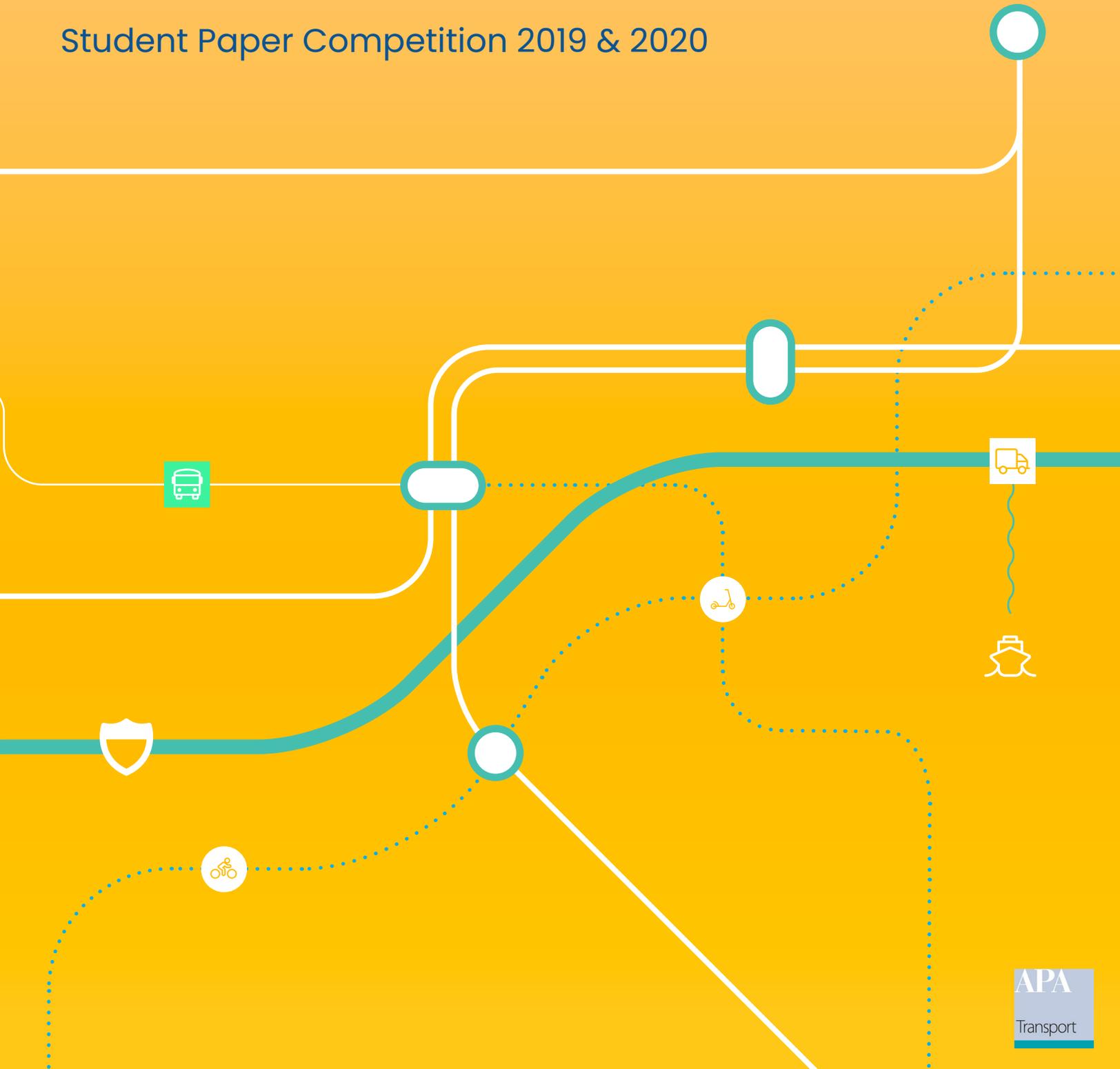


American Planning Association

TRANSPORTATION PLANNING DIVISION

Student Paper Competition 2019 & 2020



American Planning Association
**TRANSPORTATION
PLANNING DIVISION**

Student Paper Competition
2019 & 2020

Published April 2020 by the
American Planning Association:
Transportation Planning Division



Creating Great Communities for All



Contents

2019

FIRST PLACE

Assessing the Untapped Potential of the Lowell Line

Mark Bennett (Harvard University)

SECOND PLACE

Auto-Oriented Western Cities

Nathan R. Begay (University of New Mexico)

THIRD PLACE

BRT and Property Values

Matthew Bewley (Rutgers University)

2020

FIRST PLACE

Informal Transit and Women's Travel Issues in the Global South

Louis G. Alcorn (University of Texas at Austin)

SECOND PLACE

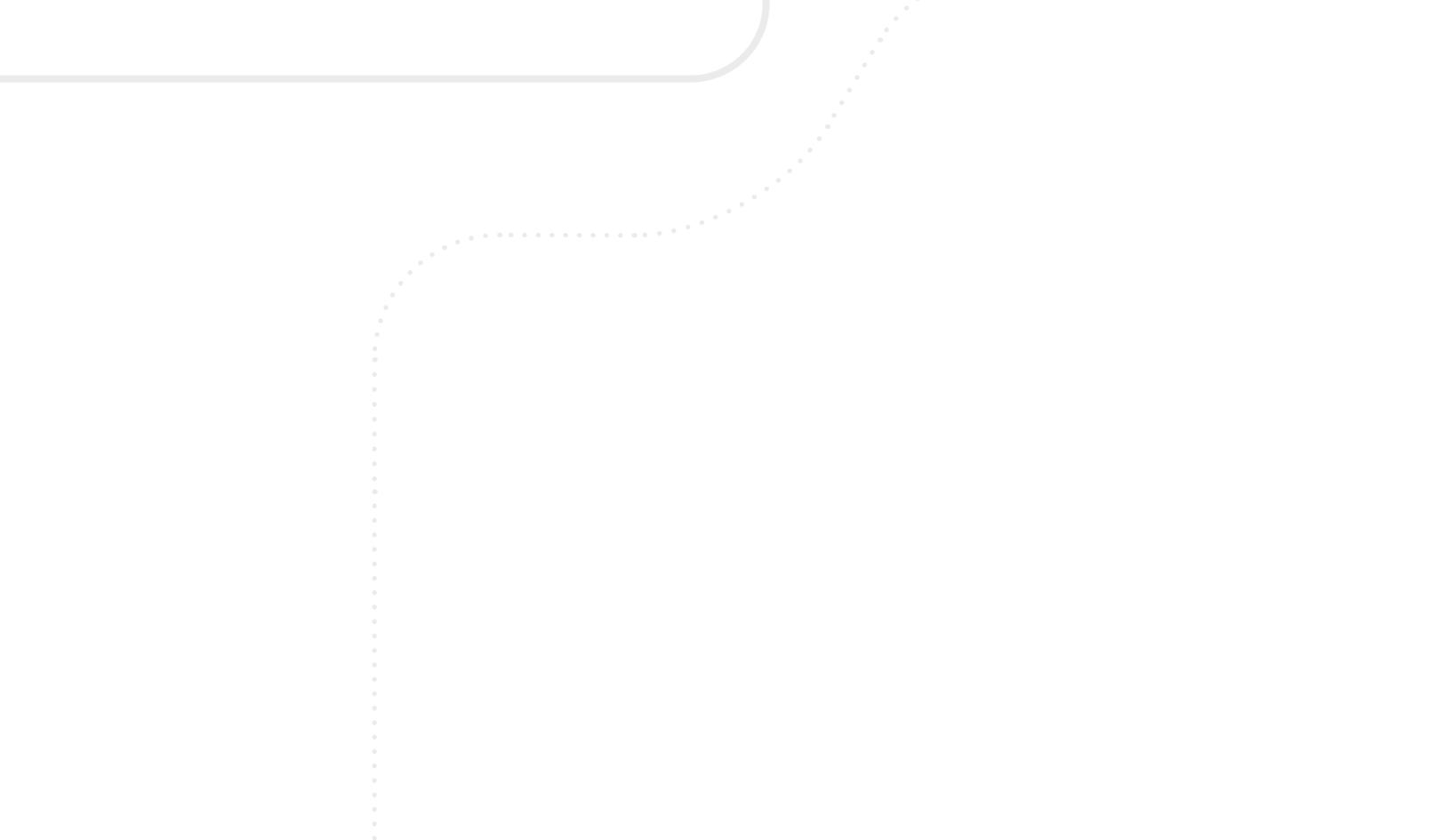
Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

Katherine Stiegemeier (University of California, Los Angeles)

SECOND PLACE

Financing the Landside Access Modernization Project at LAX

Sam Speroni (University of California, Los Angeles)



2019

1st Place

Assessing the Untapped Potential of the Lowell Line

Mark Bennett, Harvard University

Abstract:

Lowell, MA, is a city of 108,000 residents located an hour north of Boston and near the Massachusetts/New Hampshire State Line. More than a quarter of its residents are foreign-born, including significant refugee populations. Lowell is also home to the University of Massachusetts, Lowell campus. One of Lowell's greatest assets is its commuter rail connection to Boston. The line largely serves as a method to get workers from Lowell to Boston and back home at night. But further analysis shows nearly 50,000 jobs within one mile of a stops *between* Lowell and Massachusetts. Is there untapped potential to connect Lowell residents— particularly immigrant and refugee populations— with jobs *along* the line? Further, recent developments have restarted talks about expanding the Lowell line north into New Hampshire. This route would run right past UMass Lowell, offering the potential to add a new station that both better serves university students and staff as well as the bordering Highlands neighborhood and its significant immigrant and refugee populations. This study analyzes the possible siting of that station and its potential benefits.

The Lowell Line

Among Lowell's greatest transportation assets is its commuter rail line to Boston, known as the Lowell Line. The 25.4-mile rail line connects Lowell to North Station in Boston, as well as seven stops in between, on a 45-minute journey that runs seven days a week. The Lowell Line has long served as an important commuter link for the city, but untapped potential and future expansion mean the rail line could serve an even higher opportunity for Lowell going forward—for all residents, including Lowell's significant immigrant and refugee populations. According to 2017 US Census estimates, 27.8% of Lowell residents are foreign born.¹

A Brief History

To understand the Lowell Line's future is to appreciate its past. In 1803, the Middlesex Canal was completed, linking Boston Harbor to the Merrimack River in Lowell and unleashing Lowell's full potential as the soon-to-be cradle of the American Industrial Revolution. Although the canal was an engineering marvel, the technology's preeminence lasted only three decades. In 1835, the Boston & Lowell Railroad opened, with many portions of the route

following precisely along the canal. This new rail line, one of the first permanent railroads in the United States, quickly proved superior to the canal, taking much of the canal's freight business with it.² Early on, local service was added to the line allowing passengers to stop and board at cities between Lowell and Boston. From its inception, the Lowell Line was an important link for immigrants traveling to and from Lowell in search of work and a better life.

The Boston & Main Railroad acquired the line in 1895 and passenger service, at its peak, carried passengers from Boston up to Concord, New Hampshire. In 1965, three stations along the route were shuttered and by 1967, passenger service was eliminated to New Hampshire, with Lowell becoming the new terminus. In 1973, the Massachusetts Bay Transportation Authority (MBTA) took ownership of the Lowell Line and subsequently closed another four stops within the following decade. For thirteen months in 1980-81, passenger service was reconnected to Concord, but operation ceased when federal funding was withdrawn.³

Today's Lowell Line

Today, the Lowell line runs 25 daily weekday trains from Lowell to Boston and 26 trips from Boston to Lowell. On weekends, eight trains run each way between the two cities. The Boston terminus is North Station. Each of the trips include seven stops: North Billerica, Wilmington, Anderson/Woburn, Mishawum, Winchester Center, Wedgemere, West Medford. However, some stations run as “flag stops.” Although the MBTA still owns the Lowell Line, it is operated on contract, as are all MBTA commuter rail lines, by Keolis, a private rail operator based in France.

The first weekday train from Lowell to Boston departs at 5:35am, and the final train to Boston leaves at 11:05pm. The first weekday train from Boston to Lowell leaves North Station at 5:35am and the final train to Lowell departs Boston at 12:15am. As shown in Figure 1, the schedule leaves large gaps in nighttime service on weekdays and even larger gaps on weekends.

Ridership

The MBTA's most recent ridership records from 2015 indicate a weekday average ridership on the Lowell line of 11,485 passengers, including both inbound and outbound trips.⁴ Average weekend ridership is 5,938⁵ (although the MBTA has

recently offered widely conflicting counts for weekend traffic across the system.⁶) According to 2013 data (the most recent data available), the MBTA estimates 1,770 weekday passengers board the line at the Lowell stop—making it the fourth-most popular stop on the entire commuter rail network. The Anderson/Woburn stop, with 1,502 weekday boardings, is listed as the network's seventh-most popular stop. The least-used stop on the Lowell Line is Mishawum, with a reported weekday boarding of just 42 passengers, although all other stations report at least 500 boardings.⁷

Without passenger data more recent than April 2013, it is difficult to determine ridership trends on the Lowell line. However, the April 2013 count of 7,054 Lowell Line inbound boardings was up over 6,038 boardings in June 2007 but down from 8,085 in November 2011.⁸

Commuter Share

According to the 2016 American Community Survey, 729 Lowellians used rail as their primary commuting option, representing 1.4% of city residents. MBTA data that reports 1,770 annual weekday boardings at the Lowell stop suggests a large share of non-Lowell residents are boarding the commuter rail at Lowell each morning.⁹

Further, American Community Survey data report that while 3.6% of native-born residents in Lowell commute by public transit, 4.5% of foreign-born non-citizens take public transit every day.

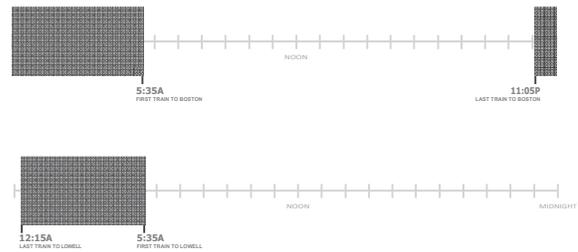
Reliability

For the 30 days between January 22 and February 20, 2018, the MBTA reports the Lowell line ran at an average on-time reliability of 91% matching the system-wide commuter rail average for that same period.¹⁰

Fares

The base fare for adults from Lowell to Boston is \$10 each way. The stops along the line are located in layered fare zones and therefore have different fare prices. Figure 2 shows the ranges of fare prices between Lowell and stops along the line. For instance, a round trip base fare to North Billerica is \$6.50. Additionally, regular passengers can save on fare by buying an unlimited monthly pass. Monthly pass costs vary depending on origin and destination. For a commuter traveling between Lowell to Boston five days a week, this monthly pass could bring the fare total down to under \$15 round trip. For a commuter traveling between Lowell and North Billerica five days a week, for example, the monthly pass could bring the cost of a round trip fare down to just over \$5.00, or approximately the same round trip fare on the rapid transit T system in Boston.¹¹

Weekday Service



Weekend Service

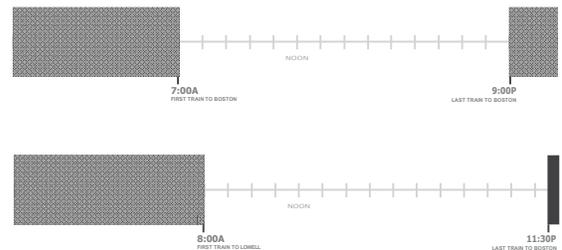


Figure 1 - Gaps in Lowell Line service, Lowell to Boston on top and Boston to Lowell at bottom
Data Source: MBTA

Fare Ranges



Figure 2 - Ridership fare ranges, including discounted fares
Data Source: MBTA

Commuter Rail Reach

Commuter rail, by its name, implies a focused role—helping passengers travel from home to their place of employment. The Lowell Line is designed primarily to carry passengers into Boston, although some passengers are also commuting between stops on the line. The Lowell Line achieves its function as a commuter option through a significant “park-and-ride” operation. With 6,215 average weekday boardings and 3,817 car parking spaces at stations along the line, there’s one parking spot for every 1.6 passengers. In Lowell, however, that number is much lower with one parking spot for every 2.5 people.¹²

Access to Jobs

However, the Lowell Line’s potential for transporting Lowellians to jobs extends beyond just employment opportunities in Boston. An analysis of business data from 2016 shows 253,488 jobs within a one-mile radius of North Station in Boston (See Figure 3). But within a one-mile radius of the seven stops between Lowell and Boston are an additional 47,223 jobs. The Mishawum stop alone features 22,954 jobs within a one-mile radius of the commuter rail stop.¹³ See figure 4 for a sampling of jobs.

Multiple surveys associated with Lowell Greater Gateway project have indicated jobs to be the top or second-highest priority need for residents,

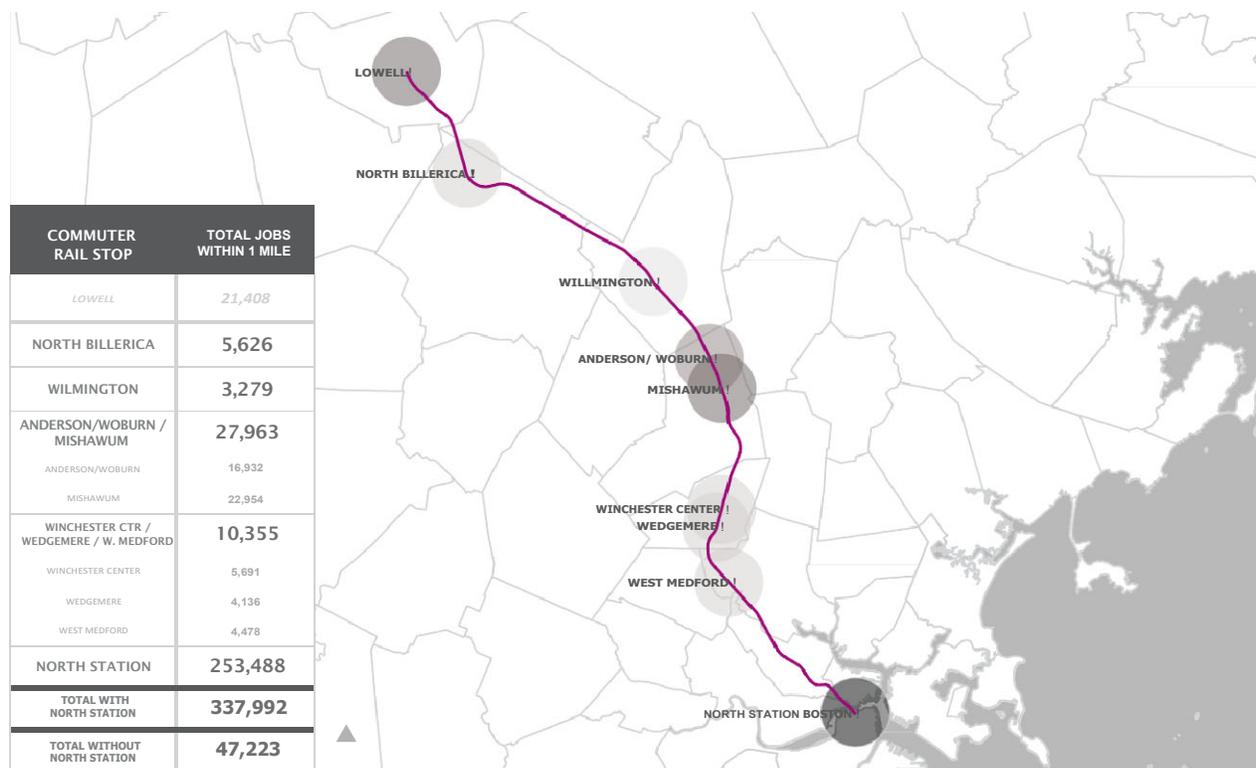


Figure 3 - Map of Lowell Line and one-mile radius around each station, shaded to show intensity of jobs within radius
Data Source: Mass GIS, ESRI Business Analyst

including immigrant and refugee populations.¹⁴ The 47,233 jobs along the Lowell Line could be a huge, untapped opportunity to place Lowell residents in good-paying jobs.

The MBTA does not keep public data tracking how many passengers from Lowell disembark at one of the seven stations along the way to Boston, but observation reveals it to be a small fraction. Could these stops provide untapped potential for employment access from Lowell—especially for immigrant and refugee populations? Further research is needed, but the raw numbers indicate yes.

Affordability

A careful analysis is needed to determine whether the commuter rail is an affordable option—particularly for low-income and immigrant or refugee workers. If we assume an employee works eight hours a day at the Massachusetts state minimum wage of \$11 and hour, that employee earns \$88 dollars each day and

takes home around \$72.50 after taxes. Assuming a discounted monthly pass rate, an employee would pay from \$5.07 per day to get to and from North Billerica, all the way up to \$14.62 per day to get to and from North Station (See Figure 2). That represents a transportation cost of between 7% and 20.2% of total take-home pay.

But these numbers are calculated based off an “ideal” scenario where the employee only works one job in one location and where there are no additional commuting costs from their home to the Lowell stop or from their departure stop to place of employment. Additionally, many low-income earners work more than eight hours a day or more than five days a week—both could change the above calculation for the better if those hours are at the same job and worse if they’re spread over jobs at multiple locations. Further research is needed to understand the affordability of commuter rail for low-income workers in Lowell and possible mechanisms to reduce cost—including reduced fares or transportation between stations and home or work.

SAMPLING OF LOWER-SKILL JOBS AVAILABLE ALONG LOWELL LINE

EMPLOYER	LOCATION	EMPLOYEES	OPEN JOB	PAY	DISTANCE FROM STATION
Marshalls Distribution Center	Commerce Way, Woburn	1100	Distribution Center Supervisor	\$55,560	.7 miles
United Stationares Supply Co	Wildwood Ave, Woburn	300	Distribution Assoc 2 (2-10:30p)	14/hr	.9 miles
Peterson Party Ctr INC	Cabot Rd, Woburn	300	Dispatcher	18/hr + Benefits	1.2 miles
Potpourri Group Inc	Billerica Ave, Billerica	500	Call Center Representative	12/hr	1 mile
Pace Industries Cambridge Div	Falkner St, North Billerica	200	Assembler	\$33.5k	.2 miles
Quad Graphics	Woburn		Print Operator	16/hr	.5 miles

Figure 4 - Sampling of available lower-skill jobs within close range of a commuter rail stop between Lowell and Boston
Data Source: Individual job listings

Untapped Potential: A Case Study

UMass Lowell

Lowell has one significant case study from which to gauge untapped commuter railridership potential. UMass Lowell is the city's second-largest employer with 2,071 employees¹⁵ and has a student body of 17,062.¹⁶ In 2011, the institution

completed a comprehensive transportation study that included an analysis of students and staff commuting patterns. The study reported that 68% of undergrad students, 25% of graduate students and 84% of faculty/staff had purchased a campus parking permit.

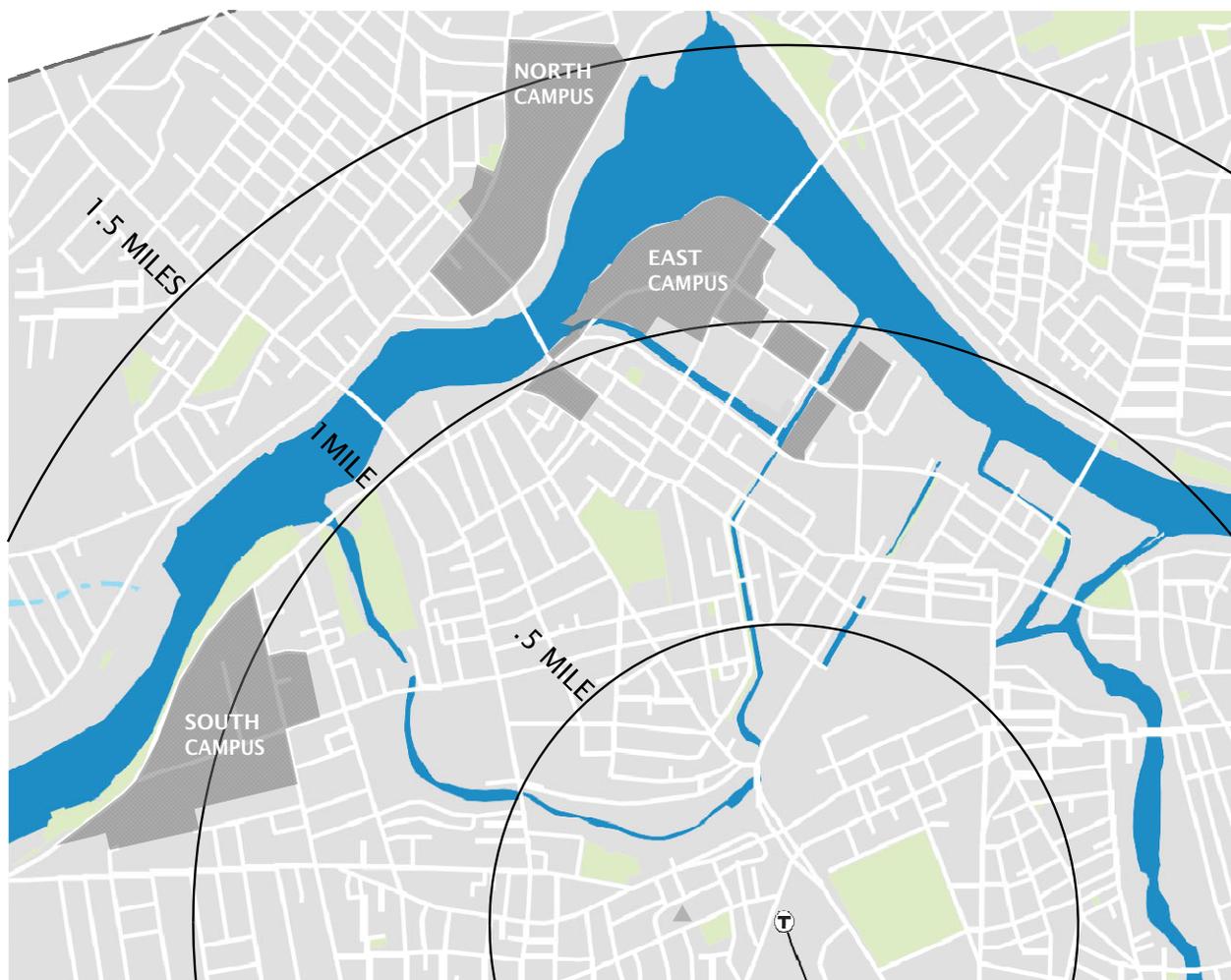


Figure 5 - UMass Lowell's three campuses in proximity to the commuter rail station
Data Source: Mass GIS, UMass Lowell

By geocoding addresses attached to each issued permit, the study also analyzed students, faculty and staff who currently buy parking passes but live within three miles of commuter rail stop. The study identified 140 faculty/staff and 550 students who owned a parking permit but lived within three miles of a stop along the Lowell Line.¹⁷

The UMass Lowell report indicated barriers to these potential rail users as:

- Three-seat ride (car to train to bus)
- Inefficient connections to campus from terminal
- Lengthy total trip time
- High cost
- Lack of parking at commuter rail stations
- Lack of flexibility or control

At the time of publication, the UMass Lowell transportation study recommended focusing on

Carpool, Bicycle and Walking as alternatives to emphasize.¹⁸ In 2018, UMass Lowell staff remain interested in bringing more faculty, staff and students to campus by rail. “Very much so,” said Adam Baacke, UMass Lowell Director of Campus Planning and Development. “The biggest challenge is the “last mile” problem of getting from the Gallagher Terminal to campus. We’d like to see a healthy combination of bus service aligned with the train schedule, improved bicycle routes, and more on-demand shared ride-hailing services.”¹⁹

Focusing on the above listed barriers could help UMass Lowell and the city of Lowell reduce the amount of daily commuting traffic and parking needed by shifting more mode share to commuter rail.

The Future

Extension to New Hampshire

The future of the Lowell Line is largely a conversation about extension into New Hampshire. It's now been 37 years since the Lowell Line has offered service to New Hampshire and more than 50 years since permanent service. Within the last few years, momentum for a proposal to once again bring Lowell Line service into New Hampshire has faced a series of significant advances and setbacks.

