, but quantitative measurements are difficult to accomplish, as baseline standards are about what to accomplish when it comes to “successful” microtransit. Monitoring simplified microtransit goals may be the process in which we can evaluate a program, but quantitative measuring may be difficult unless the specific goals have quantifiable values. Qualitative measurement is easier to handle as on-board surveying and other methods accurately gauge rider satisfaction, which is an important evaluation strategy in assessing sustainability of microtransit.

7.2.4.1 Rider Satisfaction and Surveying

Demand can be measured from both quantitative and qualitative analyses. If using a third-party microtransit application, demand can easily be measured through data analytics that are made available through agreements within third-party contracts, such as those established by GoMetro (Buenk et al., 2019). Community outreach within transit agencies may also be an effective strategy. Consistent surveying methods will be necessary, as microtransit riders are likely to be consistent. For example, the same riders will often return to the service, while some riders will use the service less frequently.

Surveying should focus on factors that intertwine with goals from the agency; however, concentration may also include other performance measures, such as costs, efficiency of service,

comfort, and overall mobility. In a case study completed by GoMetro, users were asked to rank 50 different indicators in 12 different evaluation categories on a scale of 1 to 10. This multifaceted evaluation would allow GoMetro to understand a diversity of aspects of the microtransit service.

7.2.4.2 Equity in Ridership

To continuously promote the trade-off between economy and equity, monitoring goals and performance measures framed in an equity context can be useful to achieve equity, which microtransit programs are frequently designed to accomplish (e.g., it provides service to underserved communities). One way to monitor this is by re-framing already present goals and analyzing them from an equity perspective. For example, if the particular goal is to provide a service that eliminates cost burdens, transport user fees should be evaluated with respect to the users' ability to pay, factoring in elements of demand and cost efficiency (Litman, 2020).

Additionally, the accessibility of microtransit services should be factored in. Framing measurement methods such as modes of transportation, mobility improvement strategies, and vehicular travel units should be framed from an accessibility framework. Examples of this include improvements to growth management and smart growth policies, and examples of how microtransit may play a role in smart growth. Microtransit can also help play a vital role in active modes of transportation (e.g., walking to a pick-up point) which entails equity in health implications (Litman, 2020).

Equity is rooted in microtransit's ability to be accessible and available (Buenk et al., 2019). Once again, qualitative assessments of equity may capture the services being provided. For example, in Research Triangle Park, North Carolina, the service area that on-demand transit targeted includes 12 apartment complexes that were underserved and needed increased transit options. Continuing to monitor services via demographic and qualitative assessment ensured that the services are optimizing user needs while they were consolidated into the goals of the agency (Lang, 2018).

7.2.5 Considerations for Implementation Process

To simplify the considerations proposed in this chapter, this research has summarized the discussion surrounding the microtransit implementation process. The following chart and the tables referenced therein are useful tools for any transit agency that wishes to engage the process of implementation in their respective regions. The chart in Figure 7-17 demonstrates a three-step process by which agencies can develop the considerations needed to implement microtransit services. The three-steps of the implementation process are summarized as follows: select target area, envision microtransit goals, and review implementation strategies. The tables in Appendix F go into detail about each specific area of consideration proposed in the chart for further clarity and consultation.

Figure 7-17: Process Chart with Considerations for the Implementation of Microtransit