In 2014, the NH Capitol Corridor Study was released, detailing the potential scope and cost of an extension from Lowell. At the time, the cost of expanding the passenger service through Nashua and up to Manchester came with an estimated capital cost of \$245.6 million.²⁰ Various plans have also included additional stops in Merrimack or at the Manchester-Boston Regional Airport. The New Hampshire Rail Transit Authority estimates a demand of 668,000 riders in the first year.²¹ Importantly, Pan Am Railways, owners of the track between Lowell and Manchester, have already agreed to a right-of-way deal with the MBTA to allow passenger trains on the tracks.²²

In 2016, the New Hampshire gubernatorial race focused significant attention of the issue of passenger rail service from Lowell into the state. The ultimate

victor in the race, Republican Chris Sununu, opposed the commuter rail, and in February 2017, the New Hampshire state legislature voted to kill \$4 million in federal funding to study the Capitol Corridor expansion.²³ New Hampshire has a long received criticism for opposing rail projects, including largely refusing to support Maine's eventually successful endeavor to establish rail service from Portland to Boston.²⁴ In January 2018, however, Gov. Sununu changed course and stated he was now open to using the federal funding to study a train line. The Governor indicated that the state's failed bid to attract Amazon's second headquarters forced him to think twice about the value of passenger rail in the state.²⁵

Jobs Access

The debate over a Lowell Line extension north is currently largely centered around citizens of New Hampshire gaining access to Massachusetts. However, an analysis of business data shows that within a one-mile radius of three stops proposed along the extension—Nashua, Merrimack and Manchester—are 42,853 jobs, nearly the same number of jobs accessible from the seven current stops between Lowell and Boston (See Figure 3). In Manchester alone, more than 25,000 jobs are within a one-mile radius of a potential commuter rail station.²⁶

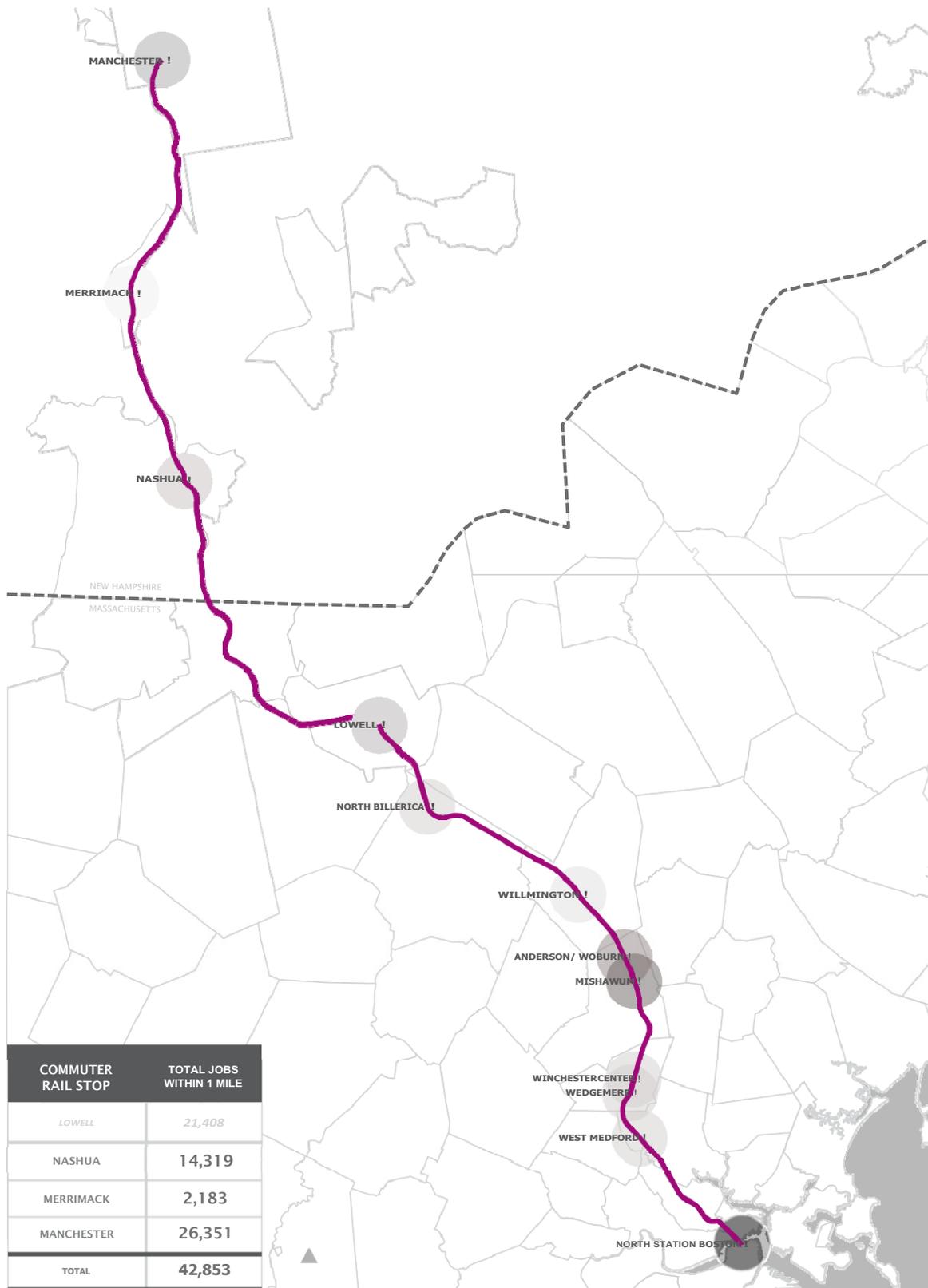


Figure 6 - Proposed route extension into New Hampshire with one mile radius around each proposed station, shaded to display job intensity within each radius.
 Data Source: Mass GIS, ESRI Business Analyst

Additionally, UMass Lowell's 2011 transportation study reported that a significant number of faculty, staff and students are commuting from Nashua.²⁷ A commuter rail stop in Nashua could provide options for UMass Lowell commuters and potentially reduce the number of cars commuting into and out of the city every day.

A Second Lowell Station

Within recommendations for an extension into New Hampshire is an idea to construct a second Lowell stop on the line at the UMass Lowell south campus. This second station would be almost exactly one mile down the tracks from the current Lowell stop, which is close, but not unprecedented. In fact, on the Lowell Line itself, the Winchester Center and Wedgemere stops are less than a half mile apart and the Anderson/Woburn and Mishawum stops are just under one mile apart.

UMass Lowell Director of Campus Planning and Development Adam Baacke expressed enthusiasm for the idea of a second station on the school's south campus:

“This would be a wonderful thing that we have proposed on many occasions in conjunction with the discussions of expanded rail to New Hampshire. Unfortunately, it has generally been received with little enthusiasm by MassDOT/

MBTA. It would not be a complete cure for the last mile issues though, since we likely have greater demand for commuter students and employees to access East and North Campus from the Gallagher than South.”²⁸

This second station could provide three major benefits:

1. A more direct connection for UMass Lowell students, faculty and staff to access work and school via the commuter rail, potentially helping shift mode share from car to rail.
2. New access to commuter rail for significant portions of Lowell outside university populations. Figure 7 shows 5 and 10-minute walksheds from a proposed second station, comparing that coverage with walksheds of the current station. Significant sections of immigrant-heavy Highlands neighborhood would now also be within walking distance of the rail.
3. New housing, office and educational facilities in large under-utilized parcels in the immediate vicinity of a new station.

Although this additional station has largely only been discussed within the context of a commuter rail line extension to New Hampshire, Lowell, including its immigrant and refugee populations, could still reap all three above benefits by only extending the line one mile to reach the UMass Lowell south campus. This option should be explored further.

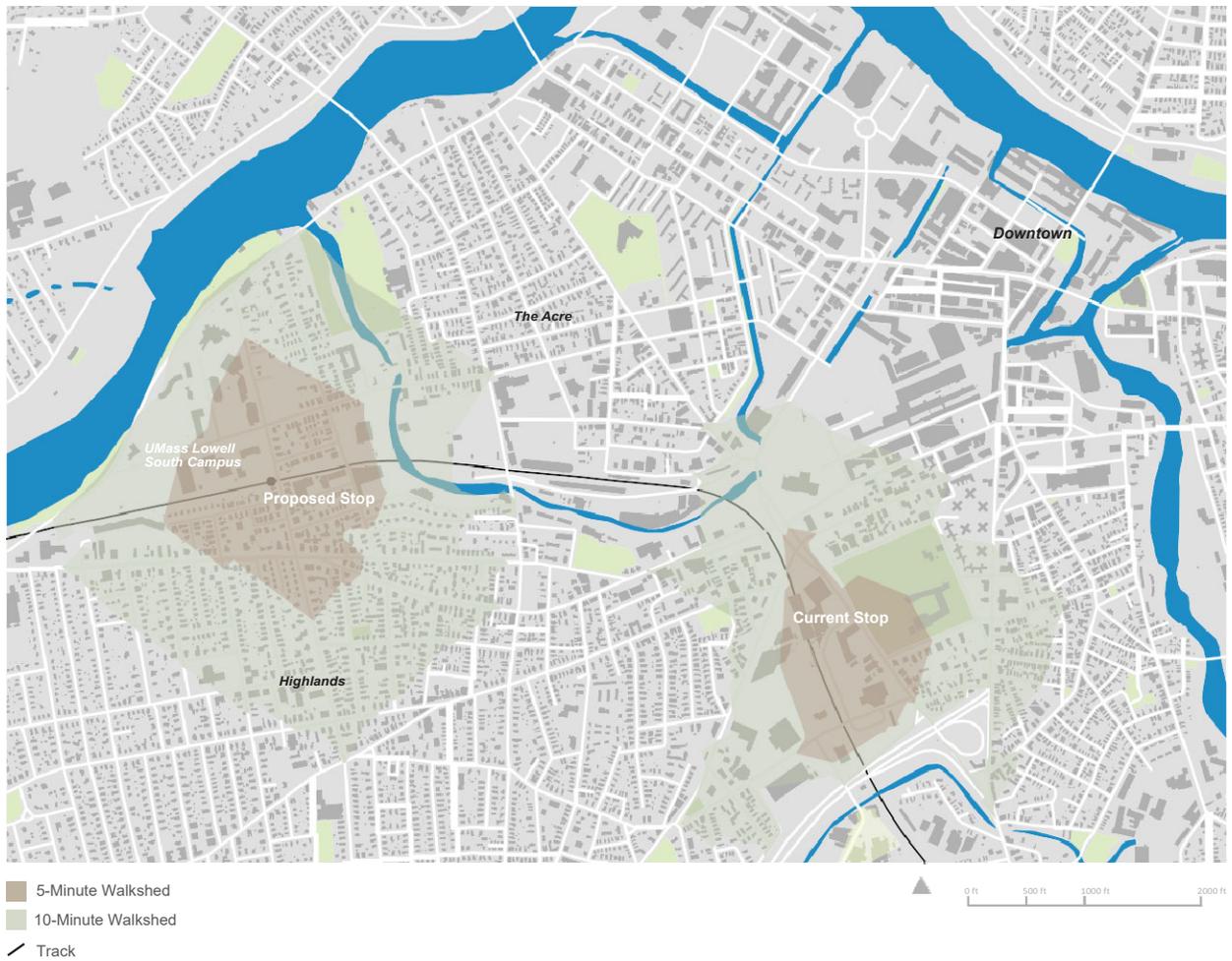


Figure 7 - Walkshed coverage of current Lowell commuter rail stop (right) compared to potential additional walkshed coverage from a second stop (left)

Data Source: Mass GIS

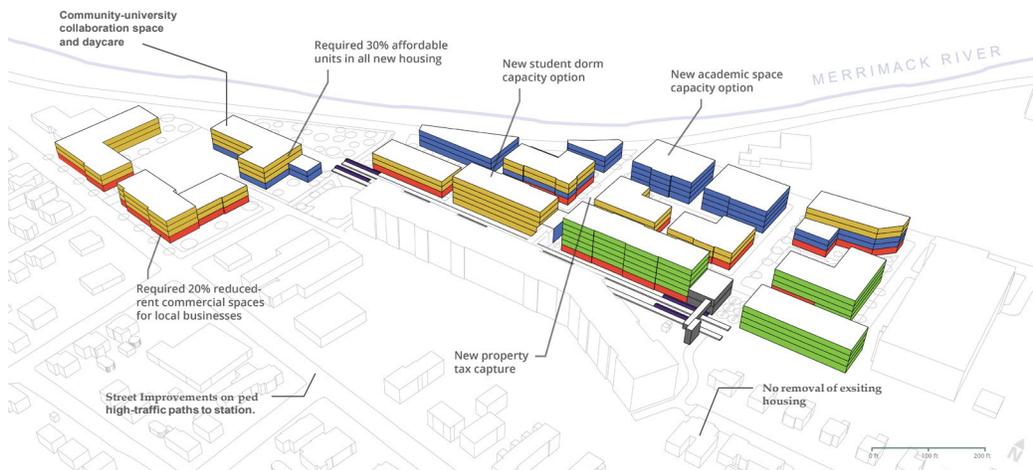


Figure 8 - Initial massing and programming model showing potential TOD around new commuter rail stop that benefits both the neighboring university and immigrant populations.

Summary and Recommendations

The Lowell line is a critical transportation link between not only Lowell and Boston but the seven stops between the two cities as well. While nearly 300,000 jobs are located within a mile radius of eight stops connected to Lowell by commuter rail, fewer than 750 Lowell residents rely on the train to get to work. Analysis shows 50,000 of those jobs are located proximate to stations between Lowell and Boston. City and nonprofit officials should not ignore these job opportunities when working with residents seeking work. Further study is needed to determine opportunities for Lowell residents to access work in cities along the commuter rail line, not just in Boston.

Additionally, Lowell is home to one of the largest refugee populations per capita in the United States. Special consideration needs to be taken to understand how the commuter rail can better serve this vulnerable population.

Further, how could a commuter rail extension into New Hampshire open up additional job opportunities for Lowell residents? More study is also needed to determine the feasibility and impact of a second station in Lowell, at the border of the UMass Lowell South Campus and Highlands neighborhood. But analysis shows siting a station at the campus would not be unprecedented.

The commuter rail provides opportunities for residents of Lowell to connect to work outside the city while also connecting outside residents to jobs within Lowell by means other than personal automobile. This study suggests the current Lowell Line presents potentially untapped potential for further connecting students and workers of all skill sets and backgrounds.

Sources

- 1 U.S. Census Bureau; American Community Service, 2013-2017 American Community Survey 5-Year Estimates; generated by Mark Bennett, using American FactFinder, <<http://factfinder2.census.gov>>.
- 2 Lorenzo, Al. The Use of Granite in the Lowell Canal System. 2004 (3)
- 3 Skoropowski, Eugene K. "N.H. commuter rail: a success in 1980." Editorial. NH Business Review, August 1, 2008. <http://www.nhbr.com/August-1-2008/N.H.-commuter-rail-a-success-in-1980/>
- 4 MassDOT. State of the System Report: Commuter Rail. Report. MassDOT. 2015. <https://www.massdot.state.ma.us/Portals/49/Docs/Focus40CommuterRail.pdf>
- 5 MBTA. Ridership and Service Statistics. Report. MBTA. 14th ed. 2014. [https://cdn.mbtace.com/uploadedfiles/documents/2014%20BLUEBOOK%2014th%20Edition\(1\).pdf](https://cdn.mbtace.com/uploadedfiles/documents/2014%20BLUEBOOK%2014th%20Edition(1).pdf)
- 6 Nicole Dungca. "I not sure how many weekend commuter rail riders it has." Boston Globe, March 18, 2017. <https://www.bostonglobe.com/metro/2017/03/17/how-many-riders-use-weekend-commuter-rail-the-not-quite-sure/jD19ZNWI6L7BfNKuFoMV9K/story.html>.
- 7 MBTA. Ridership and Service Statistics. Report. MBTA. 14th ed. 2014. [https://cdn.mbtace.com/uploadedfiles/documents/2014%20BLUEBOOK%2014th%20Edition\(1\).pdf](https://cdn.mbtace.com/uploadedfiles/documents/2014%20BLUEBOOK%2014th%20Edition(1).pdf)
- 8 MBTA. Ridership and Service Statistics. Report. MBTA. 14th ed. 2014. [https://cdn.mbtace.com/uploadedfiles/documents/2014%20BLUEBOOK%2014th%20Edition\(1\).pdf](https://cdn.mbtace.com/uploadedfiles/documents/2014%20BLUEBOOK%2014th%20Edition(1).pdf)
- 9 U.S. Census Bureau; American Community Service, 2016 American Community Survey 5-Year Estimates; generated by Mark Bennett, using American FactFinder, <<http://factfinder2.census.gov>>.
- 10 MBTA Performance Dashboard. Accessed March 02, 2018. http://www.mbtackontrack.com/performance/index.html#/detail/reliability/commuter_rail/.
- 11 MBTA. "Commuter Rail Fares." Commuter Rail < Fares and Passes < MBTA - Massachusetts Bay Transportation Authority. Accessed March 02, 2018. <https://mbta.com/fares/commuter-rail>.
- 12 MBTA. "Lowell." Lowell Line < Commuter Rail < Schedules & Maps < MBTA - Massachusetts Bay Transportation Authority. Accessed March 02, 2018. <https://mbta.com/schedules/CR-Lowell/line#info-and-maps-tab>.
- 13 Angius, et al. Intercept Survey Methods and Results. Report. Graduate School of Design, Harvard University. 2018.
- 14 Esri Business Analyst 2016. ArcGIS Desktop. Redlands, CA: Environmental Systems Research Institute
- 15 City of Lowell. "Top Employers | Lowell, MA." The City of Lowell. Accessed March 02, 2018. <https://www.lowellma.gov/794/Top-Employers>.
- 16 UMass Lowell. "Facts at a Glance." Facts at a Glance | UMass Lowell. Accessed March 02, 2018. <https://www.uml.edu/Institutional-Research/Facts-at-a-glance.aspx>.
- 17 University of Massachusetts Lowell. Campus Transportation Plan. Report. 2011. https://www.uml.edu/docs/UML-Campus-Transportation-Plan-sm_tcm18-197880.pdf
- 18 University of Massachusetts Lowell. Campus Transportation Plan. Report. 2011. https://www.uml.edu/docs/UML-Campus-Transportation-Plan-sm_tcm18-197880.pdf
- 19 Interview, Adam Baacke, Feb. 26, 2018
- 20 New Hampshire DOT. Capitol Corridor Rail and Transit Alternatives Analysis (Parts A & B). Report. New Hampshire DOT. 2014. <http://www.nhrtta.org/fullpanel/uploads/files/final-summary.pdf>.
- 21 "NH Capitol Corridor." NH Capitol Corridor | NH Rail Transit Authority. Accessed March 02, 2018. <http://www.nhrtta.org/nh-rail-projects/nh-capitol-corridor/>.

22 Clauss, Kyle. "Push on to Extend Rail Service from Lowell into N.H." Lowell Sun, February 4, 2015. http://www.lowellsun.com/todayshadlines/ci_27456359/push-extend-rail-service-from-lowell-into-n.

23 Fisher, Damien. "Authority stays, rail funds go." Nashua Telegraph, February 26, 2017. Authority stays, rail funds go.

24 Bookman, Todd. "Some Mainers Fault N.H. For Not Doing More To Support New England Rail." WBUR News, October 24, 2017. <http://www.wbur.org/news/2017/10/24/new-hampshire-rail-funding>.

25 Lisinski, Chris. "N.H. governor opens bridge for commuter rail expansion study." Lowell Sun, January 25, 2018. http://www.lowellsun.com/news/ci_31618923/ticket-ride-interstate-trains.

26 Esri Business Analyst 2016. ArcGIS Desktop. Redlands, CA: Environmental Systems Research Institute

27 University of Massachusetts Lowell. Campus Transportation Plan. Report. 2011. https://www.uml.edu/docs/UML-Campus-Transportation-Plan-sm_tcm18-197880.pdf

28 Interview, Adam Baacke, Feb. 26, 2018

2019

2nd Place

Auto-Oriented Western Cities

Nathan R. Begay, University of New Mexico

Auto-Oriented Western Cities: Parking Mitigation Techniques and Strategies to Create Better Urban Environments

Table of Contents

Table of Contents	2
Abstract	3
Introduction	3
Parking and Its Problems	6
Literature Review	7
Parking Management Strategies	10
Parking in Albuquerque	11
Regulatory Documents	12
Recommendations	15
Parking Inventory and Evaluation	16
Review and Revise Parking Standards	17
Encourage Flexible Parking Lot Use	19
Summary	21
Next Steps	22
Conclusion	23
Works Cited	24

Abstract

Western American cities struggle with the effects of sprawl; excessive parking lots define the sunbelt city and landscapes still develop to accommodate automobiles. One of the most damaging aspects of auto-oriented cities is the oversupply of parking lots. In order to create more vibrant, multi-modal cities, planners must address current parking lot supply and establish methods to mitigate excessive parking. Through a comprehensive parking inventory, planners may begin to target key areas in the city with high concentrations of parking. Using the parking inventory, revisions can be made to current parking standards to facilitate parking reductions in key areas and city-wide. Further, cities can use parking inventory analyses to revise and update zoning documents to lower parking minimums, establish parking maximums, and create reductive incentives in planning documents. The city of Albuquerque, NM is used to explore the possibilities of parking mitigation within a typical, mid-sized automobile-oriented city. Overall, creating methods to quantify parking spaces can assist planners to realign supply with demand and create better urban landscapes.

Introduction

Across the United States, cities have expanded and grown in ways unique to their geographic limitations, economic forces, and individual tastes. Many cities along the sunbelt took advantage of ample space and technological advances to build large sprawling cities. The growing prevalence of the automobile not only allowed developers to build well outside of city centers, the automobile drastically changed the scale of the built environment, leading to urban landscapes that sprawled outwards in low-density

structures designed to accommodate a single use. Suburbia may have been born on the east coast, but it thrived in the west. Despite recognition of the negative consequences to auto-oriented development, cities are reluctant to transition away from the urban environments that reinforce their dependence on automobiles. Even with a shift within the transportation planning paradigm towards multi-modal systems, the remnants of automobile-oriented cities are still dominant fixtures in the landscape. Among narrow sidewalks and wide unwalkable streets, surface parking lots are some of the most damaging elements of automobile-oriented landscapes in cities.

Of the many sunbelt cities that exist within the American west, the city of Albuquerque can be representative of many sprawling auto-oriented cities. Like many sunbelt cities, Albuquerque's auto-oriented sprawling development pattern has created vast surplus of parking lots and structures across the city. From shopping centers to sporting venues, structures are surrounded by parking infrastructure that create barriers between pedestrians and destinations. Parking lots have made traveling by other modes incredibly difficult and often makes traveling by car the most convenient option. Parking also creates impermeable surfaces incapable of absorbing stormwater, consumes valuable land that could be used for development, and costs millions of dollars in maintenance and operations far into the future.

Despite long-present growth patterns, transportation planning trends suggest a shift in the planning paradigm towards greater access through multi-modal systems serving all types of travelers. With this shift, cities will no longer need miles of surface parking to meet demand. Other cities began shifting towards policy and regulations, transitioning from traditional automobile-dominated landscapes towards multi-modal

transportation-oriented development. Specifically, dozens of cities have moved towards lowering or removing minimum parking requirements from zoning codes, implementing parking maximums, changing parking design layout, and utilizing parking lots for other uses. These policy changes have allowed cities to reclaim underutilized land occupied by parking for more productive uses.

Western cities previously dominated by automobiles have taken steps towards implementing policy changes that may change how cities develop. Albuquerque has recently made great steps toward reducing parking in the city. After rewriting the city's zoning code --the Integrated Development Ordinance (IDO) --the city has removed parking minimums completely from historic district overlays like Downtown, Nob Hill, Old Town, McClennan Park, and Barelás as a means to maintain physical character and reduce impacts made by personal vehicle use. The city based parking requirements off land use, implemented maximum parking requirements, and reduced minimums for some land uses. Moving forward, the city must address not only future parking construction, but create plans to reuse oversized or unutilized parking lots. In order to create a more equitable, walkable city, Albuquerque needs to create pleasant walking environments which make walking and biking accessible and convenient. Removing and adapting unnecessary parking, the city can work towards the greater goal of walkable, equitable landscapes.

Albuquerque – and western cities like it - can pursue this grander goal through many methods proposed by academics and tested in other cities. First, the city should conduct a parking inventory in order to understand the grander scope of the problem, identify key areas for redevelopment, and estimate land value for surface parking to

contextualize the problem for stakeholders. When the scope of the problem is better understood and contextualized, there is greater possibility for change to occur. Second, parking minimums and maximums should be applied more broadly, especially within key areas identified by the parking inventory. Finally, cities may benefit from exploring flexible use and establishing flexible zoning code requirements within establish parking infrastructure. Through pop-up events, shared parking, or conversion of surface parking into parklets, cities could create vibrant public space where it has never existed before. There are multiple methods to approach excess parking but this effort requires collaboration between city officials and developers. However, the benefits of creating vibrant public space within previously inactivated areas may transform underutilized parking into valuable community space.

This paper explores methods to identify and mitigate excessive parking lots using the city of Albuquerque as representative of many western sprawling cities in the United States. In order to address sprawl and transform auto-oriented landscapes, surface parking needs to be reimagined through a multi-faceted approach which intends to address supply and demand city-wide.

Parking and Its Problems

Current parking design practices carried into present day development from former development patterns of the 1950s automobile-dominated America where cities-- provided huge investments in infrastructure. Popular destinations were surrounded by large swaths of asphalt, parking garages, wide streets, and other road infrastructure. America's huge investment in the automobile still manifests itself in the built environment today. However, with the threat of climate change and the effects of

sprawl, the world is beginning to see the consequences of an automobile oriented landscape. Cities continue to adhere to remnants of America's enthusiastic investments into the automobile in the forms of parking minimum requirements and construction of roads, however, new policy strives to establish a new paradigm in transportation.

Literature Review

Donald Shoup is the leading scholar in the market impacts of surface parking and has written the cornerstone book *The High Cost of Free Parking* (2011) in which Shoup discusses the consequences of excessive parking in cities. In his research he finds many cities produce excessive amounts of parking that is not only detrimental to people and businesses, but costs cities millions of dollars. Shoup proposes three changes to reduce the amount of created parking: charge fair market prices for on-street parking, spend revenue to benefit metered neighborhoods, and remove off-street parking requirements (Shoup, 2016, 20). These proposals have been used by multiple cities to some degree and have been met with varying degrees of success, which is discussed in his newest book *Parking and the City* (2018). In his analysis, Shoup claims parking lots should adjust pricing to continuously remain at 85% capacity and cities should determine, based upon peak hours and use, how much parking should cost at different time of the day to optimize supply and demand (Shoup, 2011). Shoup argues market forces are the best instrument to mitigate parking needs in cities and, by providing free parking, cities continue to reinforce car usage and surface lots will continue to destroy the urban landscape by creating car-dominated public space. Shoup's market analysis illustrates the problem and provides methods to combat negative outcomes.

Along with Donald Shoup, the Victoria Transit Policy Institute (VTPI) has conducted research to identify different costs generated by parking. In its document *Transportation Cost and Benefit Analysis--Parking Cost* (2018), VTPI calculates land area and value, construction and maintenance costs, environmental costs, and equity and efficiency among other analyses. In the document, VTPI found approximately 4.97% of urban land is dedicated to parking and is especially concentrated in Central Business Districts (CBDs). The construction and maintenance costs of parking depend upon the size, shape, topography, design, and location of parking. On average, surface parking spaces can cost anywhere from \$670 to \$4,000 per space annually depending on its location (VTPI, 2018, 28). In a study conducted in twelve cities in the United States, they calculated parking cost on average \$103 and \$74 per square foot for spaces underground and above ground respectively (Shoup, 2016). Per parking space, construction costs averaged around \$34,000 and \$24,000 underground and above ground respectively (Shoup, 2016). Beside construction costs, the VTPI also researched the social costs of parking spaces. "There is some debate among economists as to whether unpriced parking should be considered a *subsidy*," VTIP states, "since most of these costs are ultimately borne onto motorists through 'housing costs, taxes, retail purchases and as a portion of employment benefits' as a bundled good" (VTIP, 2018, 28). This rises the question; who pays for parking? Based on subsidy analysis, everyone does, regardless of use. When costs are externalized, it becomes apparent much of the costs are not just held by motorists, but by non-motorists as well.

Table 1 Sharnhorst (2018) compares parking spaces to population and household value in five cities

	New York City	Philadelphia	Seattle	De Moines	Jackson Hole
Population	8,537,673	1,567,872	704,352	215,472	10,529
Parking Spaces	1,965,377	2,172,896	1,596,289	1,613,659	100,119
Spaces Per Household	0.6	3.7	5.2	19.4	27.1
Total Value	\$20.55 billion	\$17.46 billion	\$35.46 billion	\$6.42 billion	\$711 million
Value Per HH	\$6,570	\$29,974	\$117,677	\$77,165	\$192,138

Recently, Eric Sharnhorst (2018) in conjunction with the Research Institute for Housing America, conducted a parking inventory in five cities around the country: New York City, Philadelphia, Seattle, Des Moines, and Jackson Hole. Sharnhorst compared parking stall density to housing density to not only evaluate excess parking, but quantify land value and the costs externalized onto homeowners. All cities, excluding New York, illustrate extremely dense parking in key parts of the city that often do not reflect housing density. The inventory suggests cities and homeowners are paying for parking whether they need it or not. In Seattle, the total value of parking is estimated to be \$35.79 billion, despite the fact that the city has 1,596,289 parking spaces for a population of 704,352. This translates to 5.2 spaces per household and an externalized cost of \$117,677 per household (Sharnhorst, 2018). Des Moines and Jackson Hole have dramatically higher parking densities with 19.4 and 27.1 spaces per household respectively. Although this inventory was only conducted on five cities, it is not unreasonable to believe this pattern persists in other cities across the country. Further, this analysis did not study auto-oriented cities from the southwest. Regardless, Sharnhorst's inventory presents a truth known but never quantified: cities have too much parking.

Parking Management Strategies

VTPI proposed ten parking management principles to create better parking management strategies in the document *Parking Management: Strategies, Evaluation, and Planning* (Litman, 2016). These strategies are listed in the table below.

Table 2 Litman (2016) Ten parking management strategies.

Consumer choice	People should have viable parking and travel options.
User Information	Motorists should have information on their parking and travel options.
Sharing	Parking facilities should serve multiple users and destinations.
Efficient utilization	Parking facilities should be sized and managed so spaces are frequently occupied.
Flexibility	Parking plans should accommodate uncertainty and change.
Prioritization	The most desirable spaces should be managed to favor higher-priority uses.
Pricing	As much as possible, users should pay directly for the parking facilities they use.
Peak management	Special efforts should be made to deal with peak-demand.
Quality vs. Quantity	Parking facility quality should be considered as important as quantity, including aesthetics, security, accessibility, and user information.
Comprehensive analysis	All significant costs and benefits should be considered in parking planning.

Through these management strategies, VTPI describes a new parking paradigm which “strives to provide *optimal* parking supply and price” in a manner that maximizes supply and minimizes price for motorists and property owners (Litman, 2016, 7). The new parking paradigm is reflective of individual parking needs of building use and traffic while encouraging the shift towards a wider definition of “transportation” that is multi-

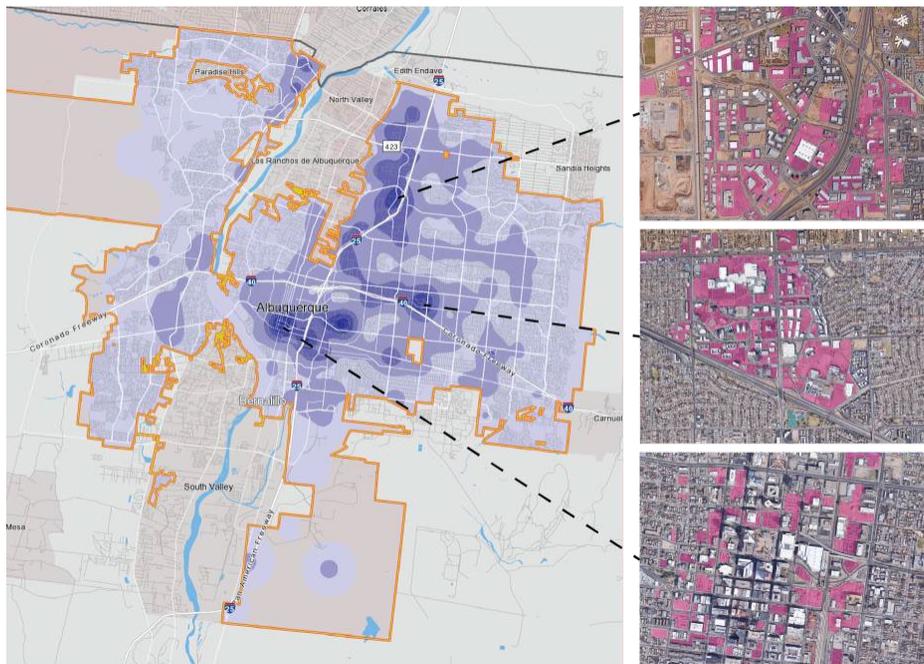
modal and accessible. Litman discusses a variety of parking management strategies including shared parking, more accurate and flexible standards, updated parking regulations, and other policy changes (Litman, 2016). Overall, parking management supports flexible systems which value land use efficiency over automobile-oriented landscapes.

Using the ten management strategies, western cities like Albuquerque can begin to mitigate parking excess while taking into account future growth and development. This next section provides further context into Albuquerque's parking, its zoning ordinances' role in excessive parking creation, and how the city intends to address the problem in the future.

Parking in Albuquerque

In the city of Albuquerque, sprawling development patterns lend itself to excessive surface parking. Characteristically, the city's primary residential areas are separated from major employment centers. Thus, employees must commute long distances in their personal vehicles to get to work, necessitating high levels of parking near high employment centers. In an initial aerial analysis of high employment centers, there appears to be a high concentration of surface parking surrounding places of employment (see Figure 1).

Figure 1 A surface parking analysis of the three highest employment concentration centers in Albuquerque (from top to bottom): Journal Center, Uptown, and Downtown



The Journal Center is one of the primary employment centers in the city and accommodates anticipated parking needs, yet many lots sit empty and underutilized. Uptown suffers from similar circumstances; however, the area features a wider mix of uses. Regardless, most of the parking created in Uptown remains empty and underutilized throughout the year. Downtown has benefitted from the historic overlay zoning ordinance and has succeeded in keeping large lot development at bay, yet structures farther away from Central Ave (the city's core transit corridor) tend to provide larger lots. Although this is not a comprehensive analysis of all parking spaces, these figures still illustrate some of the large surface parking spaces that developed based upon parking standards in the city's former zoning code.

Regulatory Documents

In 2017, the city implemented a new zoning code, the IDO. The IDO intends to facilitate transportation-oriented development while guiding the city towards greater

density in some places and more sustainable growth patterns. However, much of the development patterns seen today are the product of previous land use practices and the Comprehensive City Zoning Code written in the 1970s and used until 2016. Comparing the Comprehensive Zoning Code and the IDO illuminates the source of Albuquerque's development patterns and shows how the latter intends to change land use patterns to create better outcomes.

Both planning documents regulate parking requirements based upon land use and size; however, the IDO is more specific in both use and size requirements. The Comprehensive City Zoning Code is more general with its definition of use and did not specify a wide variety of uses. The IDO on the other hand, is more specific with uses and parking need calculations. The specificity of use allows some land uses to construct parking amounts that reflects projected traffic. On average, the IDO does not require as much parking as the Comprehensive Zoning Code requires.

In addition to parking minimums, the IDO applies parking maximums in some uses and removes parking minimums for others. The Comprehensive City Zoning Code did not require off-street parking in Downtown and Old Town historic overlay zones but the IDO expands this exemption to other districts (the McClellan Park area, Barelas, and Nob Hill). The IDO also provides ways for developers to reduce parking requirements: general reductions for Urban Centers and Main Street Areas, shared parking reductions, reduction for proximity to transit, electric vehicle charging station credit, van and car pool parking credit, on-street parking credit, off-site parking allowance, public parking allowance, and parking study allowances. The

Comprehensive City Code on the other hand, only offered transit reductions, mixed use shared parking reductions, and on-street parking credits.

Overall, the IDO made great steps towards reducing parking requirements for the city and integrates more alternatives for developers to reduce their required parking when accounting for mass transit services, historical context, alternative modes of transit, and flexible use of parking. Figure 4 provides a comparison of parking requirements for selected land uses for both documents.

Table 3 Comprehensive City Zoning Code Compared to the Integrated Zoning Ordinance

Comprehensive City Zoning Code	Integrated Development Ordinance
Retail and services (unless otherwise specified in this section): one space per 200 square feet for the first 15,000 square feet of net leasable area; then, one space per 250 square feet for the next 45,000 square feet of net leasable area; then, one space per 300 square feet for the net leasable area that exceeds 60,000 square feet.	Adult retail/Bakery goods: 4 spaces/ 1,000 sq. ft. GFA
	Building & home improvement materials store: 2 space/1,000 sq. ft. GFA
	General retail/Grocery Spaces: 4 space/1,000 sq. ft. GFA UC-MS-PT: 2.5 spaces / 1,000 sq. ft. GFA Maximum (UC-MS-PT): 4 spaces / 1,000 sq. ft. GFA for primary buildings with more than 100,000 sq. ft. GFA
	Liquor retail: 4 spaces/1,000 sq. ft. GFA
	Pawn Shop: 4 spaces/1,000 sq. ft. GFA
Manufacturing and wholesaling: one	Artisan manufacturing: 3 spaces / 1,000

space for each three employees on the largest shift or one space per 1,000 square feet of net leasable area , whichever requirement is greater.	sq. ft. GFA
	Light Manufacturing: 1 space / 1,000 sq. ft. GFA
	Heavy manufacturing: 1 space / 5,000 sq. ft. GFA
	Natural resource extraction: No requirement
	Special manufacturing: 1 space / 1,000 sq. ft. GFA
Office: one space per 200 square feet of net leasable area on the ground floor and one space per 300 square feet of net leasable area in the basement areas and on all floors above the ground.	Office: 3.5 spaces / 1,000 sq. ft. GFA UC-MS-PT: 2.5 spaces / 1,000 sq. ft. GFA <u>Maximum</u> (UC-MS-PT): <u>4 spaces / 1,000 sq. ft. GFA</u> for primary buildings with more than 100,000 sq. ft. GFA

In addition, this comparison illuminates a dissonance between perceived need and actual need. In order to prepare for actual need, cities must maintain an up-to-date comprehensive code which reflects needs for the city.

Recommendations

To create more multi modal cities and continue aspirations to reduce surface parking, cities like Albuquerque must see parking as flexible space with variable use and design. These recommendations provide methods to mitigate future parking growth and apply new use to surplus parking.

Parking Inventory and Evaluation

A parking inventory should be considered to determine areas most affected by excessive parking. By quantifying the amount of existing parking in the city, the land can be valued and assessed for potential future use. Placing value on parking may motivate city officials, businesses, developers, and citizens to work towards more efficient use of space that reflects intended future development patterns.

Once an inventory is complete, Sharnhorst's methods may be applied to evaluate conditions in Albuquerque. First, Sharnhorst established a study area based on the U.S. Census 2017 place geometry (Census Shapefile) to find boundaries, population, and land area. Second, Sharnhorst separated parking type into three categories: on-street parking, off-street surface, and off-street structured. However, in the case for Albuquerque, there appears to be no existing parking data either with the city or with Bernalillo County. To calculate land value and estimated replacement cost, Sharnhorst combined parcel geometries with an assessed land value, then summarized price based on a 0.5 square kilometer hexagon. Sharnhorst then compared hexagon parking densities with hexagon land values to calculate estimated land value.

Benefits

With an in-depth parking inventory, the city could have a better understanding of parking over-supply issues and may identify key areas where intervention is most needed. In addition, placing a monetary value on parking space gives proper context to the problem and allows people to comprehend how much land value is lost with surface parking. The inventory and evaluation also provide land owners with an estimated land value for parking spaces that they may consider for future redevelopment.

Challenges

Sharnhorst's analysis received funding from the Mortgage Bankers Association and utilized existing GIS resources from all five cities. Albuquerque does not have such existing resources and must conduct the inventory using other means, or by building a comprehensive database.

Review and Revise Parking Standards

Removing parking minimums was the primary recommendation made by Donald Shoup in an attempt to minimize parking lot spaces. Shoup (2016) found developers are often forced through parking minimums to construct large parking lots that are unlikely to reach full capacity and cost more to build. Therefore, Shoup theorized if parking minimums were removed, developers will allow market forces to determine how much parking they really need. The city of Buffalo, NY was the first city in the United States to remove minimum parking requirements completely from their zoning code (Poon, 2017). Their zoning code was a representation of automobile-oriented code, originating in 1953 but now utilizes a new form-based code system that intends to make the city of Buffalo more sustainable (Poon, 2017).

Albuquerque has also moved towards removing minimum parking requirements in Downtown, Old Town, and Nob Hill. By removing parking minimums, developers are not held liable to provide parking for customers, considering there is already plenty of on-street and off-street parking options in these districts.

Using the parking inventory, Albuquerque should continue efforts to remove minimum parking requirements in key neighborhoods and districts around the city. Large shopping districts like Uptown and the Northeast Heights, and large office centers

like Journal Campus may be potential candidates for parking reductions based on satellite imagery vast amounts of underutilized parking. In emerging communities, parking minimums should be removed completely to allow market forces to determine need. Currently, the IDO provides multiple ways for developers to avoid excessive parking but it should expand these efforts to key areas identified in the inventory.

For example, the city could implement more parking maximums. In the IDO there are two uses with parking maximums--office and general retail--which cap parking at 4 spaces/1000 sq ft of GFA (Gross Floor Area) for primary buildings with more than 100,000 sq. ft. of GFA. However, a study in London by Guo and Ren (2012) implied removing minimums is still more effective than implementing maximums; their study found minimums almost double the amount of parking developers would've voluntarily provided. Although parking maximums may help ensure parking remains below particular boundaries, the removal of parking minimums may still be the most effective measure for parking reductions.

Benefits

If parking minimums are further revised, developers will be incentivized to conduct their own site context analyses and provide only the necessary amount of parking based upon market needs. Businesses will be enabled to negotiate with adjacent businesses to determine how much parking is needed to supply both businesses with needed parking. Businesses will also save money in initial build-out costs and long-term maintenance costs on unnecessary surface parking.

Challenges

Having too little parking may cause just as many problems as it solves.

Businesses will still need to provide parking to comply with ADA accessibility and must consider future growth in their assessments. Right-sizing parking space will take trial and error on the developer's part and may require additional parking construction in the future. However, at the moment, Albuquerque is still an auto-centric city with excessive parking. Gaining the political will to withstand pushback and challenge parking norms may be the biggest challenge in advocating for revised parking standards.

Encourage Flexible Parking Lot Use

Wherever surface parking exists, that land is dedicated solely to parking use. Many of these prior recommendations require time, political will, money, and education to implement. But in the short-term, parking spaces can be used by local vendors and host events for pop-up purposes. Parking located near heavily trafficked areas hold the opportunity for local vendors to use parking as a place to congregate and operate. Popular pop-up uses across the country include: food truck parks, parklets, markets, and hosting large events. In Albuquerque, designating areas for food trucks along employment hubs may create greater use of parking lots.

Some destinations can be more successful than others in establishing food truck parks. Activity hubs like Journal Center have high concentrations of jobs with a very low concentration of food options. Figure 5 shows food options as red icons. As illustrated, there are little food options near offices located between Masthead Rd and Paseo del Norte. During lunch time, this causes high congestion on streets and nearby restaurants. If food trucks were given a designated area in Journal Center to gather and

provide services, this will help curb congestion, provide services to an underserved area, and activate underutilized space.

Figure 2 Journal Center food options



Along with pop-up use, flexible use of parking based on peak hours will allow adjacent businesses to share parking rather than requiring individual lots. Shared parking requires partnerships between businesses with different peak hours like office buildings operating on weekdays 9-5 pm and restaurants and theaters which tend to be busy during the evenings and weekends (Litman, 2016). Although Albuquerque does allow shared parking credits,

they could use the parking inventory to determine key areas where shared parking would operate best.

Table 4 Different peak demand times for various uses (VTIP, 2016)

Weekday	Evening	Weekend
Banks and public services	Auditoriums	Religious Institutions
Offices and other worksites	Bars and dance halls	Parks
Park & Ride facilities	Meeting halls	Shops and malls
Schools, daycare centers and Colleges	Restaurants	
Factories and Distribution centers	Theaters	
Medical clinics	Hotels	
Professional services		

Benefits

Creating space specifically for pop-up activities invites users to activate a space that is being underutilized. It allows local businesses to access markets they have not been able to and spur business. It may also reduce congestion during lunch period as employees may opt to frequent food trucks rather than drive to surrounding restaurants. Peak use management will allow businesses with complementary hours of operation to share parking rather than building their own infrastructure. This will save both businesses money and facilitate collaborative mixed use.

Challenges

It may be difficult to convince office building owners to allow food trucks to frequent parking lots and food truck owners will have to negotiate with businesses to determine best place for operation. Shared parking will also require negotiation between businesses. This option can utilize governmental assistance in permit creation but overall, requires private investment of time and resources.

Summary

Although these methods are demonstrated within the context of Albuquerque, many of these methods can be widely applied to other cities, especially along the sunbelt. Within western cities, a comprehensive parking inventory, evaluation, and revision of parking standards could make an immense impact on the urban landscape for years to come. This summary presents the primary goals each mitigation method.

Parking Inventory

- Conduct a parking inventory to target key areas and determine highest concentration of parking

- Utilize On The Map analysis to determine if housing or work concentration correlate with parking inventory
- Place monetary value on parking lots to incentivize parking reductions
- Evaluate parking inventory to target key areas in the city with excessive parking

Revise Parking Standards

- Use parking inventory to determine key districts and neighborhoods in the city to remove parking minimums. Implementation should target locations.
- Use parking maximums as supplemental tools to keep parking below a determined limit but still rely upon minimum removals. Implementation should target land use.

Encourage Flexible Use in Parking Lots

- Encourage pop-up use by local vendors for markets, vending, and events
- Establish larger shared parking practice using peak management methods
- Recalculate parking needs using new IDO requirements and allow developers to redevelop excess parking

Next Steps

Overall, creating parking standards based upon supply and demand depends upon city and regional context: growth rates, existing development patterns, existing zoning code, future goals and aspirations for the city. First and foremost, cities could benefit from revisiting their comprehensive plans and determine if their parking requirements reflect how they wish for land development to occur and surface parking to be provided in the future. However, a parking inventory may illuminate other opportunities for cities to pursue in the future. Based upon the resources available to

cities, they should consider conducting a parking inventory to determine where to concentrate their efforts. Growth is an essential consideration when determining best course of action. Rapidly growing cities may see better results with modifications to their zoning code first before conducting a parking inventory. Cities with slower growth like Albuquerque may wish to begin with the parking inventory as it allows cities to analyze existing infrastructure rather than prepare for new development. Using regional context and future goals, western cities can begin to shape their environments in ways that compliment multi-modal transportation and facilitate efficient land use.

Conclusion

The new transportation paradigm, as articulated by Todd Litman of VTPI, calls for new innovative ways to increase multi-modal transportation access for everyone. Although cities have made great strides in mass transit systems, bicycle infrastructure, and pedestrian safety, not much emphasis has been placed on excessive surface parking lots. For the past century, cities have shaped themselves around automobile needs and other modes of transportation have suffered the consequences. In order to create a more robust urban environment, the City of Albuquerque needs to consider densification through reutilization of parking space, prevention of excessive parking, and activation of underutilized space. Through this new planning method, western cities can prepare for multi-modal urban landscapes while addressing issues from past transportation planning paradigms.

Works Cited

- Berg, N. (2016). Lots to lose: how cities around the world are eliminating car parks. *The Guardian*. <https://www.theguardian.com/cities/2016/sep/27/cities-eliminating-car-parks-parking>
- City of Albuquerque. (2018). Integrated Development Ordinance. *City of Albuquerque Planning Department*. <http://documents.cabq.gov/planning/IDO/IDO-Effective-2018-05-17.pdf>
- City of Albuquerque. (2011). Comprehensive City Zoning Code. *City of Albuquerque Planning Department*. <https://www.cabq.gov/planning/documents/ZoningCodeFullTextMay2014.pdf>
- Guo, Z., & Ren, S. (2013). From Minimum to Maximum: Impact of the London Parking Reform on Residential Parking Supply from 2004 to 2010? *Urban Studies*, 50(6), 1183–1200. <https://doi.org/10.1177/0042098012460735>
- Litman, T. (2016). Parking Management: Strategies, Evaluation and Planning. *Victoria Transport Policy Institute*. http://www.vtpi.org/park_man.pdf
- Poon, L. (2017). Buffalo Becomes First City to Bid Minimum Parking Goodbye. *Citylab*. <https://www.citylab.com/equity/2017/01/buffalo-is-first-to-remove-minimum-parking-requirements-citywide/512177/>
- Scharnhorst, E. (2018). Quantified Parking: Comprehensive Parking Inventories for Five U.S. Cities. *Research Institute for Housing America*. [https://www.mba.org/Documents/18806_Research_RIHA_Parking_Report%20\(1\).pdf](https://www.mba.org/Documents/18806_Research_RIHA_Parking_Report%20(1).pdf)

Shoup, D. (2016). Cutting the Cost of Parking Requirements. *Access Magazine*, (48). [http://www.accessmagazine.org/wp-](http://www.accessmagazine.org/wp-content/uploads/sites/7/2016/05/access48-webprint_cuttingthecost.pdf)

[content/uploads/sites/7/2016/05/access48-webprint_cuttingthecost.pdf](http://www.accessmagazine.org/wp-content/uploads/sites/7/2016/05/access48-webprint_cuttingthecost.pdf)

Shoup, D. (2005). *The High Cost of Free Parking*. Chicago: Planners Press, American Planning Association.

United States Environmental Protection Agency [EPA]. (2012). *Costs of Low Impact Development: LID Saves Money and Protects Your Community's Resources*. Washington, DC: Office of Wetlands, Oceans, and Watersheds.

<https://www.epa.gov/sites/production/files/2015-09/documents/bbfs3cost.pdf>

Victoria Transport Policy Institute [VTPI]. (2018). *Transportation Cost and Benefit Analysis II--Parking Costs*. <http://www.vtpi.org/tca/tca0504.pdf>

Weston Solutions and Sites Southwest. (2017). *Bernalillo County Green Stormwater Infrastructure: Low Impact Design Strategies for Desert Communities*. Bernalillo County.

[https://www.bernco.gov/uploads/FileLinks/590808d5c7dd4e0cbfaf3009cf1affb9/Green Infrastructure and Low Impact Design Guide 1.pdf](https://www.bernco.gov/uploads/FileLinks/590808d5c7dd4e0cbfaf3009cf1affb9/Green_Infrastructure_and_Low_Impact_Design_Guide_1.pdf)

2019

3rd Place

BRT and Property Values

Matthew Bewley, Rutgers University

ABSTRACT

Theory suggests bus rapid transit (BRT) systems, by increasing the accessibility of nearby properties, should increase the values of those properties. Empirical evidence bears this out—public transit infrastructure, including BRT, does generally generate an “accessibility premium.” To supplement the existing empirical evidence, this paper uses property appraisal data from before and after the installation of a new BRT system to evaluate the effect of BRT on land values in San Antonio, TX. This approach differs slightly from others’, which have tended to use total sales value rather than appraised land value.

First, a comparison of means is conducted for property values closer to and further away from BRT stops. Second, a hedonic regression model is built, using among other variables a “distance to stops” measure derived from the appraisal shapefile. These two techniques produce somewhat contradictory results: the comparison of means reveals that properties closer to BRT stops increased in value more slowly than did properties further from BRT stops, while the regression model suggests a significant, small, and negative effect of distance on land value (i.e. the closer to a stop, the higher the value). For example, the model estimates that a typical residential lot of 8,000 square feet is expected to have a total land value roughly \$60 greater for every 100 meters closer to a BRT stop. Despite these contradictory results, overall the paper provides evidence that an accessibility premium arises even from the accessibility boost provided by San Antonio’s not-very-rapid bus rapid transit system.

INTRODUCTION

Context

As with many American cities, the history of mass transportation in San Antonio during the 20th century is a history of the successive conversion of the same streetcar lines to different modes of transportation (Texas Transportation Museum n.d.). Mule- and horse-driven streetcars gave way to electric streetcars, and as

early as the 1920s these began to be converted to bus service, whose coverage has sprawled with the city and its highways in the century since (Hendricks 2017). San Antonio is referenced by multiple authors as the first American city to begin and complete the conversion of its streetcar network to bus service, in 1933 (Hendricks 2017; Texas Transportation Museum n.d.; Viña 2011; Caine 2017, pp. 6-7). The completion of this conversion saw the creation of a public agency whose descendant, VIA Metropolitan Transit (hereafter “VIA”), still manages the city’s mass transportation system.

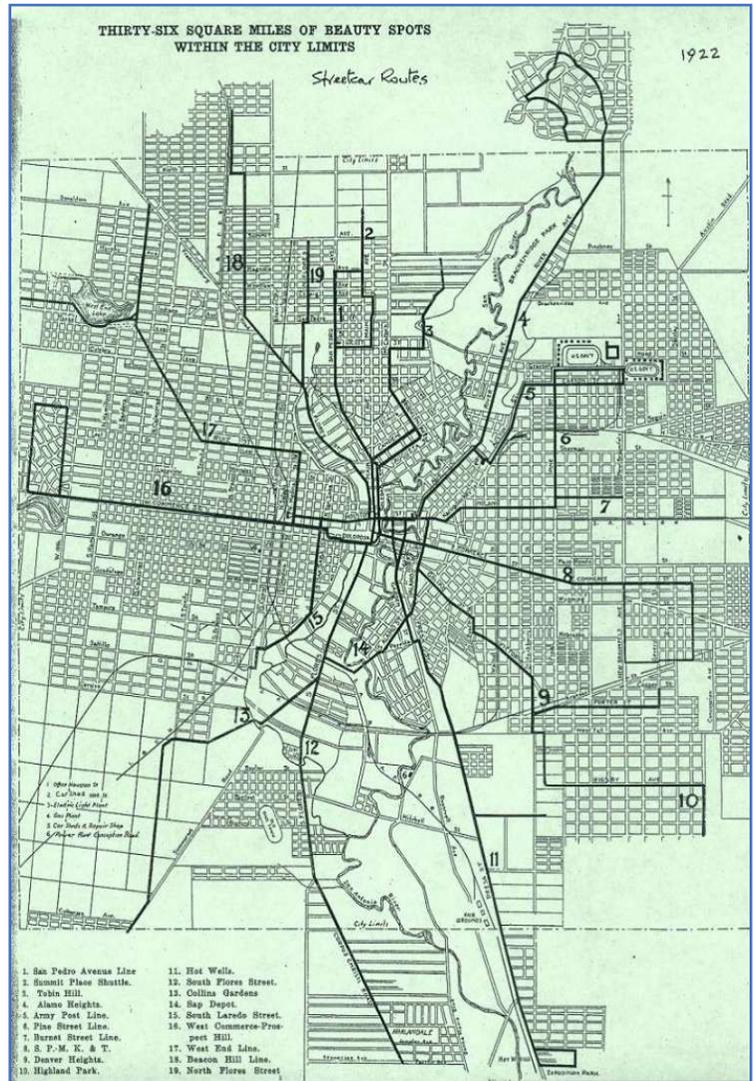


Figure 1: Map of San Antonio Streetcar Lines in 1922

More recently, the city government and regional planning authority have made efforts to encourage infill development and use of transportation modes other than the car. The city’s most recent comprehensive plan, published in 2016, envisions the densification of the region’s transportation corridors as well as of the “regional centers” those corridors run between (MIG 2017, p. 10). One such effort is VIA’s Primo bus service, which is distinguished from non-Primo

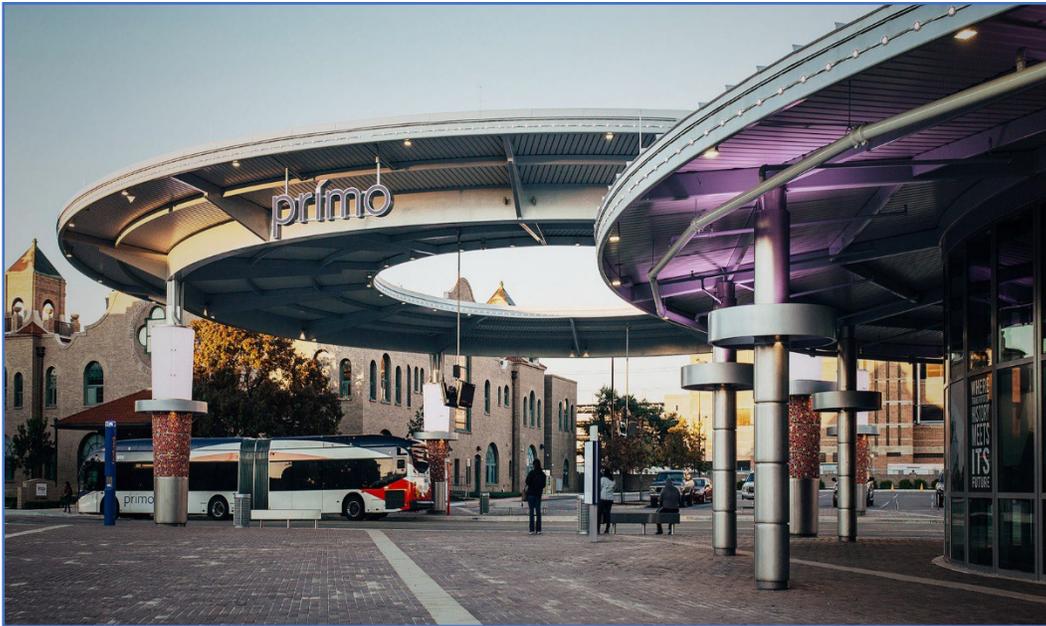


Figure 2: New VIA Bus Terminal

routes by its higher frequency and its use of several newly-renovated bus terminals (see image, left). VIA currently operates two of these routes as Route 100 and Route 101, and the agency has

announced plans to begin service in 2019 on two more, as Route 102 and Route 103 (Primo Service n.d.). This paper focuses on the first of these routes, VIA Route 100, which began operations in late 2012 (Riley 2012).