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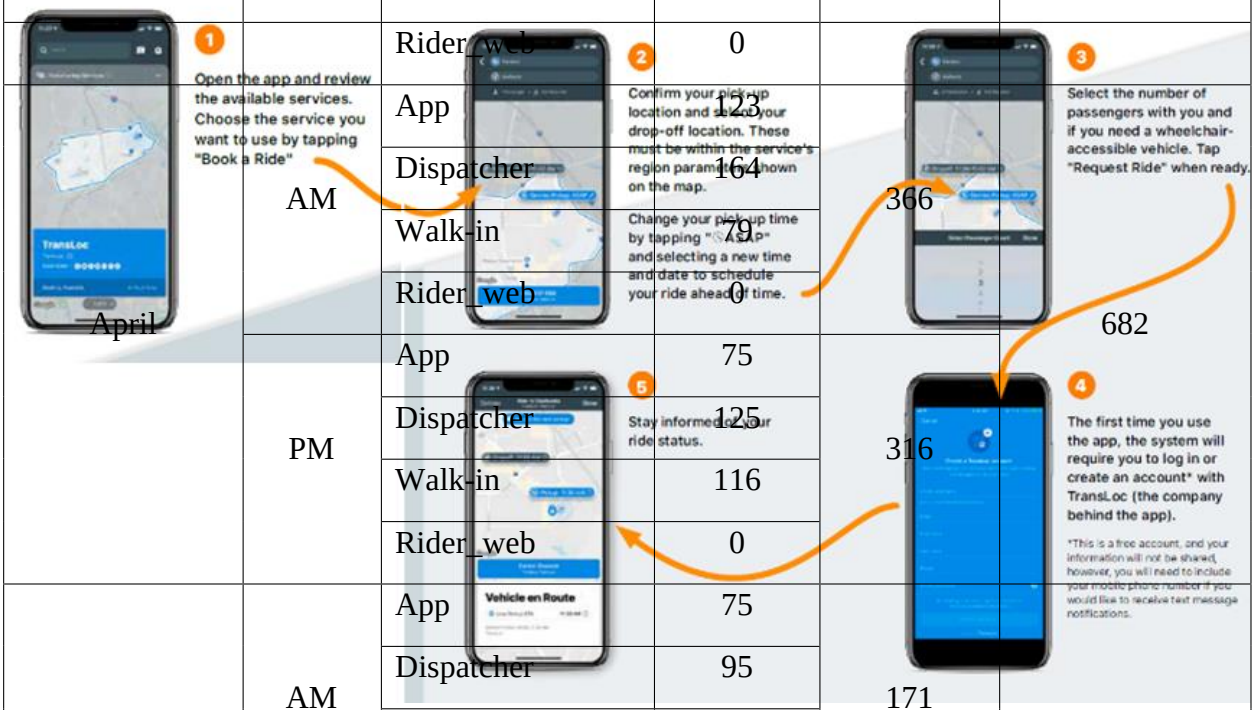
Appendices

Appendix A. Overall Trips Summary

Month	Time Slot	Source of Trip Booking	Number of records	AM/PM total	Monthly Total
January	AM	App	331	838	1590
		Dispatcher	417		
		Walk-in	85		
		Rider_web	5		
	PM	App	219	752	
		Dispatcher	161		
		Walk-in	371		
		Rider_web	1		
February	AM	App	306	929	1625
		Dispatcher	486		
		Walk-in	116		
		Rider_web	21		
	PM	App	186	696	
		Dispatcher	187		
		Walk-in	323		
		Rider_web	0		
March	AM	App	181	621	1164
		Dispatcher	338		
		Walk-in	91		
		Rider_web	11		
	PM	App	103	543	
		Dispatcher	148		
		Walk-in	292		

Month	Time Slot	Source of Trip Booking	Number of records	AM/PM total	Monthly Total
April	AM	Rider_web	0	366	682
		App	123		
		Dispatcher	164		
		Walk-in	79		
		Rider_web	0		
	PM	App	75	316	
		Dispatcher	125		
		Walk-in	116		
		Rider_web	0		
May	AM	App	75	171	471
		Dispatcher	95		
		Walk-in	1		
		Rider_web	0		
	PM	App	74	300	
		Dispatcher	98		
		Walk-in	128		
		Rider_web	0		
June	AM	App	141	265	628
		Dispatcher	114		
		Walk-in	10		
		Rider_web	0		
	PM	App	112	363	
		Dispatcher	97		
		Walk-in	154		
		Rider_web	0		
July	AM	App	170	299	723



Month	Time Slot	Source of Trip Booking	Number of records	AM/PM total	Monthly Total
		Dispatcher	106		
		Walk-in	23		
		Rider_web	0		
	PM	App	128		
		Dispatcher	108	424	
		Walk-in	188		
		Rider_web	0		
August	AM	App	211		773
		Dispatcher	125	370	
		Walk-in	34		
		Rider_web	0		
	PM	App	143		
		Dispatcher	141	403	
		Walk-in	119		
		Rider_web	0		
September	AM	App	264		1026
		Dispatcher	223	545	
		Walk-in	58		
		Rider_web	0		
	PM	App	192		
		Dispatcher	139	481	
		Walk-in	150		
		Rider_web	0		
October	AM	App	258		
		Dispatcher	411	763	1369
		Walk-in	94		

Month	Time Slot	Source of Trip Booking	Number of records	AM/PM total	Monthly Total
		Rider_web	0		
	PM	App	244	606	
		Dispatcher	258		
		Walk-in	104		
		Rider_web	0		
November	AM	App	236	582	1078
		Dispatcher	290		
		Walk-in	560		
		Rider_web	0		
	PM	App	252	496	
		Dispatcher	164		
		Walk-in	80		
		Rider_web	0		

Appendix B. Guide for Booking a Trip through Mobile App (Transloc)

Dear East Gainesville neighbor,

You are invited to participate in a brief survey about microtransit in East Gainesville. The information about the project and contact person is provided in the attached document. There are two sets of questions, one for microtransit users and the other one for non-users. Please read the text carefully and answer to the questions considering your travel behavior. This brief survey will take approximately 5 - 10 minutes and will not collect any identifying information of any respondent.

Please return the survey using the prepaid envelope.

We would like to receive your responses by February 14, 2021, although we will be accepting them for two weeks after that date

You may also scan the following QR code using your phone or type in the link provided below to access the online version of this survey.

https://ufl.qualtrics.com/jfe/form/SV_d5zFihqua0FfFfn

If you know of anybody who would be interested in participating in this survey please share the QR code or link above

Thank you for helping us to understand the role microtransit plays in East Gainesville communities' everyday lives. Your participation is highly appreciated.

Sincerely,

Dr. Ruth Steiner

Appendix C. Interview Questions for Local Officials and Community Leaders

Sample Community Leader Interview Questions

1. Tell me about your perception of the travel needs of citizens in East Gainesville.

2. Can you share with us what role public transportation plays for citizens in East Gainesville?

3. Are you familiar with the Microtransit service that has been operating in parts of East Gainesville since Spring 2019?

[If yes, go to question 4. If no skip to question 5]

4a. How have you become aware of this service?

4b. How often have you observed this service in the community?

4c. Do you know of anyone who makes use of this service in the community? Can you provide a description of their use of this service?

4d. *Analytical questions (A series of questions are provided below as ideas to continue analyzing the role of Microtransit in East Gainesville)*

Observations of the Microtransit Service

What are the patrons of this service using it to access?

How does a service like Microtransit affect the community?

Do you know of services that patrons try to access outside of the Microtransit service reach?

How favorable is the general community evaluation of the microtransit?

Are you aware of any adjustments that would enhance this service?

Description of commute patterns for the community at large

Can you describe the commute patterns that people in East Gainesville face when accessing:

Work?

Social Services?

Health Services?

School?

Other?

Overall Evaluation of the Microtransit Service

What are its strengths?