As will be the case for the upcoming routes 102 and 103, Route 100 connects several major employment centers and runs along one of the city’s major corridors. The route was conceived and continues to be described as a connection between San Antonio’s downtown and the South Texas Medical Center, site of several hospitals and of one campus of the city’s University of Texas branch. Between these two centers, Route 100 mirrors a converted streetcar

route by running along Fredericksburg road, whose abutting neighborhoods contain multiple historic districts and parks.¹ Figure 3, below, depicts the entirety of the route:

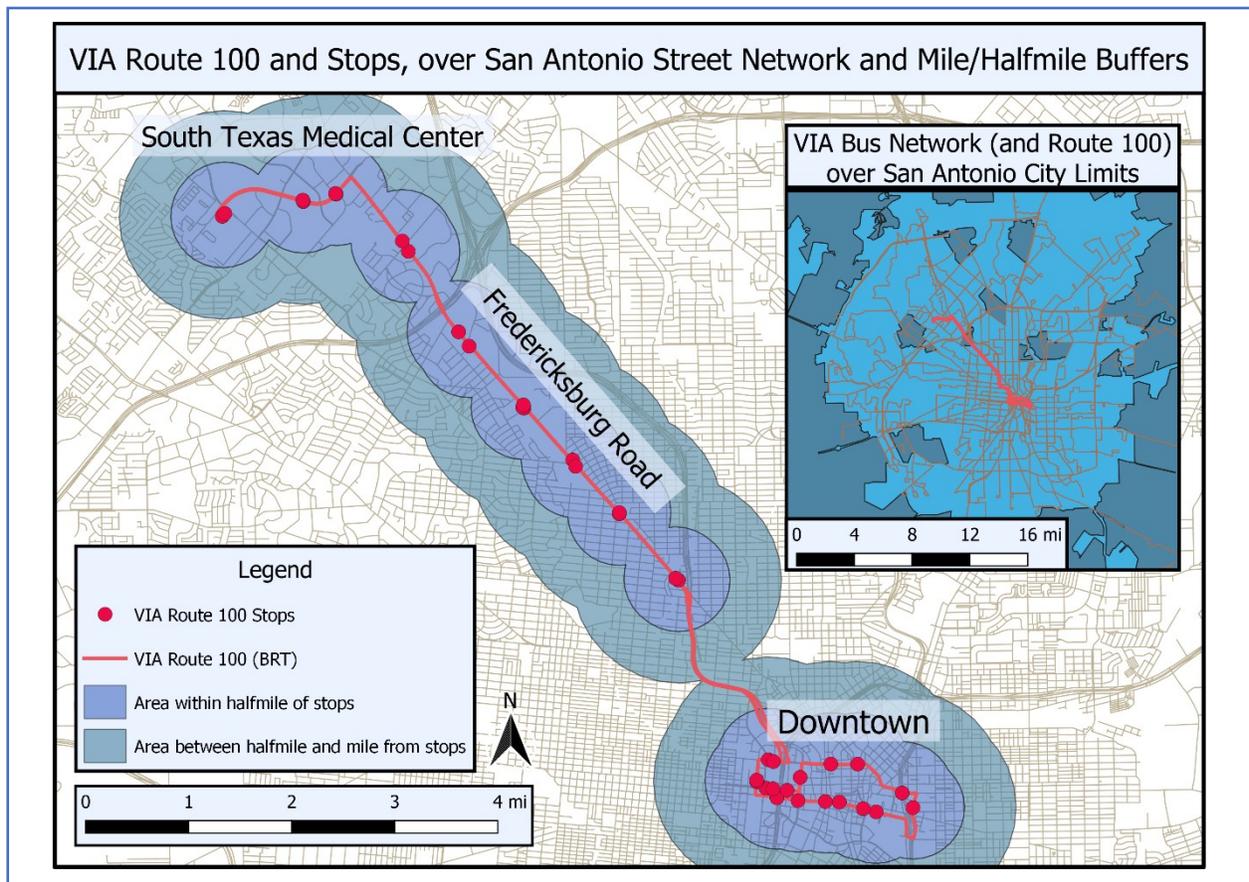


Figure 3: VIA Route 100 and Stops over VIA Bus Network

Primo service has been designed with a variety of other features that would be expected to increase accessibility along its route. Probably most notable is the service's designation as BRT, which in practice means that Primo routes run at significantly higher frequencies than a typical, fairly low-frequency VIA route (*Primo 100 Schedule* n.d.). Weekdays feature 10 minute frequencies between peak hours of 9am and 6pm, with 15-30 minute frequencies for most of the rest of the day. Leaving VIA's depot in the outbound direction (away from downtown), the first bus departs at 4:15am, and the last departs at 12:30am the next day. Saturdays and Sundays, the

¹ See Figure 1 for a map featuring this route, among others.

route operates a roughly similar schedule with longer headways throughout the day—the daytime 10 minute frequencies become 15 minute frequencies, and other hours’ 15-30 minute frequencies become 30-40 minute frequencies.

The service lacks certain features of BRT systems that have been the focus of international study, like Bogotá’s paradigmatic TransMilenio system (Transportation Research Board n.d., p. 2). In particular, *Primo* service is not separated from private car traffic, and does not attempt or plan to attempt frequencies lower than 10 minutes. Still, assuming the scheduled frequencies are met, *Primo* offers clear improvement over more typical VIA routes, which offer 20-30 minute weekday frequencies and longer weekend frequencies. Overall, the service offered by VIA’s *Primo* Route 100 represents potentially a more significant corridor-specific improvement in mass transit accessibility than has been seen in San Antonio since the early 20th century. As suggested by the brief literature review below, such an improvement could reasonably be expected to have particular, predictable effects on land use in the neighborhoods nearest to the route.

Study Aims and Literature Review

The connection between transportation and land use has been studied in a variety of contexts, allowing researchers to develop a finer understanding of how individuals decide where to live and work, as well as where firms decide to locate. The literature on the rail accessibility “premium,” for example, is diverse and goes back decades (Bowes and Ihlandfeldt 2001; Pagliara and Papa 2011; Bohman and Nilsson 2016). By 2016, this relationship had been studied thoroughly enough that one paper on the subject noted it was offering to retell “[a]n old tale” (Zhong and Li 2016). Overall, the effect is what might be expected: despite variation due to

market segment, land use, and other factors, a property's increased proximity to a rail transit station is fairly reliably associated with increased value for that property.

A similar effect would be expected from improvements in bus service, which typically do not represent nearly the level of expense of an increased rail transit service but nevertheless promise to better connect the areas the service runs through. Studies of this hypothesis are less numerous than studies of the rail premium effect, and the literature is on the whole a more recent one. In addition, the effects it finds are more ambiguous, varying in size and direction due to factors like the market segment a property occupies and the timeframe of the study (Perk and Catalá 2009; Wang et al 2015; Jun 2012; Munoz-Raskin 2010).

A more recent study deserves additional focus, because it serves both as a representative example of the literature on bus routes' effect on property values and as a model for part of this paper's methodology. Perk and Catalá (2017) study the effect of several new BRT routes in Eugene, OR on the sales values of nearby properties. Notably, the authors call Eugene's EmX system a "full-featured rail-like" system, similar to Cleveland's HealthLine (Perk and Catalá 2017, p. 7). The authors construct one hedonic regression model for each of three points in time: before the introduction of BRT service, several years after the introduction of BRT service in the late 2000s, and again several years later to allow the model to be run with the most recent data. The authors then calculate the network distance to the nearest BRT station of each property within 3 miles of the BRT station, and combine this distance as a variable in a regression that included typical variables for a hedonic model—square footage, school district, median income, etc. Overall, Perk and Catalá find that decreasing distance had a significant and positive effect on sales value. Depending on the year, their model predicts an increase in sales prices of between

\$823 and \$1,128 for every 100 meters closer a property is to a BRT station (Perk and Catalá 2017, p. 24).

Both theory and empirical literature suggest that if a new, higher-frequency bus line improves accessibility for the areas it runs through, it will also lead the economic value (and property values) of those areas to increase. It is hard to believe frequency improvements as significant as VIA Primo's would have little detectable effect on the value of nearby properties. However, the system also lacks many of the "rail-like" characteristics that some studies suggest cause more reliable increases in property values, and even studies of fully-featured systems like TransMilenio have produced conflicting estimates of the effect of BRT systems on property values. To further test the prediction that the increased accessibility provided by a BRT system will be associated with increased property values, this paper examines the land values of properties within a mile of bus stops served by San Antonio's Primo stops.

Data

Data sources

Seemingly every study of BRT's impacts on property values has used some type of data on actual sales. This paper, in contrast, uses appraisal data as collected by the Bexar County Appraisal District (BCAD), which assesses all properties in San Antonio and nearby municipalities for the purposes of property tax collection. This data was chosen in part for the practical reason that it was most easily available, but it was also hoped that using a tax assessor's data would lead to insights that data on actual sales might not. BCAD provided its GIS datasets for the years 2006, 2012, and 2018. The appraisal district's GIS data contain basic geographic information, as well as a subset of the information that appraisers collect for particular properties.

Stop and route information for VIA Route 100 were sourced from VIA's GTFS feed, which was accessed through Transitland's collection of transit operator GTFS feeds.² This information included stop and route locations, allowing the distance to each stop to be calculated for inclusion in a regression model.

All other datasets were obtained either from the City of San Antonio (COSA)'s spatial data portal or from the EPA's Smart Location Database. The former provided information on relevant amenities like historic districts and parks. The latter was used as a source of data on neighborhood and accessibility characteristics whose influence on property values would need to be accounted for in a hedonic regression.

Data processing

From VIA's GTFS data, all stops served by VIA's Route 100 were extracted. Several stops were removed by hand to reflect the route as currently depicted on Google Maps, which is the navigation service VIA encourages its riders to use for trip planning. VIA's GTFS feed includes stops served by what seems to be a planned but unused service pattern, involving inbound and outbound travel through downtown on two parallel streets a block apart from each other (Villarreal 2012).³ Although their inclusion did not significantly affect the selection of properties for analysis, stops associated with this unused service pattern were nevertheless removed.

To select properties for analysis, GIS software was used to construct circular buffers of a mile and a half-mile in radius, measured from each VIA Route 100 stop. The mile buffer was

² See the following link for VIA's feed registry: <https://transit.land/feed-registry/operators/o-9v1z-viametropolitantransit>.

³ The linked article features a map displaying this service pattern through downtown: <https://therivardreport.com/via-primo-service-improvement-or-disruption/>.

used to select all properties within a mile of any stop. This subset of properties was then used for the removal of outliers and oddly-valued records, as described below.

Once the appropriate property subsets were constructed, the datasets required significant cleaning before they could be reliably used for calculations and regression analysis. A list of the manipulations conducted is provided in Appendix A.

Next, the variable of interest was calculated: land value per acre. Because most of these calculations produced extremely large values, these values were then converted to units of square feet to allow easier interpretation. Outliers were excluded at 3 standard deviations' difference from the mean. For 2006, this entailed excluding 502 properties, for 2012, 8 properties, and for 2018, 528 properties. Each year's GIS dataset originally contained roughly 30,000 property records. The much smaller number of outliers for 2012 seems to be due to a small number of extremely high-value properties being split and recombined for no reason that was apparent from the dataset alone. As might be expected, excluding outliers beyond 3 standard deviations in 2006 and 2018 largely excluded properties in the densest parts of San Antonio's downtown, and the hard-to-explain idiosyncrasies that those properties display in 2012 suggests that excluding them in 2006 and 2018 allows drawing somewhat more reliable conclusions.

Finally, for each year, the mile and half-mile buffers were used to select all properties within a half-mile of any VIA Route 100 stop and all properties between a half-mile and a mile from any VIA Route 100 stop. These subsets were used to compare mean land values, as described [below](#).

Methodology

Comparison of means

In order to determine whether properties within a half-mile of any VIA Route 100 stop appreciated more quickly than properties between a half-mile and a mile away from any VIA Route 100 stop, mean land values were calculated for each property subset. The differences between these means were then compared by calculating percentage differences and by running t-tests with each pair of means. This combination of procedures allows two questions to be [tentatively answered](#). Do properties less than a mile and more than a mile from VIA Route 100 stops have different mean values, and did the properties given the VIA Route 100 “treatment” starting in 2012 increase in value more or less quickly than properties not given the “treatment”?

Regression

In addition to a comparison of means, an ordinary least squares regression model was fit, so that the effect of a variety of variables could be estimated and controlled for. As explained in Perk and Catalá, a typical hedonic regression model of property values takes as predictors four vectors of variables, which account for the distance of parcels to places of interest, the characteristics of individual parcels, locational amenities, and neighborhood characteristics (Perk and Catalá 2017, pp. 12-13).

This paper’s regression model did not include building characteristics that are typically included in hedonic models of property values, like number of bedrooms, presence of a fireplace, and year of construction. A very small number of these variables were present in BCAD’s GIS datasets, and those that were were inconsistently recorded. Focusing on land value rather than the combination of land and improvement value may have somewhat mitigated this weakness, but

this nonetheless represents a major departure from most other models that have been used to estimate BRT systems’ impacts on property values.

A summary of the predictor variables used can be found in the chart below. Although the model includes fewer variables than would be ideal, there are at least two to represent each of the above-listed categories of vectors:

VARIABLES AND SOURCES		
Variable Name	Variable Description	Source
LandValPerLandSqFt	Variable indicating land value per land area (in square feet)	BCAD GIS dataset
MinDistToStops	Variable indicating distance to closest VIA Route 100 stop (in meters)	BCAD GIS dataset and VIA GTFS feed
HistoricZone	Categorical variable indicating property’s presence in a Historic District	COSA data portal
MinDistToHistoricSite	Variable indicating distance to closest historic site boundary (in meters)	COSA data portal
MinDistToPark	Variable indicating distance to closest park boundary (in meters)	COSA data portal
ResDensity	EPA dataset’s variable ‘D1A’—gross residential density, as housing units per acre	EPA Smart Location Database (from 2010 Census)
JobDensity	EPA dataset’s variable ‘D1C’—gross employment density, as jobs per acre	EPA Smart Location Database (from 2010 Census)
RoadDensity	EPA dataset’s variable ‘D3a’—total road network density	EPA Smart Location Database (from 2010 Census)
Jobs45MinDrive	EPA dataset’s variable ‘D5ar’—jobs within 45 minutes’ travel by car	EPA Smart Location Database

In summary, predictor variables included those that attempt to account for the effect under investigation (MinDistToStops), several that attempt to account for major amenities (HistoricZone; MinDistToHistoricSite; MinDistToPark), and several that account for neighborhood and accessibility characteristics of each parcel’s location (ResDensity; JobDensity; RoadDensity; Jobs45MinDrive).

For variables involving distance, straight-line distances were calculated from the centroids of all parcels to either the closest point or the closest edge in a layer of interest. For example, MinDistToPark reflects the result of calculating the distance of each parcel’s centroid to its closest park boundary. Although network distance would better approximate the actual route between a given parcel and a given stop, it was judged that there were no significant geographic features that would cause parcels’ network distance to be different enough from their straight-line distance that the direction of the relationship between distance and land value would be strongly affected.

RESULTS

Comparison of Means

Extent	COMPARISON OF MEANS		Percent Change
	Mean Land Value (2006)	Mean Land Value (2018)	
Half-mile from any VIA Route 100 stop	\$3.45 per sq ft	\$7.06 per sq ft	+105%
Between a half-mile and a mile from any VIA Route 100 stop	\$2.33 per sq ft	\$6.19 per sq ft	+166%
Percent difference (half-mile vs. mile/half-mile)	+33%	+12%	
Difference of means test statistic	33.96	9.84	
Difference of means p-value	4.68e ⁻²⁴⁸	8.17e ⁻²³	

As reflected in the chart above, the comparison of means suggests several relevant conclusions. In both 2006 and 2018 (before and after the beginning of Primo service), properties within a half-mile of Route 100 stops had a higher mean value than properties between a half-mile and a mile from Route 100 stops, with a high degree of confidence. This is as expected,

because of the closely related factors of the accessibility premium of major corridors and the concentration of highly-valued properties around those corridors.

However, the comparison also shows a clear reduction between 2006 and 2018 in the difference between the two groups' means. The test statistic for the difference of means shrinks by several times between the two years, and the group of properties further away from VIA 100 stops increased in mean value by roughly 50% more than the group of properties closer to the stops. This is exactly the opposite of the change that would be expected if the introduction of Primo service led to an increased accessibility premium for properties closer to its stops.

This change can be more effectively visualized with a box plot, as below:

Figure 4: Box Plot of Land Value (outliers beyond 1.5 * IQR hidden)

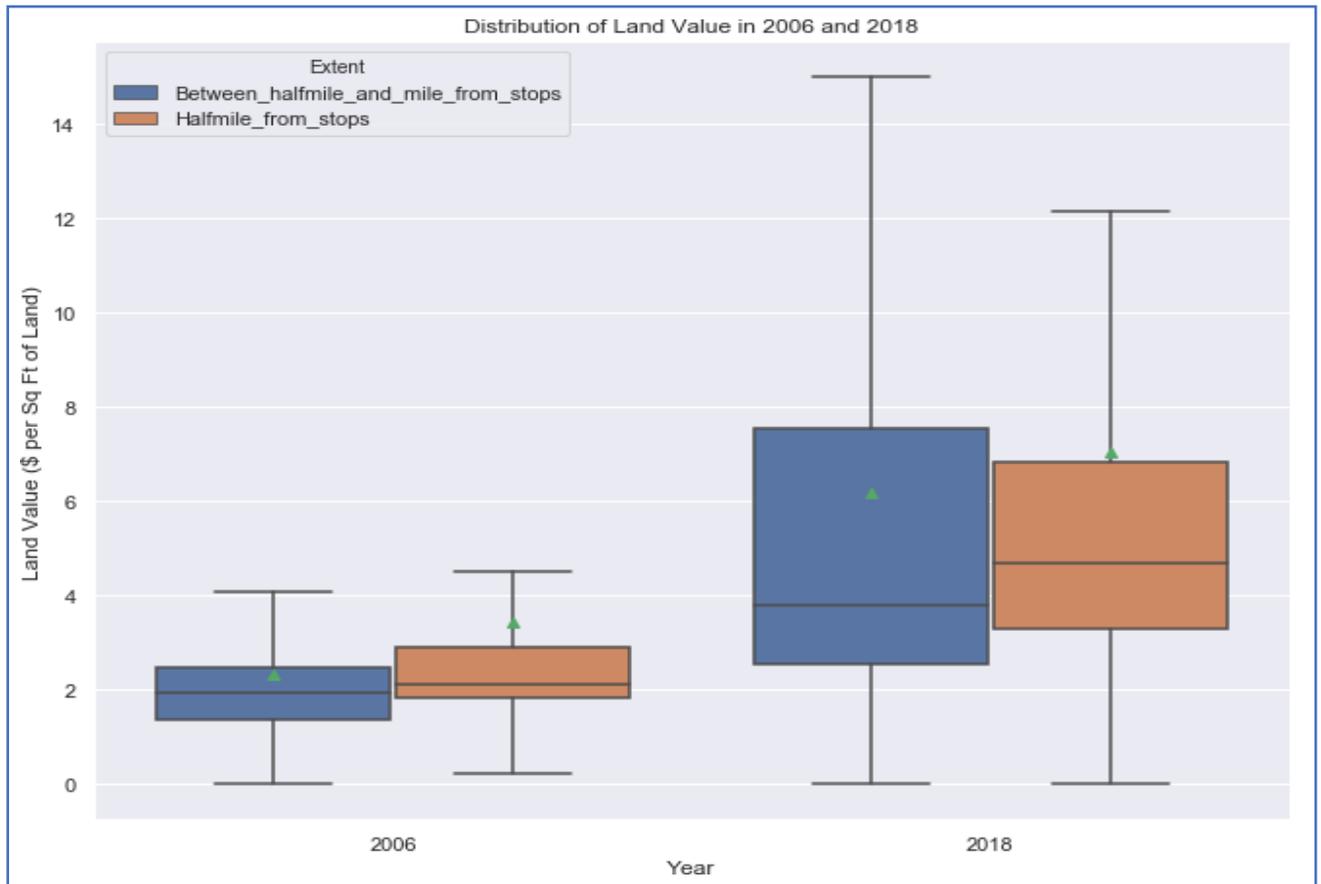


Figure 4: Box Plot of Land Value in 2006 and 2018

As discussed above, the mean values (represented by the green triangles) of the two groups clearly converge, even though the properties within a half-mile of Route 100 stops have a larger mean value in both years. More interestingly, the box plot also helps visualize the large increase in the inter-quartile range of each group of properties. Small and roughly equivalent in 2006, each group's IQR has expanded by several times by 2018, and the IQR of properties beyond a half-mile now fully overlaps the IQR of properties within a half-mile. Although both distributions are extremely right-skewed, this change suggests that the relative increase in the mean values of properties beyond a half-mile from Route 100 stops could be due to an increase in value by a large number of properties in the upper half of that group's distribution. This

interpretation is supported by an ugly (but useful) box plot displaying the values beyond 1.5 * IQR:

Figure 5: Box Plot of Land Values in 2006 and 2018 (showing outliers beyond 1.5 * IQR)

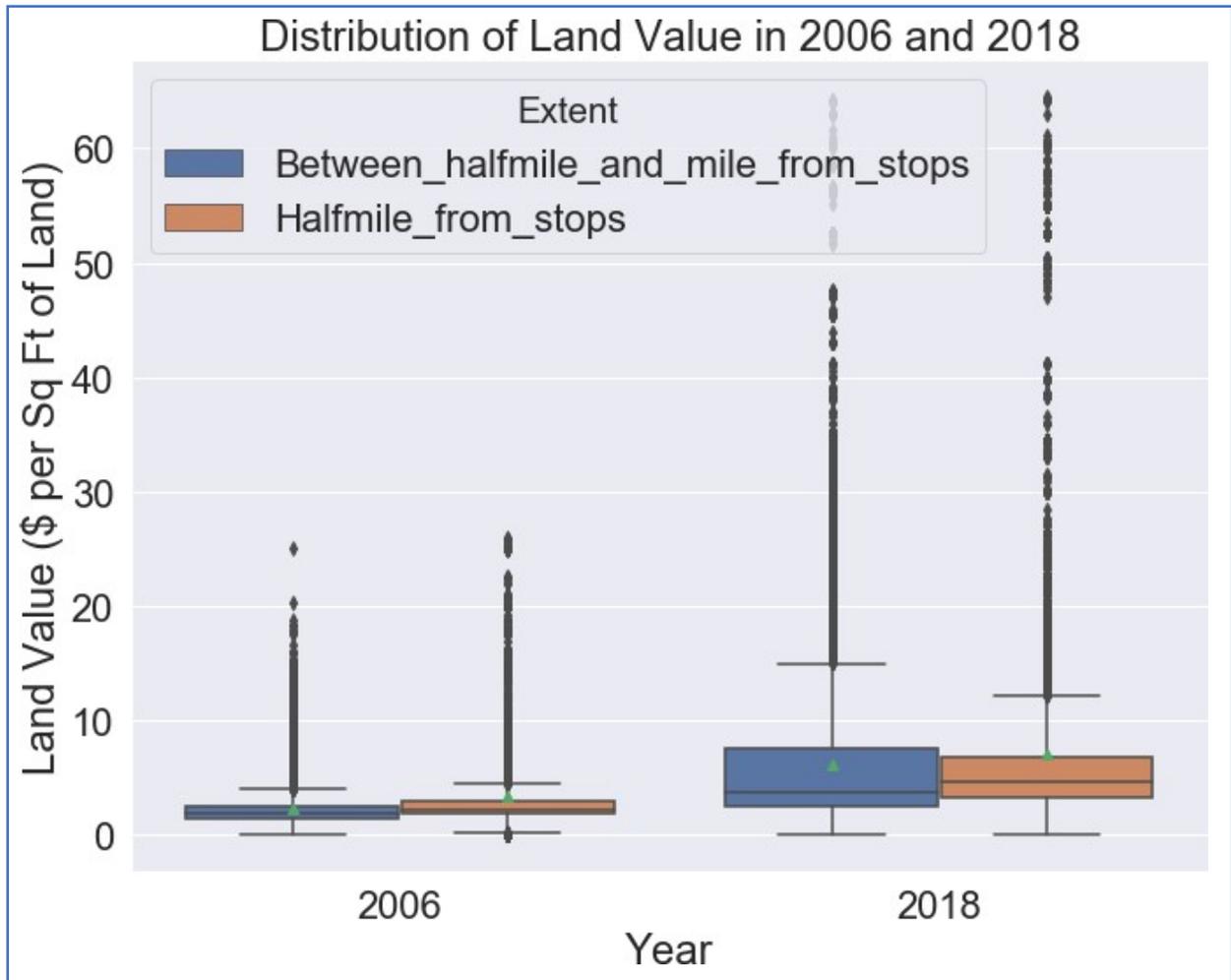


Figure 5: Box Plot of Land Values in 2006 and 2018, Including Values > (1.5*IQR)

Regression

REGRESSION RESULTS (2018)			
Variable Name	Coefficient (Standard Error)	t Statistic	p-value (* indicates $\alpha =$ 0.05)
Intercept	7.7716 (0.583)	13.323	0.000*
MinDistToStops	-7.243e⁻⁰⁵ (8e⁻⁰⁵)	-2.786	0.005*
HistoricZone	3.3574 (0.104)	32.324	0.000*
MinDistToHistoricSite	-0.0006 (2.06e ⁻⁰⁵)	-29.559	0.000*
MinDistToPark	0.0007 (2.9e ⁻⁰⁵)	23.275	0.000*
ResDensity	0.0068 (0.020)	0.349	0.727
JobDensity	0.2810 (0.003)	111.055	0.000*
RoadDensity	0.1453 (0.006)	24.575	0.000*
Jobs45MinDrive	-4e ⁻⁰⁵ (3e ⁻⁰⁶)	-13.374	0.000*
R-squared	Observations	F-statistic	
0.420	28,588	2584 (p=0.00)	

The results of the regression also suggest some contradictory conclusions. As in Perk and Catalá (2017) and a number of other studies, the regression produces a model with a negatively-valued coefficient for the term representing a parcel's distance to its nearest bus stop. That is, parcels that are closer to bus stops are predicted to have higher land values, by virtue of being closer to a bus stop. The model suggests this estimated effect is right on the line of statistical significance at the 95% level, and the size of the effect is moderate. For every meter closer to a bus stop, the model predicts an increase in value of \$0.00007 per square foot, or an increase of 0.7 cents per square foot for every 100 meters closer. In other words, if a 1-acre property (43,560 sq. ft.) is 100 meters closer to a bus stop than another 1-acre property, the closer property is predicted to have a total appraised land value roughly \$315 greater. A more typically-sized residential lot of

8,000 square feet would be expected to have a land value roughly \$60 greater for every 100 meters closer to a Primo stop. The estimated premium is significantly smaller than but very roughly on the order of the premium estimated by Perk and Catalá, who as noted in the literature review above estimate an increase in a property's sales price of between \$823 and \$1,128 for every 100 meters closer to a BRT stop.

All of the other predictor variables produce estimates with a higher (virtually 100%) degree of confidence, other than residential density. Compared to the other distance-related variables, the effect of the BRT stops seems fairly small in comparison. An unexpected result is that increasing distance to parks is associated with increasing land values. An entirely expected result is the effect of distance to historic sites and presence in a historic zone, the latter of which far outweighs the effect of any other predictor. The same hypothetical 8,000 square foot lot would be expected to see an increase in land value of \$26,880 in a historic district.

Similarly, job and road density are both predicted to increase property values with a high degree of confidence. Interestingly, the EPA measure of jobs within a 45 minute drive shows a very small effect relative to the measure of job density, which is the predictor with the second-highest estimated effect after historic zone presence. By effectively suggesting that jobs closer to a parcel contribute to its value much more than jobs further away, this might be interpreted as a vindication of the same vein of theory that predicts an accessibility premium from BRT stops.

The model's R^2 value suggests that the model explains a fairly large amount of the observed variance (42%), though as explained [below](#) this should value should be treated with caution due to apparent heteroscedasticity.

Discussion

Checking regression assumptions

Multicollinearity

The variance inflation factor (VIF) is a measure of how much a predictor variable’s variance is increased by its relationship to other predictor variables. A higher VIF suggests a stronger correlation between a given predictor variable and at

VARIANCE INFLATION FACTORS	
Variable	VIF
MinDistToStops	1.09
HistoricZone	1.20
MinDistToHistoricSite	2.92
MinDistToPark	2.75
ResDensity	1.21
JobDensity	1.23
RoadDensity	1.42
Jobs45MinDrive	1.43

least one of the other predictor variables. VIFs that are traditionally thought of as being large (i.e. $VIF > 5$) indicate a high degree of correlation between two or more of the predictor variables, which could cause a regression model’s estimates to vary due to relationships among the predictor variables, rather than due to a relationship between the predicted variable and the predictors.

As can be seen in the chart above, none of the variables display very worrying VIFs, other than perhaps distance to historic sites and distance to parks. These both have fairly large VIFs (2.92 and 2.75, respectively), which could indicate their correlation with each other. Overall, though, multicollinearity was not judged to be present to a significant degree, so no variable were excluded on this basis.

Homoscedasticity

Another fundamental assumption of regression is that the errors of a linear model exhibit equal variance for each value of an independent variable. The figure below of fitted values

plotted versus residuals shows that this assumption is clearly violated in this case, for reasons that will be suggested below.

Figure 6: Scatterplot of Fitted Values versus Residuals

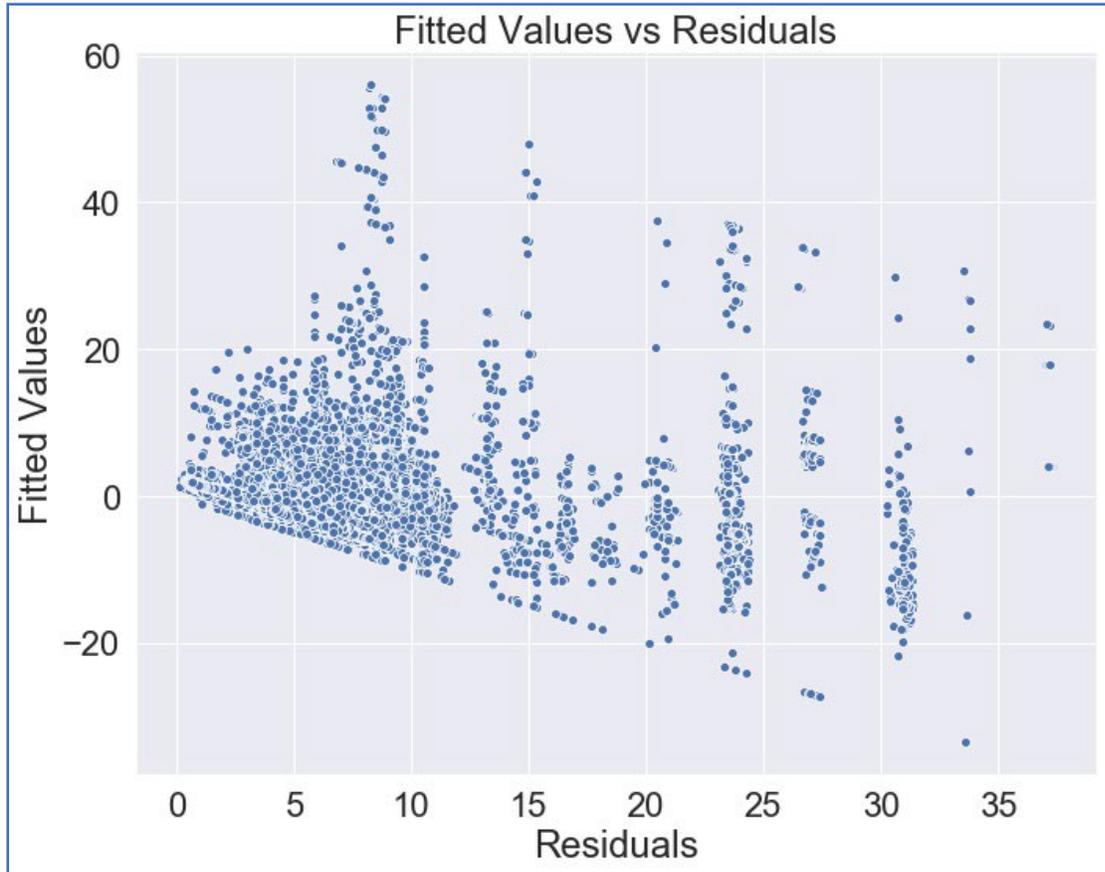


Figure 6: Fitted Values vs. Residuals

The residuals show a “banded” pattern, in which a wide range of fitted values are often associated with roughly the same residual value, and vice versa. This seems to be due to a large numbers of properties having a land value that matches at least one other. Specifically, 2/3 of the roughly 30,000 records in the 2018 dataset have a land value that matches the land value of at least one other property. An example is provided in the map below. In the figure, two groups of properties are displayed, the total land value for each of which has been appraised as one of two

values: \$17,970 or \$18,520. Overall, this group of properties numbers roughly 200. For each of these properties, the per-area value estimated by the model might vary significantly, but the estimated value would also vary consistently with the distance-based variables included in the models. This could produce distinct clusters of properties that have roughly similar fitted values but very different residual values, depending on which side of the boundary between these clusters a property happens to fall. A similar effect could be caused by historic district presence, the major predictor and also one that is very sensitive to boundaries.

Figure 7: Map of Identically-valued Parcels along Route 100

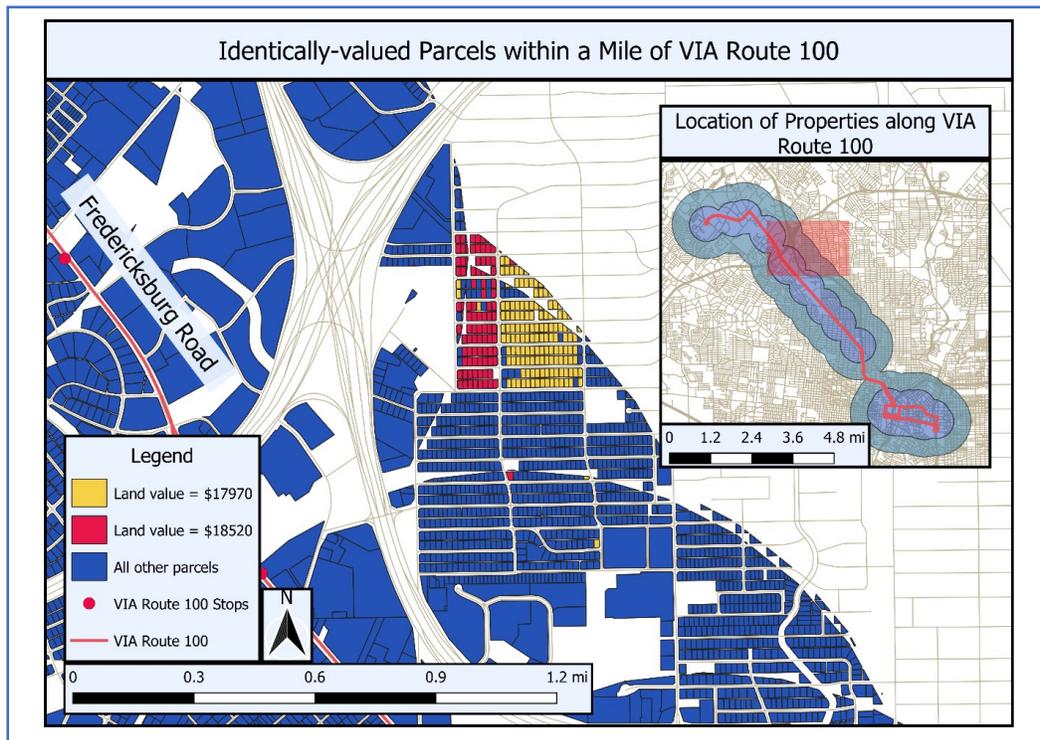


Figure 7: Identically-valued Parcels

CONCLUSION

Overall, this paper produces two major findings, which are somewhat contradictory. A comparison of mean land values suggests that properties closer to VIA Route 100 stops increased in value much more slowly than properties further from VIA Route 100 stops, between 2006 and 2018. On the other hand, the linear regression model suggests that decreasing distance to Route 100 stops can be reliably predicted to increase a parcel's land value by a moderate amount, after holding other factors constant. A potential explanation is that the subset of properties between a half-mile and a mile from Route 100 stops experienced some effect that properties within a half-mile did not, but it is difficult to speculate what that effect might be. In any case, the results lend support to the idea that higher-frequency bus service, even if not “rail-like” BRT, is associated with an increase in land values.

Moreover, this paper's methodology allows the accessibility premium to be tied specifically to land value, in ways that methodologies relying on sales price cannot. Conceivably, appraisal data could be used to answer further questions about the differential impact of accessibility on land value versus improvement value.

Using appraisal data for this purpose also presents some challenges. In part this paper might be best understood as a study of Bexar County appraisers' opinions of how changes in bus service affect the value of land that is nearer to the altered service. The overwhelming effect of historic zones might be an indicator of this. Of all the factors included in the regression, presence in a historic zone is by far the easiest for an appraiser to determine—it seems unlikely that Bexar County's appraisers consider distance to parks or distance to transportation in a fine-grained way, but historic districts offer a binary signal that can be easily factored into appraisals. On the

other hand, this also suggests the notable conclusion that appraisers seem to factor accessibility into their estimates of land value.

REFERENCES

Works Cited

Bohman, H and Nilsson, D 2016, “The impact of regional commuter trains on property values:

Price segments and income,” *Journal of Transport Geography*, vol. 56, October 2016, pp. 102-109.

Bowes, DR and Ihlanfeldt KR, “Identifying the Impacts of Rail Transit Stations on Residential

Property Values,” *Journal of Urban Economics*, vol. 50, no. 1, July 2001, pp. 1-25.

Caine, I, Walter, R, & Foote, N, 2017, “San Antonio 360: The Rise and Decline of the

Concentric City 1890-2010,” *Sustainability*, vol. 9, no. 4, pp 1-16.

Hendricks, D 2017, “San Antonio’s 55-year streetcar ride,” *San Antonio Express-News*.

Available from: <https://www.expressnews.com/sa300/article/San-Antonio-s-55-year-streetcar-ride-12169703.php>. [7 December 2018].

Jun, M 2012, “Redistributive effects of bus rapid transit (BRT) on development patterns and

property values in Seoul, Korea,” *Transport Policy*, vol. 19, no. 1, January 2012, pp. 85-

92. Available from: <https://doi.org/10.1016/j.tranpol.2011.09.003>.

MIG 2017, “City of San Antonio Comprehensive Plan: Executive Summary.” Available from:

https://sacompplan.com/files/SA_CompPlan_Executive-Summary_091916_Final.pdf. [1

December 2018].

Pagliara, F and Papa, E, “Urban rail systems investments: an analysis of the impacts of property values and residents’ location,” *Journal of Transport Geography*, vol. 19, no. 2, March 2011, pp. 200-211.

Perk, V and Catalá, M 2017, “Impacts of Bus Rapid Transit (BRT) on Surrounding Residential Property Values,” National Institute for Transportation and Communities, NITC-RR-894, July 2017. Available from: <https://doi.org/10.15760/trec.178>.

Perk, V and Catalá, M 2009, “Land Use Impacts of Bus Rapid Transit: Effects of BRT Station Proximity on Property Values along the Pittsburgh Martin Luther King, Jr. East Busway,” National Bus Rapid Transit Institute, FTA-FL-26-7109.2009.6, December 2009. Available from: https://nbrti.org/wp-content/uploads/2017/05/Property-Value-Impacts-of-BRT_NBRTI.pdf.

Primo 100 Schedule n.d. Available from: http://www.viainfo.net/wp-content/uploads/2018/07/Schedule100-Primo_08_2018.pdf. [9 December 2018].

Primo Service n.d. Available from: <https://www.viainfo.net/primo-service/>. [8 December 2018].

Munoz-Raskin, R 2010, “Walking accessibility to bus rapid transit: Does it affect property values? The case of Bogotá, Colombia,” *Transport Policy*, vol. 17, no. 2, March 2010, pp. 72-84. Available from: <https://doi.org/10.1016/j.tranpol.2009.11.002>.

Riley, C 2012, “VIA Primo is finally here,” *San Antonio Express-News*, 11 December. Available from: <https://www.mysanantonio.com/community/northwest/news/article/VIA-Primo-is-finally-here-4109603.php>. [8 December 2018].

Texas Transportation Museum n.d., “Streetcars in San Antonio.” Available from:

<https://www.txtransportationmuseum.org/history-streetcars.php>. [7 December 2018].

Transportation Research Board n.d., “Bogotá, Columbia Brief: TransMilenio BRT.” Available from: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp90v1_cs/bogota.pdf. [9 December 2018].

Villareal, E 2012, “VIA Primo Service: Mixed Reviews From Residents,” *The Rivard Report*. Available from: <https://therivardreport.com/via-primo-service-improvement-or-disruption/>. [7 December 2018].

Viña, C 2011, “Building San Antonio: The streetcar suburbs or old and new,” *San Antonio Express-News*, 25 November. Available from: https://www.mysanantonio.com/real_estate/article/Building-San-Antonio-The-streetcar-suburbs-of-2292916.php. [7 December 2018].

Wang, Y, Potoglu, D, Orford, S, & Gong, Yi, “Bus stop, property price, and land value tax: A multilevel hedonic analysis with quantile calibration,” *Land Use Policy*, vol. 42, January 2015, pp. 381-391.

Zhong H and Li W 2016, “Rail transit investment and property values: An old tale retold,” *Transport Policy*, Vol. 51, 15 October, pp. 33-48.

Figures

Figure 1:

A 1922 map of San Antonio streetcar routes shows the system at its peak, 1922, image. Howell, Mike, “Historical Streetcars: Take a look back at SA’s trademark transportation.” Available from: <https://www.mysanantonio.com/news/local/slideshow/Historical-streetcars-67262/photo-4978960.php>. [9 December 2018].

Figure 2:

Bus terminal image featured on VIA Metropolitan Transit webpage, n.d., image. Available from: <https://www.viainfo.net/primoservice/>. [9 December 2018].

Figure 3:

Author creation.

Figure 4:

Author creation.

Figure 5:

Author creation.

Figure 6:

Author creation.

Figure 7:

Author creation.

APPENDIX A:

A list of data manipulations performed for this analysis is below:

- Some properties were recorded with zero value—these were entirely removed;
- For each year, properties with land values (per unit area) more than 3 standard deviations away from the mean land value (per unit area) were considered outliers and removed;
- Certain fields contained duplicated information, including land values and what looked to be unique property ID numbers. These were judged to be duplicated records, and they were removed;
- Significant numbers of properties were recorded with negatively-valued ID fields—as with the zero-valued land value fields, this seems to be due to the assessor’s needing to assign a value shapes that are not in practice valued by the assessor but that nevertheless appear in their dataset, like a segment of river or road. These records were removed.

2020

1st Place

**Informal Transit and Women's Travel
Issues in the Global South**

Louis G. Alcorn, University of Texas at Austin

Informal Transit and Women's Travel Needs in the Global South

Abstract

Women's travel needs differ substantially from those of men. In the Global South, this divide is even more pronounced: women in the Global South require transportation options that are flexible, cheap, safe, and secure; thus women rely heavily on informal transit options or walking to meet their daily transport needs. Modernist perspectives held international development agencies like the World Bank, however, call for formalizing these systems or getting rid of them entirely in favor of formal fixed route transit options. The extant body of literature surrounding informal transit stresses the dirty and dangerous qualities of these services and ignores their adaptive, flexible characteristics or how they uniquely meet the needs of women in the Global South. Planners and engineers (most of whom are male) envision and design formal transportation systems based on data or anecdotal evidence that generally match the travel needs of male commuters while ignoring women's needs for flexible options. My research provides a different assessment of women's travel needs in the Global South and the ability of informal transit systems to serve those needs. I contend that this adaptive, flexible system may work better for women's travel needs in the developing world in spite of the objective problems with informal transit; I contend it is necessary to fix the problems of informal systems rather than regulating them out of existence.

Introduction

Most women in the Global South do not have access to an automobile and rely on existing forms of public transportation or walking to carry out their daily needs. Informal, minimally-regulated transit services dominate motorized transport in these places. Local, state, and federal government entities have historically provided woefully inadequate and expensive formal transit systems; the informal transit sector has sprung up to fill the travel demand of women who require flexible, responsive options. Relying on informal transit to provide the backbone of transit services comes with a host of negative externalities that are well documented in the literature. Planners, politicians and engineers in countries and cities across Africa, Latin America and southeast Asia have mostly supported the "modernization" and

"rationalization" of their transit systems through the eradication and replacement of informal transit services with bus rapid transit (BRT) and rail-based services.

The deficiencies of a dysfunctional transit system impact all travelers, but they have a disproportionate impact on female travelers in the Global South. Women tend to rely on public transit more than men; if a family owns a car it is traditionally prioritized for the use of the male head of household (Anand & Tiwari, 2006). Men often need only commute to one location for work, while women must combine their employment with all ancillary family businesses on a day to day basis (e.g. escorting children, church, market, etc.); thus they travel to a wider diversity of places. Formal bus and rail networks are inherently unsympathetic to their feedback and needs (Ugboma, 2018). Women clearly require transportation options that are flexible, cheap, safe, and secure—their use of informal options that allow flexible routing and variable schedules clearly demonstrates this—in spite of the safety and security problems such options offer have.

The World Bank finances a substantial amount of planning, engineering, and construction of transportation infrastructure in the Global South. The Bank strives to incorporate “gender mainstreaming” (The World Bank, 2010) into the planning and operation of these projects, but there is substantial evidence that formal system design still centers around male-dominated commute patterns and origins/destinations. I hypothesize that despite the objective downsides of informal transit, this adaptive, flexible system may work better for women's travel needs in the developing world. Policymakers should expend far more time and resources to address the limitations and deficiencies of these systems rather than destroying them.

This report synthesizes the extant body of literature on women's travel issues in the Global South focusing specifically on the role of formal and informal public transit services in meeting women's travel needs. I then introduce the topic of informal transit and provide a more detailed analysis of three key topics in women's travel: flexibility, cost, and safety and security. The discussion section contextualizes the findings from the literature synthesis into meaningful policy implications. Last, I discuss research gaps and the need for future work in the field. Overall, I conclude that in many situations informal transit

meets women's needs better than formalized alternatives. The topic of women's travel needs in the Global South, however, is still insufficiently addressed in the literature and warrants a closer academic research focus as well more attention to the policy implications of government and development agencies who develop formal transit systems in the developing world without considering how crippling or destroying informal systems impacts women travelers.

Methods:

I conducted a review of the relevant literature on women's travel needs in the Global South with an emphasis on the role that informal transit systems play in meeting these needs. I have organized my analysis of women's transportation issues and informal transit systems in the Global South around the following theoretical framework.

Theoretical Framework:

The World Bank (2002, p. 27) defines the concept of "poor" in a variety of ways that relate directly to women's transportation issues. A certain section of the population falls into the category of "income poor", which is what it sounds like – people with limited monetary resources. Some women are "income poor" and thus likely make fewer trips, most of which occur via walking. The concept of "time poor" applies to a broader cross-section of women in the Global South, resulting from long journeys to work or other places using transportation systems that are generally not well designed for the diverse travel needs of women. A woman can lack access to opportunities (e.g. employment, markets, healthcare, etc.) due to elements of both "time poorness" and "income poorness"; however, women who experience "time poorness" are not necessarily "income poor", but they could be. Finally, women in the Global South (and worldwide) suffer from "safety poorness" in that women choose to alter or limit trip making as a result of their perceived, cultural, or actual vulnerability to both issues of safety (e.g. bodily harm from a traffic crash) and security (e.g. sexual harassment and/or assault).

Literature Synthesis:*Background: What is Informal Transit?*

Informal transit systems are prevalent across the Global South, predominantly filling a gap in transportation demand that has not been sufficiently provided through a formal bus or rail system. These transit systems, sometimes called “jitneys” or “paratransit” tend to be largely unregulated (hence the term “informal”), but also keenly responsive to dynamic travel demands (Cervero, 2001; Ferro, 2015). Motorized three-wheelers, retrofitted minivans and trucks, motorcycles, bicycle rickshaws, and human- and animal-powered carts combine to produce a system that Cervero (2001, p. 1) terms “laissez-faire transit” whereby “those who are willing to pay for transport services hook up with those who are willing to provide them” in an entrepreneurial system that came about with no centralized planning (Cervero, 2001; Cervero & Golub, 2007). Informal transit systems provide a large proportion (and in many cases the lion’s share) of transportation services across much of the Global South. Figure 1 illustrates the astoundingly large market share of informal transit systems in a host of cities across Northern Africa (orange), sub-Saharan Africa (yellow), Asia (red) and Latin America (blue). In many cases women tend to be the most regular users of these services for three reasons: informal transit services (particularly non-motorized modes) tend to be 1.) more flexible, 2.) cheaper, and 3.) seen as more secure than alternatives (Agyemang, 2015; Ballas, 2009; Kamuhanda & Schmidt, 2009; Moser & The World Bank, 1996; Rosenbloom & Plessis-Fraissard, 2010; Venter, Vokolkova, & Michalek, 2007).

Modern, Western planning, policy, and engineering literature prescribes informal transport systems of the Global South as a dirty, dangerous and congestion-inducing hinderance to transportation system development (Cervero & Golub, 2007; Golub, Balassiano, Araújo, & Ferreira, 2009; Paget-Seekins, 2015). These informal transit services can complement formal transit service by serving neighborhoods that are poorly served by formal operators and by responding promptly to changing market demands. At the same time, they also come with the downsides of vicious, sometimes violent, competition among drivers for passengers, unsafe driving behavior, and general lack of proper vehicle maintenance (Cervero & Golub, 2007). The standard response advocated by development agencies like

the World Bank usually involves establishing a plan to phase out informal transit with the build-out of formal BRT or rail-based infrastructure. In many cases women make up the majority of informal transit

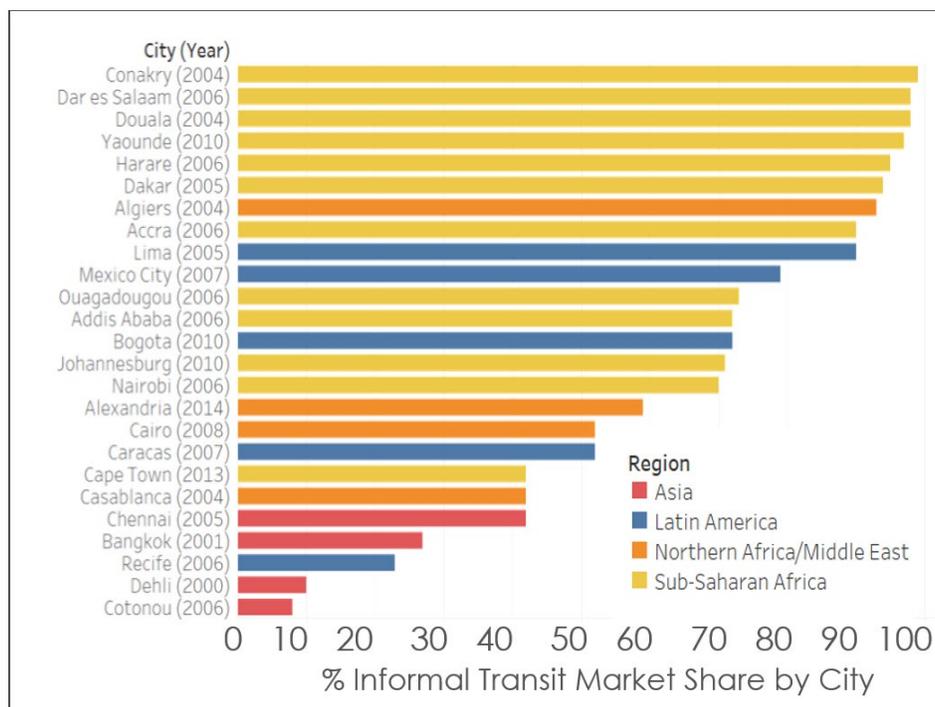


Figure 1: Informal transit market share by city (Ferro, 2015)

ridership; yet substantial evidence indicates that these formalized trunk-line-based transit systems do not accommodate women's unique and diverse travel needs and the fares charged may be far beyond their financial ability (e.g., see Agyemang, 2015; Ballas, 2009; Deng & Nelson, 2013; Kash, 2019a; Venter et al., 2007).

I explore these needs in greater detail and synthesize extant literature on informal transit and women's travel needs with respect to the theoretical framework I've outlined above.

Flexibility:

Women tend to have more diverse travel needs than men in most cases. Women generally must take care of all ancillary family businesses on a daily basis (e.g. school, church, market, etc.) meaning that they have a wider diversity of places that they need to travel to each day (Ugboma, 2018). Activities undertaken by women like childcare and informal sector employment require more frequent, shorter trips than typical commutes undertaken by men (Venter et al., 2007). Many of these trips involve travel during

off-peak hours on secondary routes that formal transit lines do not serve particularly well (The World Bank & Gwilliam, 2002). Additionally, women often travel with heavy loads (in the form of market wares, children, etc.), which makes any transit system even more difficult to navigate (Agyemang, 2015; Grieco, Kwakye, & Turner, 1995). In many cases, relying on the informal transit system remains the only conceivable way to complete these trips without access to a personal automobile. Households that can afford an automobile typically prioritize its use for the male, so while automobile ownership rates in the Global South may be rising this trend has a limited benefit to women (Ugboma, 2018).