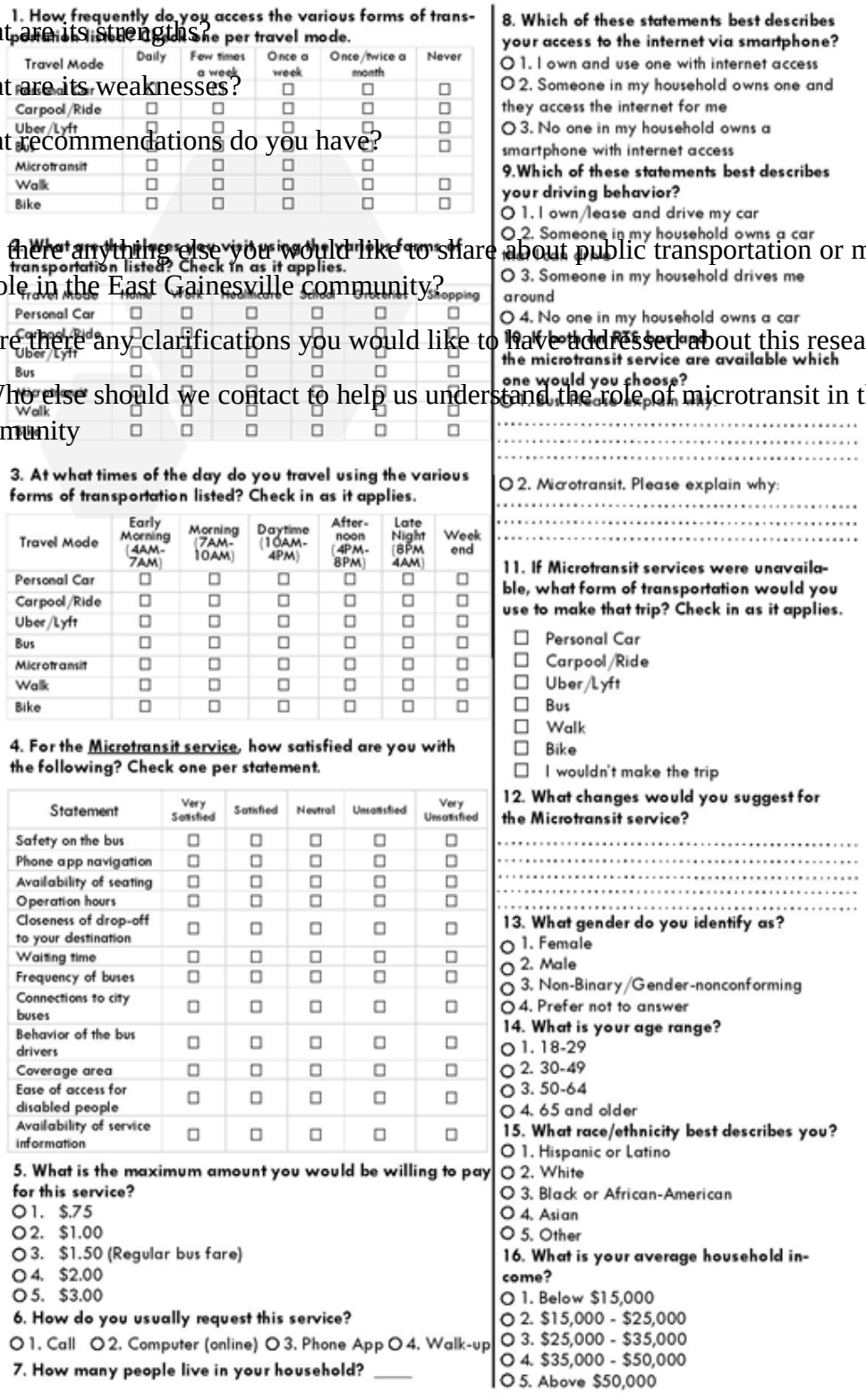
What are its weaknesses?

What recommendations do you have?

5. Is there anything else you would like to share about public transportation or microtransit and its role in the East Gainesville community?

6. Are there any clarifications you would like to have addressed about this research study?

7. Who else should we contact to help us understand the role of microtransit in the local community



MICROTRANSIT SERVICE USER SURVEY

1. How frequently do you access the various forms of transportation listed? Check one per travel mode.

Travel Mode	Daily	Few times a week	Once a week	Once/twice a month	Never
Personal Car	☐	☐	☐	☐	☐
Carpool/Ride	☐	☐	☐	☐	☐
Uber/Lyft	☐	☐	☐	☐	☐
Bus	☐	☐	☐	☐	☐
Microtransit	☐	☐	☐	☐	
Walk	☐	☐	☐	☐	☐
Bike	☐	☐	☐	☐	☐

2. What are the purposes you use the various forms of transportation listed? Check in as it applies.

Travel Mode	Home	Work	Healthcare	School	Groceries	Shopping
Personal Car	☐	☐	☐	☐	☐	☐
Carpool/Ride	☐	☐	☐	☐	☐	☐
Uber/Lyft	☐	☐	☐	☐	☐	☐
Bus	☐	☐	☐	☐	☐	☐
Microtransit	☐	☐	☐	☐	☐	☐
Walk	☐	☐	☐	☐	☐	☐
Bike	☐	☐	☐	☐	☐	☐