Across the Global South, women gain access to basic needs like employment opportunities, healthcare, and marketplaces from the informal sector. The informal sector represents a significant portion of non-agricultural employment in the Global South, comprising approximately 51% of existing employment in Latin America, 65% in Asia and 76% in Africa (Sow, 2018; Uteng & The World Bank, 2011). More than 60% of women workers in the Global South find employment in the informal sector and though men work in informal sector jobs as well, they are more likely to be employed in the formal workforce than women (Uteng & The World Bank, 2011). Formal transit lines tend to prioritize access to employment centers for formal jobs. Meanwhile, informal employment centers are often not co-located with traditional job centers and women travel longer distances to access employment than men in most cases. For example, in Durban, South Africa, 70% of women's work destinations are located outside of the central business district compared to 38% of men's (Venter et al., 2007). Informal transit provides service to informal job centers and supporting industries (e.g. marketplaces, wholesale warehouses, small-scale manufacturing, etc.); however, these services are neither cheap nor rapid. Throughout much of the Global South, women regularly spend two or more hours commuting via informal transit (and walking) every day (Kamuhanda & Schmidt, 2009; Rosenbloom & Plessis-Fraissard, 2010). The time and monetary costs of these longer journeys preclude women's access to these opportunities, so women from the lowest social strata must find work within walking distance from home (Anand & Tiwari, 2006).

Women who find employment as traders in informal marketplaces often travel with heavy loads, which introduces another unique complication to women's travel on public transport. In Africa, many

women find employment in the form of “petty trading” at informal marketplaces. Most women lack capital resources to buy in bulk, so traders make frequent trips between the wholesale market and the selling place with as many goods as they can carry (Grieco et al., 1995). In Cameroon, transportation costs incurred by *Bayam-sellam*, women who make daily trips from the rural periphery to sell perishable food crops in the urban center, soak up most of their profits (Zogo & Epo, 2016). This unique travel need requires women to take multiple modes of transport each day, which can include porters, hand or animal-powered carts, and informal minibuses. In the early 2010's, World Bank and the French Development Agency teamed up with Ghana's Ministry of Transport to pilot the country's first BRT route in Accra, the nation's capital city. Preliminary planning documents for the project highlight women (particularly female traders) as a major source of passenger demand for the service. Public feedback from women expressed a need for pedestrian-friendly access and waiting areas for women carrying heavy loads as well as a desire for cargo space and helpers to assist market women while boarding and alighting buses (Okoye, Sands, & Debrah, 2010). Upon implementation, though, the BRT route failed, in part because it failed to meet these needs. Women reported that they often would choose the informal minibuses over the formal BRT service because of its flexible operation style, which in their opinion resulted in faster travel through the use of “unapproved routes/shortcuts” and the ability to board and alight at any location, rather than at a fixed BRT bus station (Agyemang, 2015, p. 33). Additionally, women transporting heavy loads to market reported having to beg BRT staff to help them get their goods on and off the bus, while informal minibus conductors would provide this service automatically (Agyemang, 2015). This may not be standard across all informal transit systems though -- in Los Altos, Bolivia, indigenous women report that sometimes informal transit drivers prevent women from boarding their minibuses with traditional bundles (Kash, 2019b) because they take up extra space that could be used by other paying customers.

Overall, the diversity of trip types that women make in the Global South necessitates a responsive and flexible means of public transportation. Formal systems often follow formal land development corridors and job centers where men tend to be employed. Oftentimes the locations where women need to travel for work, shopping or healthcare tend to be located outside of these central locations and only

(practically) served via informal options. Finally, women generally do this travel while carrying heavy loads and/or with children in tow, so they seek to minimize walking and wait times. Informal transit fits these flexibility requirements best.

Cost:

Women across the Global South earn significantly less disposable income than men; they also spend a higher proportion of their earnings on meeting their transportation needs. Women travel longer distances, make more transfers between services, and travel along lower-volume, higher priced routes, so they end up paying more per kilometer of transit than men (Venter et al., 2007). Women are thus more likely than men to be “time poor”, “income poor”, or both (The World Bank & Gwilliam, 2002).

If women can afford the cost, evidence shows that they will pay for the more flexible and/or perceivably safer modes of transport, particularly for employment-related trips (Rosenbloom & Plessis-Fraissard, 2010). In Accra, Ghana, women reported choosing informal minibuses over the cheaper, subsidized fare of the formal BRT route due to their time and flexibility benefits (Agyemang, 2015). Similarly in Kampala, Uganda, women report spending relatively higher portions of their mobility budget on more expensive transit choices like motorcycle or car taxis when compared to men for similar reasons (Kamuhanda & Schmidt, 2009). These findings display the difficult tradeoffs that even the most fortunate women make between enduring more arduous journeys versus expending more of their small incomes.

In many regions where informal transit provides the only viable option for travel, government entities lack the resources to properly regulate the informal sector. Fares are not standardized and are subject to the whims of the drivers and conductors that operate under a precarious arrangement by which they do not take home any earnings unless the fares they collect exceed the amount of bribes they pay to union and government officials and the remuneration fee owed to the vehicle owner (Agbibo, 2016; Cervero & Golub, 2007). Sometimes, cartels of drivers collude in a scheme called “route partitioning”, which involves cutting routes into smaller sections and forcing passengers to switch buses and pay a second fare to reach their destination (Kash, 2019b, 2019a). This unregulated, laissez faire approach to providing transit impacts women more than men since they tend to have, longer and more complicated

trip patterns. Furthermore, in many cultural contexts (and particularly in Northern Africa and the Middle East), systemized patriarchy and/or religious/cultural norms limit women's ability to haggle for lower fares (The World Bank, 2011). Women tend to use informal transit because it either provides more flexible options to meet their travel needs or because viable alternatives do not exist. Ultimately, women end up paying more to fulfil their transportation needs when the government (or other oversight entity) fails to regulate the fare structure and operating procedures of the informal transit system.

Numerous cities across the Global South have invested in formal BRT or rail projects after recognizing the negative externalities of relying on these informal small-scale operations to provide the majority of transit services. This process often involves reconfiguring transit network design from a one-seat ride model to a trunk and feeder system (Paget-Seekins, 2015) in which the new service requires a passenger transfer between services or service types along the way. For example, in 2007, Santiago, Chile, created the Transantiago system, integrating their bus network with the city's Metro (subway) system (Paget-Seekins, 2015). Informal operators consolidated into various cooperatives or companies and contracted with the city for licenses to provide feeder services in different neighborhoods. Other cities in Latin America, including Bogotá, Colombia, have undergone similar transformations and outside experts laud these transformations as 'best-practice' examples of leveraging public and private resources to provide efficient and effective transit systems. Low-income residents living along the urban periphery (particularly women in these areas) do not reap these benefits because paying to transfer amounts to essentially a doubling their daily transportation costs. Of 130 residents engaged in a study in Pudahuel, Santiago by Ballas (2009), no women reported having *ever* used the Metro, instead relying on remaining informal minibus services. This finding came despite the fact that most women also reported that they would prefer to be able to utilize the multimodal transportation system but could not do so due to affordability issues (Ballas, 2009). Efforts to design a BRT system in Los Altos, Bolivia failed because the transit dependent population – those who need the service the most -- typically also had the lowest ability to pay. Kash (2019b) reports that the poorest Altanos already pay an average of 48% of their income on transport. Meanwhile, in Bogotá, two of the peripheral permit zones sold to private companies

to provide feeder service to BRT stations have fallen bankrupt (Ferro, 2018), indicating that sustaining these operations in the poorest (and simultaneously most needy) communities proves difficult.

Meanwhile, many women cannot afford travel on motorized transit service at all and rely on walking and/or lower-cost, non-motorized transportation. Cervero and Golub (2007, p. 448) report that within the poorest countries in the world “mini- and micro-bus services generally serve male customers ... while pedicab and non-motorized services tend to focus more on women making short trips to markets and retail centers”. In Bandung, Indonesia, women make up 89% of the ridership of bicycle rickshaws and 79% of horse-drawn carts while motorized transit modes remain dominated by male passengers (Joewono & Kubota, 2005). Research in West Africa confirms women’s (particularly poor women’s) low motorized travel and high walking trip rates in Conakry, Guinea and Douala, Cameroon (Godard, 2013). Women’s reliance on slower modes limits their accessibility to jobs and other resources. Anand & Tiwari (2006) contend that this lack of mobility feeds into the vicious cycle of poverty that plagues women in urban peripheral areas, stating that: “if their families are relocated to the outskirts of the city, then the women will be the first to lose their livelihood” (p. 78). The *laissez faire* method of providing transit to low-density peri-urban or rural areas works against female passengers seeking affordable access to resources. These longer-distance trips cost more to operate and generate less profit for the drivers, so they pass these externalities on to the passengers in the form of infrequent service at a premium price. Consequently, many women in rural areas across the Global South lack sufficient income to pay for motorized transit services (Zogo & Epo, 2016).

At the end of the day, a woman’s ability to satisfy her travel needs hinges on the affordability of the services accessible to her. Due to the diversity of these needs, women tend to transfer more and travel along secondary routes, both of which contribute to women paying more per kilometer for travel than men. Formalization of systems can result in more efficient, more reliable and faster transit service; however, none of these benefits matter to the women who cannot afford a ticket to ride the new metro. As such, many women simply lack the monetary and/or time resources to use motorized transport altogether

and instead rely on other types of informal transport, or their feet, to meet (or not meet in many circumstances) their travel needs.

Safety & Security:

Women across the Global South select their travel mode, time of travel and route based on factors of safety and security. In the context of transit literature, perceived security generally refers to the feeling of protection against attack or criminal activity (e.g. mugging, assault, or harassment) and safety refers to feeling protected against traffic-related harm (e.g. traffic crashes) (Singleton & Wang, 2014). Many studies lump these two concepts into one; however, the causes and manifestation of safety and security issues in transportation stem from fundamentally different sources, so I will address these concerns independently. General perceptions of passenger safety and security tend to impact women's transportation choices more than men's (Kash, 2019a). Experts vaunt the safety and security benefits that arise from investment in formal transit options (Golub et al., 2009; Hidalgo & Huizenga, 2013), due in part to the lack of accountability embedded within the modus operandi of the alternative informal sector. Still, a host of evidence shows that women continue to choose informal transit options despite these concerns.

Roadway safety is a problem for informal transit systems. Minibus drivers do not complete driver training courses and tend to operate poorly maintained vehicles that lack basic safety features like seat belts or anti-lock brakes (Cervero & Golub, 2007). Furthermore, informal transit drivers do everything in their power to maximize revenues – driving at dangerously high speeds and overloading passengers are simply byproducts of the system (Agbibo, 2016). This image of unsafe operations is magnified by reports like a 2013 medical study in Lagos, Nigeria that found 22 percent of informal transit workers to be partially blind and that 99 percent of drivers suffered from hypertension (Akoni, 2013). In places where informal transit provides basically the only viable transportation option attitudes toward informal transit safety may mimic the feelings of this commuter from Lagos, Nigeria: “Many of us know the majority of danfos [i.e. informal minibuses] are death traps, but since we can't afford the expensive taxi fares, we have no choice but to use them” (Agbibo, 2016, p. 944). This sentiment resonates in the Latin

American context where less than 20% of female informal transit passengers in Santiago, Chile stated that they felt safe using the bus system, with 46% indicating that they felt “very unsafe” with regard to traffic crashes (Ballas, 2009, p. 125).

Formal transit systems, on the other hand, provide an objectively safer transportation alternative to informal transit *once passengers board the service*; however, accessing formal transit stations typically involves traversing treacherous streets outfitted with limited to no pedestrian infrastructure. A study in Addis Ababa, Ethiopia found that the presence of public transport terminals at intersections tends to correspond with more collisions, many involving pedestrians going to/from the terminal (Tulu, Haque, Washington, & King, 2015). Deng & Nelson (2013, p. 112) attribute the predominance of male ridership on the #1 BRT line in Beijing, China to station design flaws that make in-line stations difficult to access for “women, children and elderly people”. In Lagos, Nigeria nearly 70% of BRT riders use informal transit at one or both ends of their trip (Mobereola, 2009; Olawole, 2012), in part to avoid the dangers of a first-mile/last-mile walking trip. These rates are likely higher for women because they are more likely than men to alter their trip characteristics (e.g. time of day, mode, route, etc.) due to safety (and security) concerns (The World Bank & Gwilliam, 2002).

General security of informal transit systems also does not achieve high ratings, but women also do not report feelings of security aboard formal transit services either. In many cases, government authorities deem the manifestation of informal transit alone as illegal. Informal transportation cartels operate minibus, taxi, and other transportation services more like syndicates embedded in organized crime than a public transit agency. The “war for the cent” (or *la Guerra del Centavo*) in Latin America peaked between 2007 and 2013 when rival gangs engaged in a turf war to levy taxes on transit operations slaughtered nearly 1,000 bus drivers and passengers in Guatemala City (Elbein, 2013). Formal transit, on the other hand, may provide a false sense of security. For example, in the neighborhood of Cisne Dos in Guayaquil, Ecuador, one in five women were robbed on formal transit buses and double that amount had reported witnessing an attack (Moser & The World Bank, 1996). In addition to a substantial amount of women changing their travel patterns to avoid night travel, some women opted to change their mode to

what were seen as a relatively more secure option: trucks operated by the informal sector (Moser & The World Bank, 1996). Cervero and Golub (2007) highlight the dangers and lack of accountability of the informal system as major negatives; however, this collection of research shows that despite these downsides women still turn to the informal transit sector to fulfill their transportation needs.

Women appear to feel more secure from sexual-related crime (e.g. harassment, groping, rape, etc.) when using informal transit than when using formal transit, despite the increased exposure to other general crime on these services. Government agencies design formal transit services to serve the greatest amount of people with their given resources – if the bus is bursting at the seams with passengers, this maximizes passengers served and returns positive metrics that the city can report about the service they're providing. More often than their male counterparts, women report distaste for the overcrowding on formal transit systems. In Accra, Ghana, most women prefer the informal transit mode not only because of its flexibility, but also to avoid standing for an entire journey and potentially “being sandwiched between male passengers” (Agyemang, 2015, p. 33). Women express similar sentiments about the famed Transmilenio system in Bogota, Colombia, where 37% of female passengers reported experiencing unwanted sexual assault/touching aboard the system (Kash, 2019a). Kash (2019a, p. 237) also found that women feel more secure using informal transit buses due to the simple fact that “minibus passengers travel seated [which] minimizes crowding and insulates one from the risk of transit crime”. Still, despite the benefits conferred by the minibus's geometry, informal transit by no means ensures secure access to opportunities. Nearly 85% of women surveyed in peripheral Santiago, Chile expressed feeling “unsafe” or “very unsafe” with regard to perceptions of security from delinquency and/or sexual harassment while accessing work (Ballas, 2009, p. 125).

From the perspective of safety and security, neither the formal nor informal transit options provide perfect solutions for women. Formalized transit lines generally confer a better safety rating than riding on informal services but walking long distances to access these services results in more exposure as a pedestrian vulnerable to other dangers. Meanwhile, informal transit typically requires less walking and

comes with the simple benefit that riders typically get to sit down within sight of the driver or conductor; however, crash rates for these types of services are much higher.

Discussion of Policy Implications:

Women's transportation needs substantially differ from those of men in the Global South. Women require flexibility and perceived safety and security, but simultaneously lack the monetary or time resources to pay for premium services. Overall, formal transit tends to better serve male travel needs – unsurprisingly, these systems are typically designed by men with male travel patterns in mind. Development agencies and the United Nations have made steps towards promulgating gender mainstreaming in the development of transportation infrastructure, but the blinkered approach of dissolving informal transit systems and attempting to wholesale replace them with formal infrastructure discounts the (sometimes hidden) benefits that informal transit provides. Since women often represent the majority ridership on these informal systems (in many cases a vulnerable transit-dependent ridership at that), consideration of their travel needs and patterns should be of utmost importance.

The World Bank (among other development agencies) promotes the development of formal transit infrastructure as a means to stimulate the economy, cut down on pollution, and establish a greater sense of order over the transportation systems in the Global South. On the topic of gender, World Bank states that it “takes as its starting point that no country, community, or economy can achieve its potential or meet the challenges of the 21st century without the full and equal participation of women and men, girls and boys” (The World Bank, 2019c) In 2001, World Bank adopted a “gender mainstreaming strategy” that calls for “selective and strategic integration of gender issues into the Bank's country diagnostic work, lending operations, and technical assistance” (The World Bank, 2010, p. 14). This involves including women-led groups (e.g. Market women associations) as key stakeholders in the design, planning, and provision of transportation projects (The World Bank, 2019a). Historically, these accomplishments have resulted in minimal tangible changes for women in the places where the World Bank invests in transportation infrastructure.

Politicians and development agencies vaunt investments in formal transit infrastructure to cure the ills of the informal system, but in most cases women's needs are not of paramount concern in the design of these networks. Elements of the informal transit system may already be fulfilling women's transit needs quite well, or at least better than existing formal alternatives. This is not to say that women do not benefit from the development of formal transit infrastructure like rail and BRT lines; however, evidence suggests that men benefit more than women from upgrades in transport infrastructure and technology (Zogo & Epo, 2016). Even in the case where a majority of women show positive support of expanding formal transit infrastructure in peripheral Santiago, Chile, the same group of women reported not being able to use the existing formal transit system due to the cost (Ballas, 2009). In many cases, small improvements like fare regulations that minimize transfer penalties between services or allow children (and goods) to ride free have the capacity to improve women's access to opportunities immensely.

Because women are more likely to travel on secondary routes during off-peak times, BRT or rail-based trunk-line services are simply not well-suited to serve these types of trips. From a quantitative perspective, secondary routes and off-peak operations would not maximize the government's (or development agency's) investment of limited resources. Also, in terms of geometry and logistics, larger buses would struggle to navigate the sinuous and unmaintained roadways and paths that serve the areas that women frequent (e.g. informal marketplaces). Qualitatively, formal transit and regular timetables does not incorporate the tacit knowledge and relationships established over years of providing informal transit service to know when and where passenger demand will be. To the extent that informal transit services are significantly curtailed or eliminated through the formalization of the transit system, women who rely on these services will suddenly face a loss of accessibility.

Steps towards formalizing the informal transit sector cost money (not just capital, but operational) and governments should be prepared to absorb the cost of the negative externalities they're seeking to solve, not pass these costs on to citizens. In order to (even partially) formalize the informal transit sector the government must be prepared to internalize the costs previously embedded within negative

externalities of the system (Paget-Seekins, 2015). Rationalizations that these costs will somehow disappear through improved efficiencies are unfounded. Cape Town, South Africa grossly underestimated the costs and level of effort required to transition actors within the informal transit system into the formal operation of the city's first BRT service (Schalekamp, 2017). Similarly, both Santiago, Chile and Bogotá, Colombia designed their formalization agenda with the goal of minimizing public subsidies, which has resulted in lower frequencies, higher fares, and overcrowding (Paget-Seekins, 2015), all of which serve to the detriment of the three respective aspects of women's travel discussed in this report: flexibility, cost, and security. Paget-Seekins et al. (2015) argue that paradoxically, these results create a new opening in the market that could be filled by the informal services these systems intend to replace. Successful government programs and policies exist as well. In Dakar, Senegal and Nairobi, Kenya programs combining a healthy mix of 'carrots' and 'sticks' have resulted in a more regulated fare structure and safety improvements associated with fleet renewal (Behrens, McCormick, Orero, & Ommeh, 2017; Thiam, 2016). Overall, any intervention in the informal transportation industry should be carefully examined for its gender equality implications since these changes will tend to affect women more than men (Venter et al., 2007).

In addition to policy regulations, governments across the Global South preach that technology will soon solve many of the transportation problems experienced by developing urban areas. This overreliance on hope for future technology (and the private sector) to solve complex transportation problems extends to the operation of transit services. The emergence of transportation network companies like Uber and Bolt as alternatives to the previously loathsome taxi industry in many parts of the Global South bolsters the point of view that similar services can revolutionize other modes of transport (like public transit). In December of 2018, Uber launched UberBus in Cairo, Egypt, essentially an air-conditioned, app-based alternative to existing minibus services (Dahir, 2018). Two similar services attempting to leverage app-based ride-hailing on 23-26 seater buses launched pilot projects in Nairobi, Kenya in 2019 (Dahir, 2019). These types of alternatives may confer certain benefits over the existing transit alternatives in the context of women's travel needs -- on-demand, flexible routes, and perceived

improvements in safety and security. If these companies simply pass the costs associated with achieving these 'improvements' on to passengers (which seems likely in a capitalist economy where private companies seek to maximize profits) then the evidence assembled above indicates that these services will have a limited positive impact on women's travel. Governments could provide subsidies to cover this gap; however, the long-term sustainability of this type of contract (and the companies in general) remains unclear. What remains clear though, is that charging 2 to 4 times the fare of metro and traditional minibus services is a steep premium to pay, particularly for women (Marx, 2018).

Recognizing the value of the informal transit sector in achieving an equitable and sustainable system that provides access to all residents is the first step in defining this potentially complementary relationship between the formal and informal sectors. Past research focuses on various methods for integrating informal transit modes with the build out of formalized transit systems, some suggesting the amalgamation of such services into the formal system itself, others suggesting that they should be left to self-regulate (Ferro, 2015; Godard, 2013; Heinrichs, Goletz, & Lenz, 2017; Hidalgo & Huizenga, 2013). My master's thesis details the spectrum of regulatory and programmatic possibilities in order to distill policy suggestions for integrating the formal and informal transit systems in Lagos, Nigeria (see Alcorn, 2019). Most of these studies (including my thesis) do not elaborate on women's travel needs as a part of this equation. Overall, I contend that looking at these issues from a feminist epistemology further bolsters the value conferred by the informal sector. I think that relatively small tweaks in the organization and leadership of formal and informal transit operators can provide for simultaneously equitable and efficient transit systems in the Global South.

Gaps in Extant Literature and Portends for Future Research

Gaps in Knowledge

The breadth of research on informal transit systems is vast, but very few articles specifically focus on women's travel issues. A large proportion of the research studies cited in this review include little more than a paragraph or two that specifically address women's travel needs. Women represent a majority of public transit ridership in many of the locations examined in this literature review, yet a

substantial evaluation of their travel needs in comparison to other travelers remains rare. Part of this research gap can be attributed to the scarcity of gender disaggregated data paired with the severe lack of females in leadership or management positions in the transportation sector (formal or informal).

Women need to have a place at the table to plan the future transportation networks of the Global South. The Descartes-ian argument that “men are rational and women emotional” fuels the reliance on objective, quantitative measures based in math, economics, and sciences research to justify decisions over those solicited from participatory processes and focused on “situated knowledges” or lived experience from a feminist epistemology (Peet & Hartwick, 2009, p. 243). However draconian this argument may sound on its face, decision-making for governments and transportation enterprises of the Global South often rely upon results from quantitative cost-benefit models that pay little heed to more qualitative metrics or public feedback. The World Bank and other development agencies/banks make decisions on which projects to fund largely based on numerical results from traffic models and financial spreadsheets. The World Bank has made strides toward expanding the collection of gender disaggregated data, but only a very small share of the hundreds of indicators feature gender and none of these directly relate to transportation (Grown & Fu, 2019). Since the quantitative data often cannot be disaggregated by gender, women’s travel needs get lumped in with *general* travel needs, which are usually modeled and interpreted by men. One of the World Bank indicators that *does* feature gender disaggregated data is the proportion of positions held by women in national parliaments, ministerial level positions, and senior/middle management. Results from these indicators depict private and public spheres dominated by male leadership (exhibiting a ratio of 9:1 in many contexts throughout the Global South) (The World Bank, 2019b). Additionally, evidence from the literature indicates that females are less well represented in the transportation industry than in other sectors (Kamuhanda & Schmidt, 2009; Ugboma, 2018).

Future Research

In general, a lack of readily available and reliable data across the Global South exists; however, conducting meaningful transportation analyses in the data-lite African continent is not unprecedented. A handful of studies have been conducted to map informal transit services with little to no prior data

availability. To quantify the accessibility impacts of various transportation projects, the World Bank employed a software-as-a-service platform called TransitMix to manually map transit routes in Cairo, Egypt (Quiros, 2014). In Nairobi, Kenya a group of Kenyan university students and American researchers generated General Transit Feed Specification (GTFS) datasets for informal minibuses throughout the city to provide schedule-based data and maps to local service providers and transit customers (Williams, White, Waiganjo, Orwa, & Klopp, 2015). Saddier et al. (2016) completed similar research in Accra, Ghana, using smartphones to map routes and track boarding and alighting along 315 informal minibuses routes. Other datasets that could be leveraged for these types of studies include censuses, household surveys, remotely sensed data, and migration studies. Unfortunately, to date, none of these innovative methods of generating and analyzing travel data allow for gender disaggregation. This shortfall makes quantifying accessibility metrics or other impacts of proposed policy/infrastructure changes on women's travel difficult. This lack of data forces researchers seeking to study this subject to rely on anecdotes or at best small samples of qualitative data.

Conclusion:

The developing world is urbanizing rapidly and the population of countries in the Global South is increasing faster than any place in the world has ever experienced. This growth obviously places an inordinate amount of stress on already crumbling infrastructure systems. Building out formal infrastructure will struggle to keep pace with the burgeoning travel demands of the developing world, and particularly those of women. As governments look to plan and expand transit systems, women need to have a place at the table – not just to provide curated feedback, but a real equity stake or management role in this process. In the meantime, though, it appears that informal transit presently better serves women's transportation needs in the Global South. I contend that small tweaks in the management and quasi-regulation of these services (like fare rules that allow for free/reduced rate transfers between formal and informal services) can provide palpable benefits in the relatively short term. In the longer term, informal transit also has the potential to exist as more than a stop-gap solution through more robust partnerships with formalized government transit providers. These types of agreements would look to preserve the

flexibility and security benefits of informal transit, while improving upon the cost and safety issues to provide a better, tailored transit option to women. The relationship between women's travel and informal transit remains largely unexplored in the literature (and data), yet women all across the developing world rely on these services and continue to use them every day. Rather than retrofitting cities of the Global South to be marginally more tolerable/navigable for those who can afford it, planners, policy-makers and engineers should be thinking of ways to improve transportation accessibility outcomes for all people.

References:

- Agbiboa, D. E. (2016). 'No Condition IS Permanent': Informal Transport Workers and Labour Precarity in Africa's Largest City: "No Condition is Permanent." *International Journal of Urban and Regional Research*, 40(5), 936–957. <https://doi.org/10.1111/1468-2427.12440>
- Agyemang, E. (2015). The bus rapid transit system in the Greater Accra Metropolitan Area, Ghana: Looking back to look forward. *Norsk Geografisk Tidsskrift - Norwegian Journal of Geography*, 69(1), 28–37. <https://doi.org/10.1080/00291951.2014.992808>
- Akoni, O. (2013, September 17). 14,300 Lagos drivers are partially blind—LASDRI boss. *Vanguard News*. Retrieved from <https://www.vanguardngr.com/2013/09/14300-lagos-drivers-are-partially-blind-lasdri-boss/>
- Alcorn, L. (2019). *Informal Transit Integration with Planned Transit Systems: Transport Planning and Facility Design in Lagos, Nigeria* (Master's Thesis). University of Texas at Austin, Austin, TX.
- Anand, A., & Tiwari, G. (2006). A Gendered Perspective of the Shelter–Transport–Livelihood Link: The Case of Poor Women in Delhi. *Transport Reviews*, 26(1), 63–80. <https://doi.org/10.1080/01441640500175615>
- Ballas, M. F. (2009). The Transportation Barriers of Women of Pudahuel, Santiago. *Planning Forum: Journal of Community and Regional Planning*, 13/14, 120–127.
- Behrens, R., McCormick, D., Orero, R., & Ommeh, M. (2017). Improving paratransit service: Lessons from inter-city matatu cooperatives in Kenya. *Transport Policy*, 53, 79–88. <https://doi.org/10.1016/j.tranpol.2016.09.003>

- Cervero, R. (2001, Spring). Informal Transit: Learning from the Developing World. *ACCESS Magazine*, 18. Retrieved from <https://www.accessmagazine.org/spring-2001/informal-transit-learning-developing-world/>
- Cervero, R., & Golub, A. (2007). Informal transport: A global perspective. *Transport Policy*, 14(6), 445–457. <https://doi.org/10.1016/j.tranpol.2007.04.011>
- Dahir, A. L. (2018, December 5). Uber has launched its first bus service in Egypt. *Quartz Africa*. Retrieved from <https://qz.com/africa/1484896/uber-launches-first-bus-service-in-cairo-egypt/>
- Dahir, A. L. (2019, January 23). Ride-hailing services want to disrupt—And bring order to—Kenya's unruly public bus system. *Quartz Africa*. Retrieved from <https://qz.com/africa/1531062/kenyas-matatu-buses-face-disruption-by-little-swvl-safiri/>
- Deng, T., & Nelson, J. D. (2013). Bus Rapid Transit implementation in Beijing: An evaluation of performance and impacts. *Research in Transportation Economics*, 39(1), 108–113. <https://doi.org/10.1016/j.retrec.2012.06.002>
- Elbein, S. (2013, June 3). The Most Dangerous Job in the World. *The New Republic*. Retrieved from <https://newrepublic.com/article/113293/900-bus-drivers-dead-guatemala-city-worlds-most-dangerous-job>
- Ferro, P. S. (2015, October). *Paratransit: A Key Element in A Dual System*. CODATU.
- Ferro, P. S. (2018, April 12). [Skype].
- Godard, X. (2013). Comparisons of urban transport sustainability: Lessons from West and North Africa. *Research in Transportation Economics*, 40(1), 96–103. <https://doi.org/10.1016/j.retrec.2012.06.033>
- Golub, A., Balassiano, R., Araújo, A., & Ferreira, E. (2009). Regulation of the informal transport sector in Rio de Janeiro, Brazil: Welfare impacts and policy analysis. *Transportation*, 36(5), 601–616. <https://doi.org/10.1007/s11116-009-9215-y>

- Grieco, M., Kwakye, E. A., & Turner, J. (1995, July). *Informal public transport and the woman trader in Accra, Ghana*. Presented at the Seventh World Conference on Transport Research, Sydney, Australia.
- Grown, C., & Fu, H. (2019, May 17). Little Data Book on Gender marks progress – and shows the need for more. Retrieved December 8, 2019, from World Bank Blogs website:
<http://blogs.worldbank.org/opendata/little-data-book-gender-marks-progress-and-shows-need-more>
- Heinrichs, D., Goletz, M., & Lenz, B. (2017). Negotiating territory: Strategies of informal transport operators to access public space in urban Africa and Latin America. *Transportation Research Procedia*, 25, 4507–4517. <https://doi.org/10.1016/j.trpro.2017.05.346>
- Hidalgo, D., & Huizenga, C. (2013). Implementation of sustainable urban transport in Latin America. *Research in Transportation Economics*, 40(1), 66–77.
<https://doi.org/10.1016/j.retrec.2012.06.034>
- Joewono, T. B., & Kubota, H. (2005). The Characteristics of Paratransit and Non-Motorized Transport in Bandung, Indonesia. *Journal of the East Asia Society for Transportation Studies*, 6, 262–277.
<https://doi.org/10.11175/easts.6.262>
- Kamuhanda, R., & Schmidt, O. (2009). Matatu: A Case Study of the Core Segment of the Public Transport Market of Kampala, Uganda. *Transport Reviews*, 29(1), 129–142.
<https://doi.org/10.1080/01441640802207553>
- Kash, G. (2019a). Always on the defensive: The effects of transit sexual assault on travel behavior and experience in Colombia and Bolivia. *Journal of Transport & Health*, 13, 234–246.
<https://doi.org/10.1016/j.jth.2019.04.004>
- Kash, G. (2019b). Vision Dissonance: Conflicting Conceptions of Bus Sariri. *Journal of Planning Education and Research*, 39(3), 332–344. <https://doi.org/10.1177/0739456X17745974>

- Marx, P. (2018, December 6). UberBus is a Premium Transit Service That Won't Reduce Congestion. Retrieved April 3, 2019, from Medium website: <https://medium.com/radical-urbanist/uber-launches-its-bus-service-in-egypt-f0cdc9f5b708>
- Mobereola, D. (2009). Lagos Bus Rapid Transit—Africa's First BRT Scheme. *World Bank: Sub-Saharan Africa Transport Policy Program*, (9).
- Moser, C., & The World Bank. (1996). *Confronting crisis: A summary of household responses to poverty and vulnerability in four poor urban communities*. Retrieved from <http://documents.worldbank.org/curated/en/334951468336549231/text/154620PUB0REPL0000010Box200PUBLIC0.txt>
- Okoye, V., Sands, J., & Debrah, C. A. (2010). *The Accra Pilot Bus-Rapid Transit Project: Transport-Land Use Research Study*. Retrieved from Millenium Cities Initiative: The Earth Institute at Colombia University website: <http://mci.ei.columbia.edu/files/2013/03/Transport-Land-Use-Research-Study.pdf>
- Olawole, M. O. (2012, October). *Accessibility to Lagos Bus Rapid Transit (BRT LITE) Bus Stops: An Empirical Study*. 1–15. Addis Ababa, Ethiopia.
- Paget-Seekins, L. (2015). Bus rapid transit as a neoliberal contradiction. *Journal of Transport Geography*, 48, 115–120. <https://doi.org/10.1016/j.jtrangeo.2015.08.015>
- Paget-Seekins, L., Flores Dewey, O., & Muñoz, J. C. (2015). Examining regulatory reform for bus operations in Latin America. *Urban Geography*, 36(3), 424–438. <https://doi.org/10.1080/02723638.2014.995924>
- Peet, R., & Hartwick, E. (2009). *Theories of Development: Contentions, Arguments, Alternatives* (Second). New York.
- Quiros, T. P. (2014). *Accessibility Analysis of Growth Patterns in Buenos Aires: Density, Employment and Spatial Form*. Washington, DC.

- Rosenbloom, S., & Plessis-Fraissard, M. (2010). Women's Travel in Developed and Developing Countries. *4th International Conference on Women's Issues in Transportation*, 15. Retrieved from www.trb.org/Publications/Blurbs/164708.aspx
- Saddier, S., Patterson, Z., Johnson, A., & Chan, M. (2016). Mapping the Jitney Network with Smartphones in Accra, Ghana: The AccraMobile Experiment. *Transportation Research Record: Journal of the Transportation Research Board*, 2581(1), 113–122. <https://doi.org/10.3141/2581-14>
- Schalekamp, H. (2017). Lessons from building paratransit operators' capacity to be partners in Cape Town's public transport reform process. *Transportation Research Part A: Policy and Practice*, 104, 58–66. <https://doi.org/10.1016/j.tra.2017.08.002>
- Sow, M. (2018, June 1). Figures of the week: Informal employment in African cities. Retrieved January 17, 2019, from Brookings website: <https://www.brookings.edu/blog/africa-in-focus/2018/06/01/figures-of-the-week-informal-employment-in-african-cities/>
- The World Bank. (2010). *Mainstreaming Gender in Road Transport: Operational Guidance for World Bank Staff* (No. 56954). Retrieved from <http://documents.worldbank.org/curated/en/669831468330934298/pdf/569540NWP0Tran10Box353751B01PUBLIC1.pdf>
- The World Bank. (2011). *Making Transport Work for Women and Men: Challenges and Opportunities in the Middle East and North Africa*. Retrieved from <http://siteresources.worldbank.org/EXTTTSR/Resources/463715-1322323559362/Gender-Transport-MENA.pdf>
- The World Bank. (2019a). *Integrated and Resilient Urban Mobility Project* (No. PIDISDSA23929). Retrieved from <http://documents.worldbank.org/curated/en/405691554339834112/text/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Integrated-and-Resilient-Urban-Mobility-Project-P164353.txt>

- The World Bank. (2019b). The Little Data Book on Gender: Online Tables. Retrieved December 8, 2019, from https://databank.worldbank.org/widgets/reportwidget.html?Report_Name=The-Little-Data-Book-on-Gender-Online-Tables&Id=f3945d0c
- The World Bank. (2019c). The World Bank in Gender [Text/HTML]. Retrieved December 8, 2019, from World Bank website: <https://www.worldbank.org/en/topic/gender>
- The World Bank, & Gwilliam, K. M. (Eds.). (2002). *Cities on the move: A World Bank urban transport strategy review*. Retrieved from <http://documents.worldbank.org/curated/en/928301468762905413/pdf/Cities-on-the-Move-A-World-Bank-Urban-Transport-Strategy-Review.pdf>
- Thiam, O. (2016, August 12). *In Dakar, the transport sector's formalisation began with the renewal of rolling stock*. Retrieved from <https://www.uitp.org/news/dakar-transport-formalisation>
- Tulu, G. S., Haque, Md. M., Washington, S., & King, M. J. (2015). Investigating Pedestrian Injury Crashes on Modern Roundabouts in Addis Ababa, Ethiopia. *Transportation Research Record*, (2512), 1–10. <https://doi.org/10.3141/2512-01>
- Ugboma, O. (2018, July 23). *Interview with Dr. Ogochukwu Ugboma (Lagos State University – School of Transport)* [In-person].
- Uteng, T. P., & The World Bank. (2011). *World Development Report 2012: Gender Equality and Development*. Washington, D.C.
- Venter, C., Vokolkova, V., & Michalek, J. (2007). Gender, Residential Location, and Household Travel: Empirical Findings from Low-income Urban Settlements in Durban, South Africa. *Transport Reviews*, 27(6), 653–677. <https://doi.org/10.1080/01441640701450627>
- Williams, S., White, A., Waiganjo, P., Orwa, D., & Klopp, J. (2015). The digital matatu project: Using cell phones to create an open source data for Nairobi's semi-formal bus system. *Journal of Transport Geography*, 49, 39–51. <https://doi.org/10.1016/j.jtrangeo.2015.10.005>
- Zogo, V. O., & Epo, B. N. (2016). Assessing Gender Inclusion in Cameroon's Rural Transport. *Journal of African Transformation*, 1(2), 129–144.

2020

2nd Place

Sidewalk Maintenance and Neighborhood
Income Across Los Angeles, CA:

An Analysis Two Years into the Willits
Settlement Period

Katherine Stiegemeyer, University of California, Los Angeles

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

Abstract

Following the settlement of the disability class action lawsuit *Willits v. City of Los Angeles*, the City of Los Angeles, CA, agreed to pay out over \$1.3 billion over a 30-year period to repair its sidewalk infrastructure. The city has also passed a policy of fix-and-release regarding sidewalk repairs. Under this policy, after a city-done repair and following a warranty period, the responsibility for any subsequent sidewalk damage is transferred to the adjacent property owner. Given this situation and the potential burden such a policy might place on low-income residents, the analysis here attempts to answer the question of whether low-income areas in Los Angeles have access to worse quality sidewalks than do high-income areas. Using a sidewalk Damage Severity Matrix developed by the LA Bureau of Engineering, I performed walk audits of sidewalks in ten randomly selected Census block groups across LA. The results show that low-income block groups had, on average, greater levels of sidewalk unevenness. This finding is suggestive of a potential trend that could lead to travelers in low-income areas – and particularly those with a mobility disability – having reduced accessibility due to poorer sidewalk quality. The results highlight the need for further research to better understand this relationship at this critical juncture in the future of LA’s pedestrian rights-of-way. I conclude with the recommendation that the City of Los Angeles move toward incorporating sidewalks as a part of its critical infrastructure long-term and treat them with the same priority that is given to street maintenance.

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

Introduction

In 2010, the City of Los Angeles, CA, was sued in a class action lawsuit (Willits v. City of Los Angeles) by residents with mobility disabilities over the quality and maintenance of the city's sidewalks and other pedestrian rights-of-way. The plaintiffs claimed "systemic and pervasive discrimination ... through the denial of meaningful access to the City's curb ramps, sidewalks, crosswalks, pedestrian crossings, and other walkways" (Willits v. City of Los Angeles, Complaint, p. 3). In settling the case, the City agreed to pay out over \$1.3 billion over a 30-year settlement period to repair its inadequate sidewalk infrastructure (Willits v. City of Los Angeles, Settlement Agreement, p. 21).

Sidewalks are an integral form of daily mobility for all (Aghaabbasi, 2017). Even non-walk trips typically start or end with a short walk (i.e. to enter a vehicle) that includes sidewalk access. And people with mobility disabilities in particular require sidewalks to be present and to meet certain standards for slope and connectedness (United State Department of Justice, 2010). Despite the importance of walking, there is relatively scant literature available on the presence, maintenance, and quality of sidewalks across cities or metropolitan areas, especially in regards to the potential for sidewalk quality to be an indicator of spatialized transportation inequity.

The purpose of this research is to answer the question of whether there is a difference in the accessibility of sidewalks for people with mobility disabilities by area income two years into the settlement period. In the analysis that follows I analyze this relationship through walk audits of sidewalks in both low- and high-income Census block groups across the City of Los Angeles. The results show that low-income block groups had on average a higher sidewalk unevenness score of 67.6 compared to high-income block groups at 48.0, where a higher score indicates a greater degree of unevenness.

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

This research is important because sidewalk repairs are often costly; the national average is \$2,250 and likely more in Los Angeles according to cost guides on Fixr (Repair Sidewalk Cost, n.d.). Despite this, they are the responsibility of the adjacent property owner under California state law (Moore, 2018). However, in 1973 the City of Los Angeles accepted a \$2 million dollar federal grant for sidewalk repairs and passed an ordinance taking responsibility for fixing sidewalks damaged by tree roots (McNary, 2015). They did so under the logic that, for the most part, homeowners had not been the ones to plant the trees causing the unevenness (“Who should foot the bill”, 2014). The grant money ran out within two years, and in the intervening four decades the City failed to adequately budget funds to keep up with necessary repairs (McNary, 2015). Lacking these funds, they have at points relied on programs that asked residents to help foot the bill. From 2005-2009, under the 50/50 Program, property owners split the cost of sidewalk repairs evenly with the city, and sidewalks along about 2,000 parcels saw repairs (McNary, 2015).

Following the settlement, the city instated a Sidewalk Repair Rebate Program that ran from December 2016 up to July 2018 under which residents could receive up to \$10,000 (increased from an initial value of \$2,000) for sidewalk repairs adjacent to their property. Under the Rebate Program, the City would send a surveyor to assess a resident’s sidewalk claim and make an estimate. The property owner could then receive up to the amount estimated (and no more than \$10,000) after their completion of the repair (Rebate Program Rules and Regulations, n.d.). Furthermore, in 2016 the LA City Council voted to adopt a policy of “fix-and-release” regarding sidewalks to undo the effects of the 1973 ordinance and fully transfer back sidewalk responsibility to property owners long-term (Barragan, 2016). Under the policy, sidewalks that are repaired by the city are under warranty for a specified number of years after which point the

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

responsibility for any further damage rests solely on the adjacent property owner (Iwasaki, 2017). Given these circumstances and the severity of the sidewalk problem in Los Angeles, it is important to consider whether travelers, and especially disabled travelers, in low-income areas of the city have access to equitable quality sidewalks when compared to travelers in higher-income areas of the city.

Literature Review

There are numerous studies on the topic of “walkability” (Stafford and Baldwin, 2018). Some of the existing studies have analyzed walkability across areas based on those areas’ different income or racial/ethnic makeup (Chia-Yuan, 2014; Huston et al., 2003; Kelly et al., 2007; Zhu and Lee, 2008). And there are many studies that have examined pedestrian-automobile crashes and how the burden of these injuries/fatalities is disproportionately concentrated in low-income and minority neighborhoods (Chia-Yuan, 2014; Loukaitou-Sider et al., 2007; Osama and Sayed, 2017). Some of these studies include street-level walkability measures such as sidewalk quality in their analysis comparing walkability and/or crashes across areas (Boarnet et al., 2005; Kelly et al., 2007; Loukaitou-Sideris et al., 2007; Osama and Sayed, 2017; Zhu et al., 2008).

However, more often research on the walking environment completely overlooks the needs of travelers with differing ability levels to not only be safe from crashes, but also to have basic access to the transportation infrastructure, in this case the sidewalks (Stafford and Baldwin, 2018). Furthermore, with particular relevance to the research at hand, I found only two studies – Kelly et a., (2007) and Bise et al., (2018) – that specifically addressed sidewalks as a potential measure of infrastructure inequity across a segregated city. From here, the literature review will discuss what the research has found in regards to sidewalks, walkability, and disparities

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

generally, before I provide a more detailed discussion of the two studies on sidewalk quality and equity.

The literature has demonstrated consistently that pedestrians in lower-income and majority non-White neighborhoods are worse off in terms of street-level walkability and safety. In a study of 162 Census tracts in Austin, TX, and using Census commute mode data as their trip data, Chia-Yuan et al. (2014) found that areas with a high percentage of Hispanic residents generated more walking trips (to work) and greater pedestrian crash rates than areas with a high percentage of White residents. In their study, the poverty rate and the percent Hispanic were the top two variables associated with walk trips over any built environment variables. Furthermore, they found that sidewalk completeness – meaning a fully connected sidewalk network – was positively correlated with commute walk trips and pedestrian crashes. The study thus implies that while a complete sidewalk network might exist in majority Hispanic neighborhoods, likely because they are located in denser areas of the city with greater land use mix, there could be an issue of the quality and maintenance of the pedestrian infrastructure leading to greater exposure to safety risks for walkers in these areas. Supporting this hypothesis, Zhu et al. (2008) found that schools in Austin, TX, with higher rates of poverty and Hispanic students had greater walkability in terms of completed sidewalk networks, but lower street-level walkability in terms of “sidewalk maintenance” (p. 285). It should be noted that while this study assessed “sidewalk maintenance,” the authors make no reference to their methods for doing so, nor do they refer to the potential for sidewalks not to be ADA compliant. Therefore, it is not clear whether these concerns were included in their evaluation.

Investigation into sidewalks and walkability often has focused on filling gaps in the sidewalk network – i.e. increasing completeness – to improve pedestrian safety (Osama and

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA:
An Analysis Two Years into the Willits Settlement Period

Sayed, 2017). But these studies show, however, that the mere presence of sidewalks is not always enough and that pedestrian infrastructure quality does matter for travelers. In evaluating California's Safe Routes to School Legislation, Boarnet et al. (2005) found that sidewalk improvement projects through the program – which could include installation of curbs or curb cuts as well as filling gaps in the sidewalk network (p. 135) – led to an increase in walking to school by children whose routes passed the implemented projects, according to surveys of parents. Furthermore, research has shown inequities in the sidewalk infrastructure across the City of Los Angeles leading to disparate outcomes in pedestrian-automobile collisions/fatalities (Loukaitou-Sideris et al., 2007).

In their investigation of both the spatial distribution of collisions across Los Angeles and the influence of “socio-demographic, density, land use, and traffic characteristics” on collisions, Loukaitou-Sideris et al. (2007) found that the worst pedestrian-collision intersections tended to be located in neighborhoods with high rates of poverty and minority residents. In accordance with the studies coming out of Austin, TX, the researchers asserted that this is likely because residents of these neighborhoods are more likely to walk or use transit to complete trips (p. 349). They performed case studies of high-collision intersections and found that these areas tended to have long blocks with few stops approaching the intersection, as well as narrow sidewalks and overall poor visibility. Loukaitou-Sideris et al. (2007) recommended that the City “provide the appropriate infrastructure for safe walking,” but made no comment on the quality of sidewalk infrastructure itself other than that it be of a greater width (p. 349).

Only two studies specifically focus on sidewalks and sidewalk quality as their main variables of interest in assessing spatialized equity issues related to race or income. Set in St. Louis County, MO, Kelly et al. (2007) performed audits of 1,780 street segments from 210

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

randomly selected block groups to assess the extent to which the poverty rate and the racial distribution were associated with sidewalk walkability and “physical disorder” (e.g. abandoned/vacant lots and the presence of trash or graffiti) (p. 979). Their study assessed walkability via “levelness and condition of the sidewalks (e.g. alignment, cracks, broken sections, weeds)” and the degree of obstructions present on the sidewalk (“e.g. garbage cans, cars, trees”) (p. 979). The authors (2007, p. 982) found that predominantly Black block groups were 38 times more likely to have “a lot” of unevenness in their sidewalks and 15 times more likely to have “a lot” of obstructions than block groups that were predominantly White. They did not find, however, a positive relationship between the poverty rate and walkability. Their results suggest differential investments in communities based on race, whether historical or current, that lead to a less traversable pedestrian environment for residents.

Building on this study, Bise et al. (2018) explicitly analyzed sidewalk quality as a measure of racialized transportation infrastructure inequity in the “micropolitan” town of Starkville, MS (p. 42). The authors focused on race at the Census block level. They mapped and recorded all 28 miles of the city’s sidewalk infrastructure for ADA compliance (for contrast, Los Angeles has approximately 11,000 miles of sidewalk infrastructure [Iwasaki, 2017]). They used the ratings “very poor, poor, fair, good, and excellent” in accordance with ADA qualifications where, for context, a rating of “fair” equates to a sidewalk that is “ADA compliant, but may need repair; easily used by most pedestrians; few obstructions” (p. 44). In first analyzing whether the town’s residents had equitable access along racial lines, the authors found that access to sidewalks of any quality was relatively equal across the races. However, in analyzing the quality of sidewalks, the authors found significant disparities. While 44.9% of the blocks served by sidewalks were majority non-White, only 22.6% of ADA-compliant sidewalks were adjacent to

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

majority non-White blocks. 69.1% were adjacent to majority White blocks. Their results also showed a significant positive relationship between the percentage of Black residents on a block and access to sidewalks rated “poor” or below (p. 50). Despite relatively equal access to sidewalks across racial lines, the authors found that it was the quality of these sidewalks that reflected the social histories of racial discrimination and disinvestment across their town.

What is clear from the existing literature is that research on inequities in pedestrian safety with a focus on collisions and fatalities, while wholly necessary and important, is not sufficient for assessing the walk- or rollability of the pedestrian environment for travelers of all ability levels. The research has shown that differences in the pedestrian built environment exist across cities and regions, and that low-income and minority neighborhoods tend to experience greater safety risks from their environments leading to worse health and safety outcomes. However, there is a lacuna in the research literature, and especially the Urban Planning literature, on how cities are responding to the sidewalk maintenance needs of some of their most vulnerable travelers: the mobility disabled, and especially the low-income mobility disabled. The limited research on sidewalk quality and maintenance as a measure of inequity has shown a correlation between the proportion of neighborhood residents who are Black and the decreasing quality of their sidewalks. The research that follows here continues the much-needed work in this area by analyzing sidewalk quality across Los Angeles and its relation to residents’ income following the implementation of one of the largest ever sidewalk infrastructure investment programs.

Research Methodology

Selection

To answer the research question, I began by stratifying Census block groups in the City of Los Angeles by median income. I selected block groups because they were the smallest spatial

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

unit for which data on median income were available. Since I could not survey the entire sidewalk network for an area, the smaller the spatial unit of analysis the more likely the surveyed

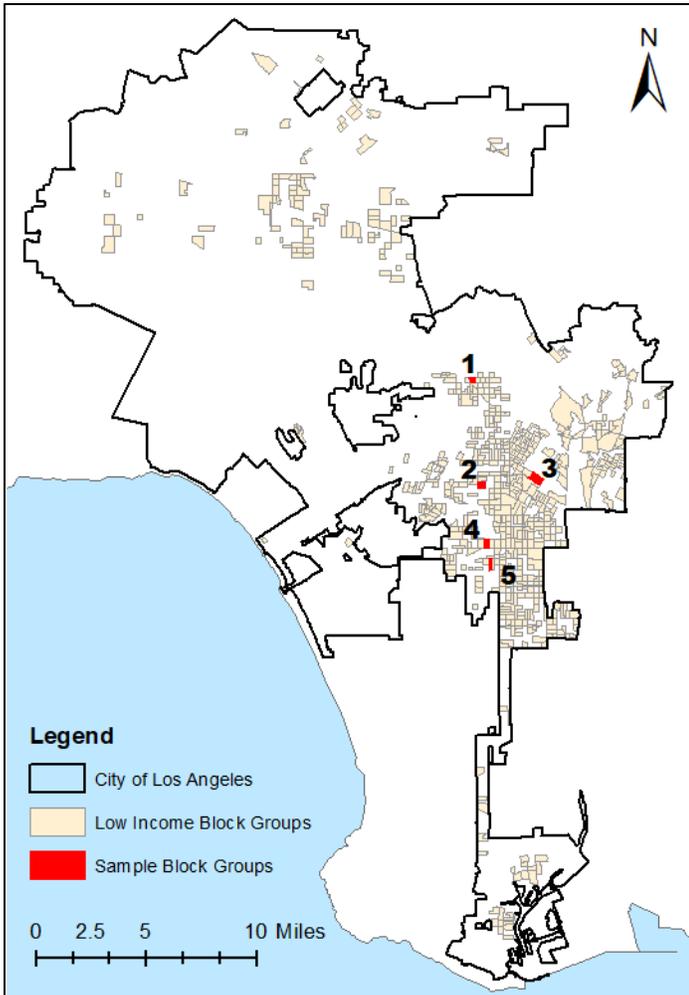


Figure 1: Block groups in the bottom quartile of median income in LA City and the 5 sampled block groups

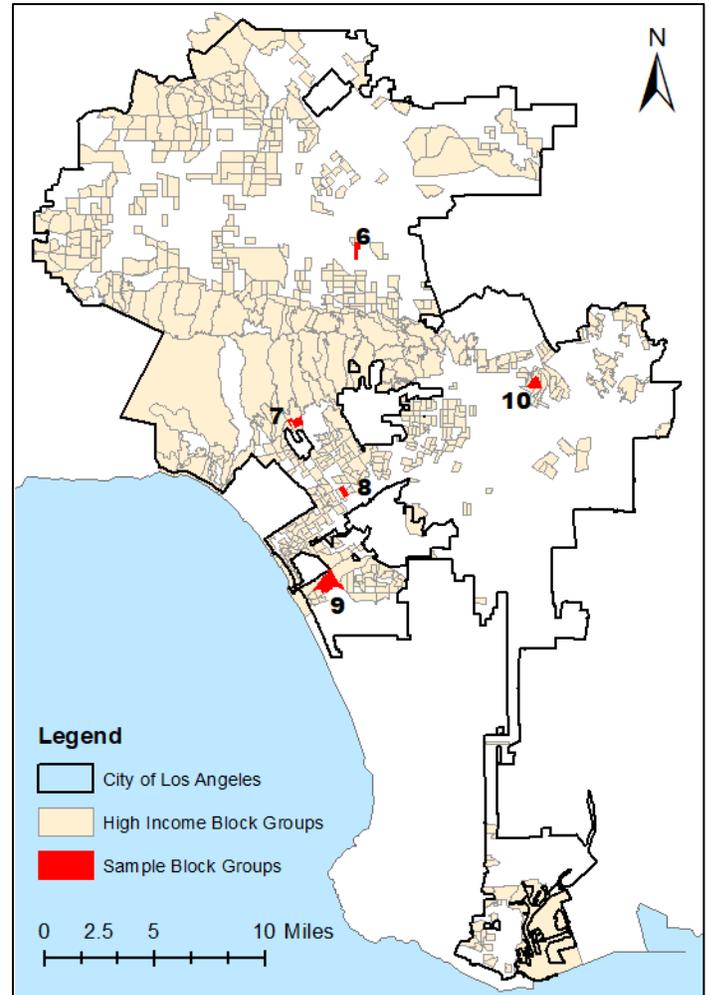


Figure 2: Block groups in the top quartile of median income LA City and the 5 sampled block groups

sidewalks would be similar to the rest of that area’s network. After separating block groups into quartiles by median income, I then randomly selected five block groups from the bottom quartile (hereafter low-income) and five block groups from the top quartile (hereafter high-income) using Excel. Median income in the low-income quartile ranged from \$5,682 to \$37,375 and in the high-income quartile from \$80,859 to \$244,844. Figures 1 and 2 show the location of the sample of block groups within LA.

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

Within each block group, I attempted to select sidewalk segments for auditing by selecting the Census blocks within each block group that were around the centroid of the block group. However, this created errors in the selection process as some blocks were still too large – over half a mile – to audit. In this situation, I tried to select segments of the block that appeared the most central to the eye. Furthermore, some block groups did not have sidewalks at their geographic centroid, and in this case I aimed to select the Census block most at the center of the block group’s existing street infrastructure. This method limits the random nature of the selection process.