3. At what times of the day do you travel using the various forms of transportation listed? Check in as it applies.

Travel Mode	Early Morning (4AM-7AM)	Morning (7AM-10AM)	Daytime (10AM-4PM)	Afternoon (4PM-8PM)	Late Night (8PM 4AM)	Weekend
Personal Car	☐	☐	☐	☐	☐	☐
Carpool/Ride	☐	☐	☐	☐	☐	☐
Uber/Lyft	☐	☐	☐	☐	☐	☐
Bus	☐	☐	☐	☐	☐	☐
Microtransit	☐	☐	☐	☐	☐	☐
Walk	☐	☐	☐	☐	☐	☐
Bike	☐	☐	☐	☐	☐	☐

4. For the Microtransit service, how satisfied are you with the following? Check one per statement.

Statement	Very Satisfied	Satisfied	Neutral	Unsatisfied	Very Unsatisfied
Safety on the bus	☐	☐	☐	☐	☐
Phone app navigation	☐	☐	☐	☐	☐
Availability of seating	☐	☐	☐	☐	☐
Operation hours	☐	☐	☐	☐	☐
Closeness of drop-off to your destination	☐	☐	☐	☐	☐
Waiting time	☐	☐	☐	☐	☐
Frequency of buses	☐	☐	☐	☐	☐
Connections to city buses	☐	☐	☐	☐	☐
Behavior of the bus drivers	☐	☐	☐	☐	☐
Coverage area	☐	☐	☐	☐	☐
Ease of access for disabled people	☐	☐	☐	☐	☐
Availability of service information	☐	☐	☐	☐	☐

5. What is the maximum amount you would be willing to pay for this service?
○ 1. $.75
○ 2. $1.00
○ 3. $1.50 (Regular bus fare)
○ 4. $2.00
○ 5. $3.00

6. How do you usually request this service?
○ 1. Call ○ 2. Computer (online) ○ 3. Phone App ○ 4. Walk-up

7. How many people live in your household? ____

8. Which of these statements best describes your access to the internet via smartphone?
○ 1. I own and use one with internet access
○ 2. Someone in my household owns one and they access the internet for me
○ 3. No one in my household owns a smartphone with internet access

9. Which of these statements best describes your driving behavior?
○ 1. I own/lease and drive my car
○ 2. Someone in my household owns a car
○ 3. Someone in my household drives me around
○ 4. No one in my household owns a car

10. If both the PRT bus and the microtransit service are available which one would you choose?
○ 1. PRT bus. Please explain why:
.....
.....
.....
○ 2. Microtransit. Please explain why:
.....
.....
.....

11. If Microtransit services were unavailable, what form of transportation would you use to make that trip? Check in as it applies.
☐ Personal Car
☐ Carpool/Ride
☐ Uber/Lyft
☐ Bus
☐ Walk
☐ Bike
☐ I wouldn't make the trip

12. What changes would you suggest for the Microtransit service?
.....
.....
.....
.....
.....

13. What gender do you identify as?
○ 1. Female
○ 2. Male
○ 3. Non-Binary/Gender-nonconforming
○ 4. Prefer not to answer

14. What is your age range?
○ 1. 18-29
○ 2. 30-49
○ 3. 50-64
○ 4. 65 and older

15. What race/ethnicity best describes you?
○ 1. Hispanic or Latino
○ 2. White
○ 3. Black or African-American
○ 4. Asian
○ 5. Other

16. What is your average household income?
○ 1. Below $15,000
○ 2. $15,000 - $25,000
○ 3. $25,000 - $35,000
○ 4. $35,000 - $50,000
○ 5. Above $50,000

THANK YOU FOR YOUR PARTICIPATION!
[Please, mail back this sheet in the prepaid envelope provided]

Appendix D. Survey for Users & Non-Users

B. MICROTRANSIT SERVICE NON-USER SURVEY

1. How frequently do you access the various forms of transportation listed? Check one per travel mode.

Travel Mode	Daily	Few times a week	Once a week	Once/twice a month	Never
Personal Car	☐	☐	☐	☐	☐
Carpool/Ride	☐	☐	☐	☐	☐
Uber/Lyft	☐	☐	☐	☐	☐
Bus	☐	☐	☐	☐	☐
Walk	☐	☐	☐	☐	☐
Bike	☐	☐	☐	☐	☐

2. What are the places you visit using the various forms of transportation listed? Check in as it applies.

Travel Mode	Home	Work	Healthcare	School	Groceries	Shopping
Personal Car	☐	☐	☐	☐	☐	☐
Carpool/Ride	☐	☐	☐	☐	☐	☐
Uber/Lyft	☐	☐	☐	☐	☐	☐
Bus	☐	☐	☐	☐	☐	☐
Walk	☐	☐	☐	☐	☐	☐
Bike	☐	☐	☐	☐	☐	☐

3. At what times of the day do you travel using the various forms of transportation listed above? Check in as it applies.

Travel Mode	Early Morning (4AM-7AM)	Morning (7AM-10AM)	Daytime (10AM-4PM)	Afternoon (4PM-8PM)	Late Night (8PM 4AM)	Weekend
Personal Car	☐	☐	☐	☐	☐	☐
Carpool/Ride	☐	☐	☐	☐	☐	☐
Uber/Lyft	☐	☐	☐	☐	☐	☐
Bus	☐	☐	☐	☐	☐	☐
Walk	☐	☐	☐	☐	☐	☐
Bike	☐	☐	☐	☐	☐	☐

4. How many people live in your household? ____

5. Which of these statements best describes your access to the internet via smartphone?

O 1. I own and use one with internet access
O 2. Someone in my household owns one and they access the internet for me
O 3. No one in my household owns a smartphone with internet access

6. Which of the following statements best describes your driving behavior?

O 1. I own/lease and drive my car
O 2. Someone in my household owns a car that I can drive
O 3. Someone in my household drives me around
O 4. No one in my household owns a car

7. Were you aware that the Microtransit service is available to you?

O 1. Yes
O 2. No

8. Why have you not used the microtransit service?

.....
.....
.....
.....
.....

9. Would you consider using Microtransit for future trips?

O 1. Yes
O 2. No

Please explain why you chose the answer above

.....
.....
.....
.....
.....

10. What gender do you identify as?

O 1. Female
O 2. Male
O 3. Non-Binary/Gender-nonconforming
O 4. Prefer not to answer

11. What is your age range?

O 1. 18-29
O 2. 30-49
O 3. 50-64
O 4. 65 and older

12. What race/ethnicity best describes you?

O 1. Hispanic or Latino
O 2. White
O 3. Black or African-American
O 4. Asian
O 5. Other

13. What is your average household income?

O 1. Below $15,000
O 2. $15,000 - $25,000
O 3. $25,000 - $35,000
O 4. $35,000 - $50,000
O 5. Above $50,000

THANK YOU FOR YOUR PARTICIPATION!

[Please, mail back this sheet in the prepaid envelope provided]

Appendix E. Complete Table of Operational Efficiency Data for Each RTS Route

Route	Operation Time	Round-trip Distance	Number of Stops	Total Number of Passengers	Efficiency (μ)	Relative Efficiency (1/μ)
120	12.08	2.36	15	1037	1.00	1.000
127	12.47	2.20	18	1566	1.00	1.000
600	14.50	8.13	4	43	1.00	1.000
601	14.50	7.93	4	32	1.00	1.000
19	2.38	5.78	25	50	1.00	1.000
38	15.80	7.45	35	3771	1.00	1.000
118	14.27	4.82	25	2377	1.05	0.956
20	19.90	11.46	51	2477	1.52	0.657
21	13.17	9.05	41	1843	1.65	0.606
9	19.38	7.66	45	2177	1.73	0.577
28	10.42	9.80	48	1165	1.96	0.511
46	10.68	4.35	25	865	1.97	0.509
35	19.52	10.13	49	1796	2.10	0.476
33	18.97	9.82	25	1206	2.13	0.469
125	10.42	4.61	27	749	2.27	0.440
13	17.92	6.47	37	1461	2.30	0.435
1	17.20	11.70	59	1556	2.42	0.413
12	20.73	9.30	47	1518	2.48	0.403
37	14.03	11.22	53	992	3.31	0.302
34	18.25	10.44	48	1088	3.47	0.289

Route	Operation Time	Round-trip Distance	Number of Stops	Total Number of Passengers	Efficiency (μ)	Relative Efficiency (1/μ)
5	20.38	12.77	65	1000	3.77	0.265
43	13.58	20.60	95	795	3.97	0.252
121	11.40	2.88	30	327	4.55	0.220
8	17.40	17.91	92	823	4.58	0.218
122	10.00	10.78	54	461	4.69	0.213
17	13.32	5.71	26	442	5.54	0.180
15	17.48	14.34	74	666	5.67	0.176
119	10.40	4.83	29	308	5.71	0.175
75	16.72	28.80	122	656	5.75	0.174
117	12.22	5.03	28	377	5.98	0.167
302	6.85	15.85	79	194	6.64	0.151
126	16.30	6.31	38	485	6.78	0.147
800	9.92	18.00	16	92	6.95	0.144
36	11.42	11.06	56	341	7.49	0.134
23	14.80	13.37	31	426	7.53	0.133
29	10.68	7.33	44	298	7.89	0.127
10	12.50	17.12	76	340	8.40	0.119
11	14.33	12.85	62	387	8.70	0.115
25	10.57	8.91	51	251	9.25	0.108
26	15.40	16.30	53	391	9.36	0.107
76	9.97	16.45	55	216	9.95	0.100

Route	Operation Time	Round-trip Distance	Number of Stops	Total Number of Passengers	Efficiency (μ)	Relative Efficiency (1/μ)
301	6.48	14.08	80	119	9.98	0.100
16	18.27	7.42	33	329	10.73	0.093
7	13.83	12.01	66	256	12.60	0.079
300	7.00	9.36	50	103	12.94	0.077
6	14.07	15.53	67	246	13.37	0.075
40	11.70	13.61	55	196	13.43	0.074
305	6.90	11.18	64	86	15.07	0.066
3	7.88	14.64	64	103	15.26	0.066
39	9.03	22.05	79	105	18.02	0.055
2	14.32	13.07	54	175	19.25	0.052
303	6.37	11.82	64	48	23.86	0.042
128	7.92	21.94	51	47	33.63	0.030
711	16.87	14.27	72	102	37.15	0.027
27	10.92	12.50	54	50	48.21	0.021
24	11.87	18.63	67	48	55.98	0.018
902	14.12	56.77	10	4	166.00	0.006
901	14.85	81.47	10	4	197.37	0.005

Appendix F. Microtransit Implementation Considerations

Service Demand	Ridership	Transit ridership can be an indicator of travel patterns in certain areas. The demand created by transit users can point to how users move between the target area and other parts of the city.	Establish Target Area for consideration with geographical boundaries Identify routes running through the target area Examine ridership data by seasons, AM/PM etc
	Boardings/Alightings	More precise transit data found in daily boardings and alightings can help narrow into specific points of interest in a target area that may support microtransit service demand.	Evaluate transit stops for average daily boardings and alightings Examine what causes demand in the vicinity of stops with high transit demand
Demographics	Income	Microtransit is a useful resource for transit dependent persons. Low-Income residents can often depend or would like to rely more on public transit than on having to take care of their own personal car.	Examine Census data by various demographics Identify areas that have relatively higher levels of low income residents or residents that depend on welfare
	Age	Elderly residents often do not own private cars and are more open to using alternative methods of transportation to move around.	Identify areas that have relatively higher levels of elderly populations
	Minorities and other socially challenged groups	Racial minorities or people with other kinds of social disadvantages are likely to use public transit relative to the general population. People with physical disabilities or immigrant populations could create demand for a microtransit service	Identify areas with higher levels of racial minorities represented in their population Identify areas where people experience many social disadvantages
Commute Patterns	Car Ownership	Consider the mobility patterns of people. Indicators of people who might need to use a microtransit include car ownership and percentage of transit commuters	Access American Community Survey data Identify areas with low car ownership
	Percentage of workers using transit to commute	One of the more relevant measures of data is the percentage of workers that commute using transit, which may be an indicator of transit dependent populations.	Identify areas with relatively higher levels of transit commuters.
Policy	Consistency with Plans	There are many plans establishing policy and approaches that may identify the target area as a place in need of an expansion of transit services. Revising multiple plans put forth by cities, counties and travel agencies can provide justification for the implementation of a service like microtransit	Read through various policy plans such as a Transit Development Plan, Land Use Plan, City Plan, Area Plan or Comprehensive Plans Identify transportations goals for the target area consistent with these policy plans

Target Area Mobility Patterns	Improve Neighborhood Connectivity	Microtransit Services are capable of improving connections within neighborhoods where services are dispersed and fixed routes cannot cover all these services and residential neighborhoods adequately. Where a neighborhood circulator may be effective in medium to high density areas, a microtransit may be more effective in low-density areas.	Identify various stores, schools and other such amenities in the target area that users would access Examine how large distances between residents and their local amenities are
	Improve Multi-Modalism in Low-Density Areas	Microtransit Services are overall very capable of addressing first mile/last mile issues in low-density areas. Often these areas are suburban in nature or exist in marginal areas of cities where the predominant land use is single-family, but there is a demand for transit. In such areas, microtransit can connect riders to their nearest transit connection.	Examine how far residents in the target area are from their nearest transit stops Identify transit connections or hubs that may be useful for residents in target area to be connected to
Addressing Existing Transit in Target Area	Supplement an Existing Route	Microtransit Services are capable of revitalizing or complementing transit routes with low frequencies in areas of high transit dependency. Moreover, they may help to broaden the coverage that the base route runs through when the coverage area is very sparse and highly residential.	Identify the transit routes running through the area Examine the frequency of service on the transit route
	Replace an Existing Route	Microtransit Services are capable of replacing routes that demonstrate low efficiency or buses that serve a specific purpose but are too large to justify the service. Indicators of routes with low efficiency include low ridership, low frequencies.	Examine how efficient the transit routes are in the area Discuss if these routes are cost-efficient or if they could function more effectively as a microtransit
Supplement service hours of operation	Provide added service during peak hours	Microtransit Services are capable of aiding transit services during peak hours when transit routes can be burdened, or when there is the highest demand for transit. Providing this alternative during peak hours helps riders move on demand to connect to their nearest amenities, whether it be a neighborhood store, job site or the nearest transit connector	Examine movement in the area during peak hours Examine the burden that local transit routes experience during peak hours Discuss if adding service during peak hours is a need
	Added service during late night hours	Microtransit Services can address late night demand. Due to lower demand during late night hours, there is a reduced amount of transit services. Many riders find themselves having to navigate their way to their destination amid insecure conditions, even walking long distances late at night.	Revisit target area demographics that may indicate the presence of late night workers Discuss with community leaders if there is a persistent need to address late night movement

Financial Stability	Diversify Funding Structure	It is suggested that diversity in fundings be sought to fund a microtransit service. The expense of the service per capita is higher than fixed route. In order to achieve financial stability, the following sources can provide diversity in funding for the service.	Establish Fare Collection Employment centers served by microtransit Apply for Federal funding (AIM)
	Funding From Local Companies	Consider that many people using this service could be using it to access a variety of work locations. If this is the case, employers can be approached to establish a source of funding.	Identify Employers interested in participating Establish deals for Companies
Partnerships	Public Private Partnerships	Establishing public private partnerships with stakeholders that may be interested in using microtransit to move employees must also be establish for long-term stability of the service. Ensuring that the service does not shift consistently and that it demonstrates a degree of consistency and reliability is important	Ensure that partnerships will preserve the long-term stability of the service
	Third Party Contractors	Decide whether the fleet and operations will be supplied by the local agency or if a third-party agency will be contracted. If a third-party is contracted, it is important to secure before licensing the data sharing structure which is essential for service evaluation	Establish Data Agreement Decide on whether contracting or providing service
Operations	Ridership	Microtransit ridership generally does not exceed 6 passengers per hour per vehicle, rendering it a low-capacity service. Ensure the coverage area is manageable for microbuses to perform this number of trips	Understand what areas can sustain a stable demand that is neither too low nor too excessive
	Flexibility in service	Service operations will need to adapt according to perceived demands within the first year of operations to fully engage the microtransit target area.	Establish anchor points for microtransit to service Routinely observe demand and expand accordingly
	Start with small coverage areas	Starting with a small coverage area will help to mature the service into an adequate coverage area. After routine observation and expansion, a threshold of service will be met when only a certain number of rides can be completed within the hour without burdening the overall system	Establish Target Area Routinely evaluate service to evaluate service threshold