I only audited sidewalk infrastructure on one side of the street. For most segments, I walked the side bordering the selected central Census block. For streets contained within a Census block, I walked the sidewalk on either the north or the east side of the street, depending on the direction of the street.

Measurement Tool

To measure the levelness of each block group’s sidewalks I used the Damage Severity Matrix (Table 1) developed by the City of LA Bureau of Engineering (BOE). BOE developed this tool to rank and prioritize sidewalk requests made through the Access Request Program in accordance with the Willits Settlement terms. For the purposes of this research I delegated 1 point to each incidence of sidewalk unevenness that fell within the bounds of those parameters considered as “Minor” by the city, 2 points for those considered “Moderate,” 3 for those considered “Severe,” and 4 for those considered “Very Severe.” I assessed segments along all three measurements – vertical displacement, cross-slope, and horizontal displacement – and assigned points based on the highest category that the segment reached in any one of these three measurements. For example, if a segment had a vertical displacement of 2 inches but no

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA:
An Analysis Two Years into the Willits Settlement Period

horizontal displacement and a cross-slope less than 2%, I would still assign 2 points to the segment.

Cross-slope is the slope of the sidewalk perpendicular to the direction of travel. I measured this using a level, which showed the degree of the angle, and I then converted this to percent slope to match the city’s matrix. For vertical and horizontal displacement, I used a measuring tape to measure the distance of the displacement. Furthermore, because the ADA requires 4 feet of width for an accessible corridor, I did not assign points to incidences of unevenness where there remained 4 or more feet of level, undamaged sidewalk width.

Damage Severity Matrix				
Severity Index	Vertical Displacement (Uplift)	Sidewalk Cross-slope	Horizontal Displacement (Cracking / Crumbling)	Possible Points
5 Very Severe	≥ 12"	≥ 20%	≥ 6" gap	40
4 Severe	< 12" to ≥ 6"	< 20% to ≥ 10%	< 6" to ≥ 3" gap	30
			≥ 50% cracking, chipping, flaking, or crumbling	
3 Moderate	< 6" to ≥ 1"	< 10% to ≥ 5%	< 3" to ≥ 1" gap	20
			< 50% to ≥ 25% cracking, chipping, flaking, or crumbling	
2 Minor	< 1" to ≥ 1/4"	< 5% to > 2%	< 1" to ≥ 1/4" gap	10
			< 25% cracking, chipping, flaking, or crumbling	
1 Very Minor	< 1/4"	≤ 2%	< 1/4" gap	0

Table 1: Sidewalk Damage Severity Matrix developed by LA City Bureau of Engineering. The point scale on the right was altered for the purposes of this study to a 0-4 scale.

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA:
An Analysis Two Years into the Willits Settlement Period

Findings and Discussion

To get final point values for each block group, I added together all instances of sidewalk unevenness for each group. I then divided this point value by the miles of sidewalk audited (measured through Google Maps) to get a normalized score for each block group, where a higher score indicates greater sidewalk unevenness. Table 2 shows the results of this process for each block group. Block group 10 in Silverlake has no score because, as is common in LA’s hillside communities, this neighborhood had no sidewalk infrastructure (Poston and Menezes, 2015).

The findings show that low-income block groups did have a higher average score (67.6) for sidewalk unevenness than did high-income block groups (48.0). However, the sample size of 9 block groups with a sidewalk score is very small and this difference in means is not statistically significant ($p = 0.2895$).

Low-Income						
Block Group	Neighborhood	Median Income	Total Population	Miles of Sidewalk Audited	Points	Score[±]
1	Hollywood	\$33,083	1,384	0.283801	19	66.9
2	Jefferson	\$34,286	1,369	0.354184	15	42.4
3	Fashion District	\$19,167	1,137	0.401877	22	54.7
4	South LA (55 th St)	\$25,694	2,261	0.573650	52	90.6
5	South LA (66 th St)	\$35,302	908	0.299650	25	83.4
Average:						67.6
High-Income						
Block Group	Neighborhood	Median Income	Total Population	Miles of Sidewalk Audited	Points	Score[±]
6	North Hollywood	\$80,994	1,211	0.458354	18	39.3
7	Westwood	\$244,844	842	0.311513	16	51.4
8	Palms	\$133,235	664	0.450076	38	84.4
9	Playa del Rey	\$155,375	1,174	0.822612	14	17.0
10	Silverlake	\$139,510	1,344	0.000000	N/A	N/A
Average:						48.0

Table 2: Sampled block groups showing final sidewalk unevenness scores.

*Score = Points/Miles of Sidewalk Audited

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period



Figure 3: Sidewalk infrastructure ends at an intersection in Palms (block group 8)

While it was not included in the BOE's Damage Severity Matrix, I also noted any absence of curb cuts at intersections during my audits. I found that there were missing curb cuts in the sidewalk infrastructure of every block group surveyed except for block group 4 in the Fashion District (and excluding block group 10). Furthermore, my results show that while higher-income areas could potentially have access to better quality sidewalk infrastructure, they are also more likely to have no sidewalk infrastructure. This is evidenced by Silverlake where there was no sidewalk infrastructure for the block group, and by Palms where the sidewalk network ended/started abruptly at multiple intersections, as seen in Figure 3.

There have been calls for an inventory to be taken of the City of LA's sidewalk network that includes sidewalk conditions (Meaney, 2017). While no such comprehensive inventory

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

currently exists, and would be a massive financial undertaking in and of itself – the merits of which have been debated (Linton, 2016) – these results suggest that there may indeed be an inequity in the quality of pedestrian infrastructure available to travelers in low-income areas. Not only is disability associated with poor economic outcomes (Meyer and Mok, 2018), but low-income households are also much more likely to lack access to a private vehicle (according to 2017 National Household Travel Survey data 70% of zero-vehicle households make less than \$25,000). This may explain why higher-income areas in Los Angeles are less likely to have a sidewalk network, as households with a disabled member find it easier to achieve automobility for their disabled household member. The findings also indicate that a disproportionately deteriorating sidewalk infrastructure in low-income areas may be of serious public concern regarding equitable mobility, especially under the City of LA’s planned fix-and-release policy. The results of this research indicate that a larger sample size of audited sidewalks is warranted to determine the potential equity concerns and impacts of the repairs and policy to come during the Willits Settlement period.

Limitations

The study’s largest limitation is its small sample size of only ten block groups (and only nine scores considering block group 10 was given no score). Such an extremely small sample size limits the opportunity to find statistically-significant results.

Furthermore, the study would benefit from a more rigorous selection and measurement methodology. In regards to selection, the study is limited by the non-random selection of street segments within the randomly selected block groups. Choosing an equal length of sidewalk to walk in each block group and randomizing the selected street segment would improve the reliability of the results.

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

In my audits I assigned point values to each incidence of sidewalk unevenness. However, this likely gave undue weight to sidewalk segments given a 1 or 2 compared to those given a 3 or 4 because 3s and 4s typically caused disruption over a greater distance of the sidewalk (Figure 4). In comparison, a section of sidewalk could receive many 1s or 2s in succession just because these disruptions were smaller (Figure 5). An improved methodology would group sidewalk segments by parcel rather than incidence, and give one score to the sidewalks of each parcel. Not only would this give more appropriate weight to segments rated as 3 or 4, but also makes sense practically considering that sidewalks are the responsibility of the parcel owner under California state law (and will be returned to this status under fix-and-release policy [Barragan, 2016]) and most sidewalk improvements happen at the parcel level (McNary, 2015).



Figure 4: An incidence of unevenness given 4 points (block group 6, North Hollywood)

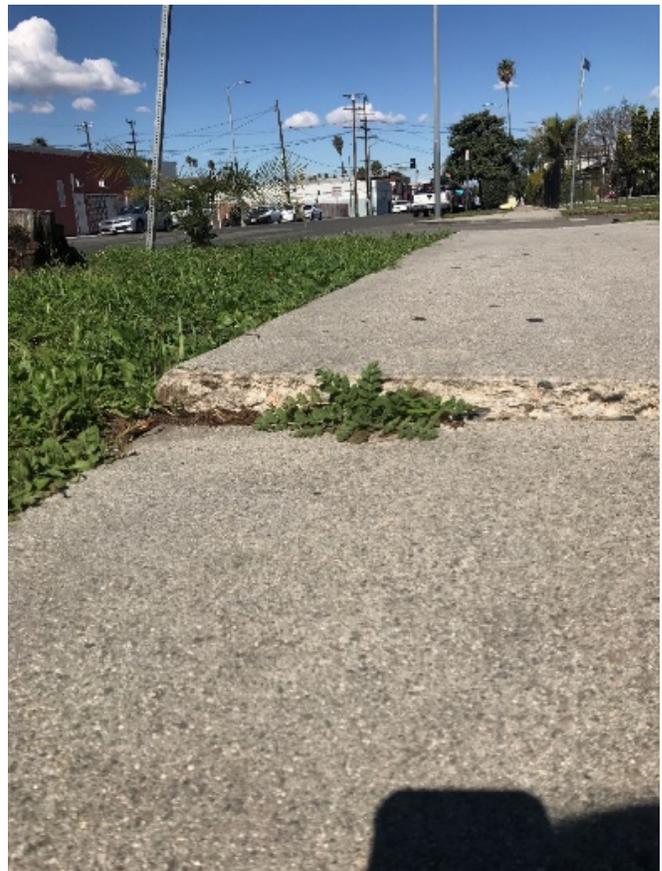


Figure 5: An incidence of unevenness given 1 point (block group 4, South LA)

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

These results are also limited by the fact that I did not differentiate sidewalk segments by the land use type of the adjacent parcel. It is possible that the maintenance and quality of sidewalks differs between residential, commercial, and mixed-use areas. Typically, as I observed in my audits, sidewalks on residential streets are narrower than those on larger commercial streets. This makes them more susceptible to becoming non-ADA compliant with the same amount of damage. In block group 3 in the Fashion District neighborhood, which was surrounded by commercial zoning, the sidewalks were very wide. As seen in Figure 6, this meant that there could be unevenness that did not affect the entire width of the sidewalk – leaving more than the required 4 feet of passable width for ADA compliance. It is possible that zoning is a



Figure 6: Wide sidewalk with unevenness that leaves >4 ft. of passable width (block group 3, Fashion District)

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

confounding variable in this analysis, and the strength of the results would be improved by controlling for land use – comparing commercial to commercial and residential to residential.

Furthermore, I did not account here for other measures of sidewalk accessibility. I limited my analysis to the structural quality of the sidewalks as this is what the city is liable to improve under the Willits Settlement. But sidewalks can also be obstructed by non-permanent objects such as cars, trash cans, construction facilities, dock-less scooters, or other debris. All of these can make sidewalks harder to access or inaccessible for pedestrians with and without mobility disabilities, though typically place a larger burden on those with mobility disabilities. While the city is also liable for regulating such obstructions, these are not included in the analysis here.

Policy Recommendations

Further research is needed to understand the relationship between area income and the quality and maintenance of sidewalk infrastructure. In addition to expanding the sample of sidewalks, this research should address the aspects discussed in the limitations section and implement a two-person auditing system to increase internal validity (Zhu and Lee, 2008; Kelly et al., 2007). Further research should also analyze the City of LA's data on where sidewalk requests have been received and where repairs have been implemented, as soon as these data are available. Doing so will provide a better framework for understanding the current status of sidewalk infrastructure in Los Angeles as well as how the city has been responding to the demands, increasing our understanding of the potential spatialized equity issues at play.

Acknowledging the need for further research, the results of this study are still suggestive of a potential inequity for low-income residents in accessing a high-quality sidewalk network. Based on these results I recommend that the City of Los Angeles re-evaluate their policy of fix-and-release to be implemented alongside the Willits Settlement repairs. The fix-and-release

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

policy was passed to avoid a situation similar to what happened in the decades following the 1973 ordinance and to reduce the burden on the city of trip-and-fall lawsuits. However, this plan allows the city to avoid its responsibility to pedestrians of all ability levels. Instead, the city should work to incorporate sidewalks and their funding into a comprehensive transportation plan along with streets and transit. This view has been espoused the LA-based pedestrian advocacy group Investing in Place (Iwasaki, 2017).

In order to create a truly equitable and accessible transportation network we must fund our most basic of transportation infrastructure, the sidewalk. As one option, Investing in Place recommends that funding from Measure M and SB1 be put towards sidewalks in the future (Iwasaki, 2017). If the city wants to continue to claim a commitment to pedestrian-oriented and safe environments (“Mayor Garcetti Launches Complete Streets Program”, 2018), sidewalks must be prioritized in the same manner as roadways. No one would suggest that we make maintenance of travel lanes for cars a responsibility of adjacent property owners, so we must ask why this is the solution for pedestrian rights-of-way. Such a policy disproportionately burdens low-income neighborhoods with the cost of maintaining a public right-of-way of which they are likely to be in greater need, as evidenced by the lack of sidewalks in some of the high-income areas in this study and by their lower rates of car ownership.

In an interview, Jessica Meaney (2019), the executive director of Investing in Place, described the parameters of the Willits Settlement as “the floor” of what could and should be done for the city’s sidewalks. Following from this, I recommend that the City of Los Angeles look into incorporating equitable use design concepts into their program of sidewalk repairs. As Aghaabbasi et al. (2017) discuss, equitable use is a concept under universal design. Where accessibility is oriented towards regulations to establish a minimum compliance necessary to

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA: An Analysis Two Years into the Willits Settlement Period

accommodate disabled travelers, universal design is that which accommodates the widest range of people across their lifetime. For sidewalks, Aghaabbasi et al. (2017) recommend that such a design practice incorporate firm and non-slip surfaces and tactile pavement to warn of changes in level and direction, along with standard slope, adequate width, and curb ramps. These are in addition to amenities such as appropriate height street seating furniture with back and arm supports, public toilets facilitated by handrails, and wheelchair/child-accessible drinking fountains (p. 5).

Clearly, both of these recommendations require a paradigm shift in the direction that the City of Los Angeles is taking their sidewalk planning. Both call for a reconceptualization of sidewalk infrastructure as critical public space. This is the opposite of what will happen under the fix-and-release policy, where sidewalks will become a private rather than public responsibility. Los Angeles must seize on the opportunity presented by the Willits Settlement to fully re-evaluate how it addresses the city's most basic travel infrastructure and move towards a policy that will ensure full accessibility for all travelers in all areas of the city.

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA:
An Analysis Two Years into the Willits Settlement Period

References

1. Aghaabbasi, M., Moeinaddini, M., Asadi-Shekari, Z., Zaly Shah, M. (2017). The equitable use concept in sidewalk design. *Cities*,
2. Barragan, B. (2016, March 29). Los Angeles Passes Plan to Fix its Bad Sidewalks. *Curbed Los Angeles*. Retrieved from: <https://la.curbed.com/2016/3/29/11327554/los-angeles-sidewalk-repair>
3. Bise, R.D., Rodgers, J.C., Maguigan, M.A., Beaulieu, B., Keith, W. Maguigan, C.L., and Meng, Q. (2018). Sidewalks as Measures of Infrastructure Inequities. *Southeastern Geographer*, 58(1), 39-57.
4. Boarnet, M.G., Anderson, C.L., Day, K., McMillan, T., and Alfonzo, M. (2005). Evaluation of the California Safe Routes to School Legislation. *American Journal of Preventative Medicine*, 28, 134-140.
5. CBS Los Angeles. (2017, August 1). LA to reimburse property owners up to \$10K for sidewalk repairs. Retrieved from <https://losangeles.cbslocal.com/2017/08/01/la-sidewalk-repair-rebate/>
6. Chia-Yuan, Y. (2014). Environmental supports for walking/biking and traffic safety: Income and ethnicity disparities. *Preventative Medicine*, 67, 12-16.
7. Huston, S.L., Evenson, K.R., Bors, P., and Gizlice, Z. (2003). Neighborhood Environment, Access to Places for Activity, and Leisure-time Physical Activity in a Diverse North Carolina Population. *American Journal of Health Promotion*, 18, 58-69.
8. Iwasaki, N. (2017, October 18). It's Time to Stop Trippin': Fixing the City of LA's Sidewalks. Investing in Place. Retrieved from <https://investinginplace.org/2017/10/18/its-time-to-stop-trippin-fixing-the-city-of-las-sidewalks/>

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA:
An Analysis Two Years into the Willits Settlement Period

9. Kelly, C.M., Schootman, M., Baker, E.A., Barnidge, E.K., and Lemes, A. (2007). The association of sidewalk walkability and physical disorder with area-level race and poverty. *Journal of Epidemiology and Community Health*, 61, 978–983.
10. Linton, J. (2016, March 15). Some Benefits and Some Drawbacks of L.A. City’s Sidewalk Repair Plan. Streetsblog LA. Retrieved from:
<https://la.streetsblog.org/2016/03/15/some-benefits-and-drawbacks-of-l-a-citys-sidewalk-repair-plan/>
11. Loukaitou-Sideris, A., Liggett, R., and Sung, H. (2007). Death on the Crosswalk: A Study of Pedestrian-Automobile Collisions in Los Angeles. *Journal of Planning Education and Research*, 26, 338-351.
12. Mayor Garcetti Launches Complete Streets Program (2018, June 23). Retrieved from:
<https://www.lamayor.org/mayor-garcetti-launches-complete-streets-program>
13. McNary, S. (2015, March 2). Why LA won’t be fixing your sidewalk anytime soon. *KPCC – Southern California Public Radio*. Retrieved from:
<https://www.scpr.org/news/2015/03/02/50086/why-l-a-won-t-be-fixing-your-sidewalk-anytime-soon/>
14. Meaney, J. (2019, March 11). Phone interview.
15. Meaney, J. (2017, August 7). Updates from the City of LA’s Sidewalk Citizen Advisory Committee. Investing in Place. Retrieved from:

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA:
An Analysis Two Years into the Willits Settlement Period

<https://investinginplace.org/2017/08/07/updates-from-the-city-of-las-sidewalk-citizen-advisory-committee/>

16. Meyer, B.D. and Mok, W.K.C. (2018). Disability, earnings, income and consumption. *Journal of Public Economics*, 1-19. Doi: 10.1016/j.jpubeco.2018.06.011
17. Moore, S. (2018, August 24). Pricey sidewalk repairs are homeowners' responsibility in California. *ABC10*. Retrieved from <https://www.abc10.com/article/news/local/pricey-sidewalk-repairs-are-homeowners-responsibility-in-california/103-587393992>
18. National Household Travel Survey (2017). U.S. Department of Transportation Federal Highway Administration. Retrieved from: <https://nhts.ornl.gov/>
19. Osama, A. and Sayed, T. (2017). Evaluating the impact of connectivity, continuity, and topography of sidewalk network on pedestrian safety. *Accident Analysis and Prevention*, 107, 117-125.
20. Poston, M. and Menezes, R. (2015, June 27). City of L.A. slow to repair sidewalks despite complaints and injuries. *Los Angeles Times*. Retrieved from: <https://www.latimes.com/local/california/la-me-sidewalks-20150628-story.html>
21. Rebate Program Rules and Regulations. (n.d.). Safe Sidewalks LA. Retrieved from: <http://sidewalks.lacity.org/rebate-program-rules-and-regulations>
22. Repair Sidewalk Cost (n.d.). Fixr. Retrieved from: <https://www.fixr.com/costs/repair-sidewalk>
23. Stafford, L. and Baldwin, C. (2018). Planning Walkable Neighborhoods: Are We Overlooking Diversity in Abilities and Ages? *Journal of Planning Literature*, 33, 17-30.
24. United States Department of Justice. (2010). 2010 ADA Standards for Accessible Design. <https://www.ada.gov/regs2010/2010ADASTandards/2010ADAstandards.htm>

Sidewalk Maintenance and Neighborhood Income Across Los Angeles, CA:
An Analysis Two Years into the Willits Settlement Period

25. Who should foot the bill for L.A.'s sidewalk repairs? (2014, February 23). *Los Angeles Times*. Retrieved from: <http://articles.latimes.com/2014/feb/23/opinion/la-ed-sidewalks-20140223>
26. *Willits v. City of Los Angeles* (2010). Complaint. August 4, 2010.
27. *Willits v. City of Los Angeles* (2010). Settlement Agreement and Release of Claims. January 8, 2016.
28. Zhu, X. and Lee, C. (2008). Walkability and Safety Around Elementary Schools Economic and Ethnic Disparities. *American Journal of Preventative Medicine*, 34(4), 282-290.

2020

2nd Place

Financing the Landside Access
Modernization Project at LAX

Sam Speroni, University of California, Los Angeles

Abstract

Los Angeles International Airport (LAX) is undertaking a major program of projects to upgrade its landside facilities and access for the first since it prepared for the 1984 Olympics. Scheduled for delivery in 2023, this Landside Access Modernization Program (LAMP) includes new parking and rental car facilities linked together and to the terminals by a new Automated People Mover, which will also connect with a light rail line currently under construction by Los Angeles Metro. Los Angeles World Airports (LAWA), the city agency that owns and operates LAX, is financing the LAMP through a series of public-private partnerships, which thus far have succeeded in bringing the program to its construction phase. This paper explains the uniqueness of LAX and details the planning and financing of the LAMP. The LAMP is vital for LAX’s future, but it is long overdue. In the context of federal airport planning practices, I recommend policy changes and initiatives that can improve landside airport planning so that future growing airports do not fall victim to difficulties similar to LAX’s past three decades.

***“Los Angeles is going places,
and LAX is helping us get there.”***

— Mayor Eric Garcetti, October 2018

1. Introduction

Los Angeles International Airport (LAX) is iconic. It is the world’s largest origin-destination airport and the country’s second-busiest. Its 1961 Theme Building is the second-most recognized landmark in Los Angeles after the Hollywood sign (Los Angeles Conservancy, 2019). Yet perhaps equally popular is the dread with which Angelenos speak of getting to LAX on the ground.

The Landside Access Modernization Program (LAMP) is a \$5.5-billion series of projects intended to add ground transport access capacity to LAX while both streamlining operations tangential to the

airport and improving the traffic situation on airport grounds and in the surrounding area. The LAX of the future will have an Automated People Mover ferrying passengers between the terminals and new parking and rental car facilities. With a scheduled 2023 delivery, the LAMP has just begun construction in earnest, with the demolition of a former restaurant to make way for its new elevated guideway in January 2019 (LAWA, 2019c).

In this paper I first provide an overview of the situation in Los Angeles and at LAX leading into the LAMP. Then I detail the LAMP's project elements and how they were financed, with an eye toward the context of aviation finance. I conclude with a discussion of the strengths and weaknesses of current airport planning and finance in the United States and provide two policy recommendations for strengthening this sector of transportation planning. Ultimately, I argue that the LAMP overcomes traditional airport planning barriers through its creative financing structure to become a model for financing landside improvements, but that the barriers the LAMP faced reveal a need for a more passenger-centered approach to airport planning.

2. Defining LAX

2.1. Changes and Growth in Los Angeles

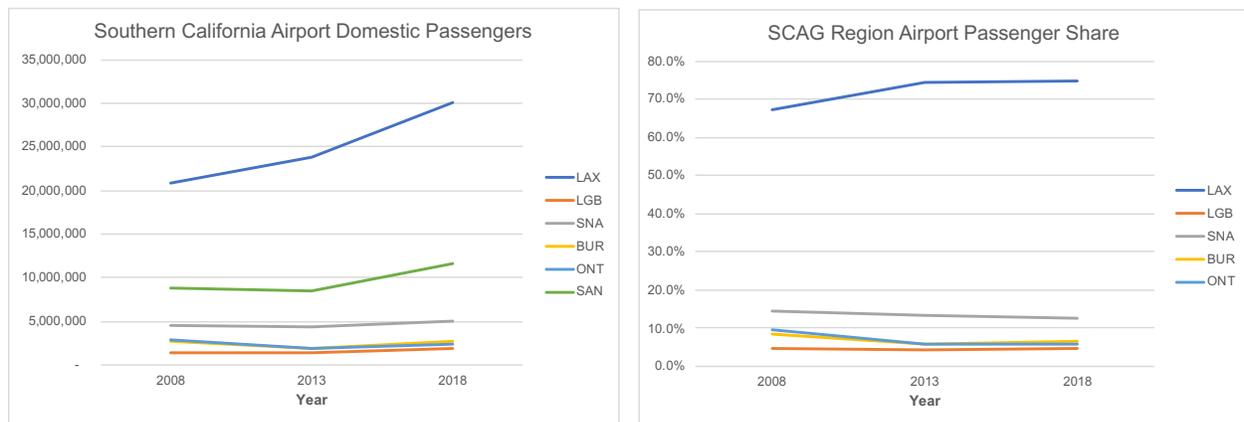
Southern California has experienced dramatic growth in the past four decades. In 1980, the population of the Los Angeles-Long Beach-Anaheim Metropolitan Statistical Area (MSA) was about 9.5 million. By 2018, that population had soared to an estimated 13.3 million—a 41-percent increase (US Census Bureau, 2019). In a similar timeframe, vehicle ownership in the Southern California region has also soared (Manville, Taylor, & Blumenberg, 2018). Between 1990 and 2000 the region added 1.8 million people while adding 456,000 household vehicles; between 2000 and 2015 the region added 2.3 million people but added 2.1 million vehicles. Those many more people and many, many more vehicles are still using the same landside access paths to LAX as Angelenos were before the 1984 Summer Olympics.

2.2. Changes and Growth at LAX

Despite this intense population growth, LAX saw no major passenger-serving projects between 1984 and the groundbreaking of the new Tom Bradley International Terminal in 2010, which became the first phase of the Modernization Project (LAWA, n.d.). During that time, the FAA installed a new control tower in 1996, and in 2000 LAX installed its colorful pylon display at the Central Terminal Area (CTA) entrance—but both of these are features that passengers only *see*. Terminals and access paths remained roughly the same, while passenger traffic soared.

As Figure 1 shows in its left graph, passenger travel at most of the six biggest passenger airports in Southern California (SCAG Region and San Diego County) increased, with LAX seeing the steepest change. Correspondingly, the right graph shows LAX's share of the passenger traffic among the five SCAG region airports (this time excluding San Diego) increased as well. Los Angeles World Airports (LAWA) officials attempted to head off growth from spiraling beyond their control by increasing its operations at then-LAWA-owned Ontario and by purchasing Palmdale in attempts to disperse traffic, but it struggled to get interest from both passengers and airlines for Palmdale, and it unsuccessfully attempted to subsidize airline routes and operations in Ontario (Alvarez & Yuvienco, 2019).

Figure 1: Southern California Air Passenger Statistics, 2008–2013 (Bureau of Transportation Statistics, 2019).



2.3. LAX is Unique Among Major US Airports

Beyond its passenger volume and its role in the regional economy, LAX is unusual among airports in the United States with regard to its relationship with the airlines. It is the only airport in the country that all five largest carriers designate as a hub or operating base, and it has an unusually even distribution of carrier shares. Table 1 shows the top 20 airports in the country by enplaned passengers, sorted by the standard deviation of carrier share among the seven largest carriers by operating revenue, lowest to highest. LAX is at the top with the most-evenly-distributed carrier share percentages, while American-dominated Dallas (DFW) is at the bottom. Despite handling the second-highest number of enplaned passengers and the highest number of originating passengers in 2018, Los Angeles is the only airport among the top 20 that does not have a carrier holding more than 20 percent of its overall passenger share.

This has three important financial implications for Los Angeles World Airports (LAWA), the Los Angeles city agency that operates LAX: competition, bargaining power, and investment incentive for airlines. All airlines at LAX are competing with one another to gain access to the country's largest originating passenger base and to the airport's strategic position on the Pacific Rim. This compels the airlines to work toward keeping up with each other (Bachman, 2016). If one airline improves its passenger experience or adds to its flight capacity, others will want to keep pace. As I will later explain, this led to the airlines financing some of the LAMP's terminal cores.

Consequently, the airport—rather than the airlines—has the upper hand in bargaining power, and this puts LAWA in a position to fulfill its own agenda for airport improvements more so than the agendas of the airlines. Whereas for airports like Charlotte (American), Atlanta (Delta), and Dallas (American) toward the bottom of Table 1 that are highly-concentrated hubs, LAX does not need to concede to the wishes of one single airline. At an airport like Charlotte, if American Airlines has specific wishes for airport development or landside transportation, it has enormous bargaining power in that

Table 1: Airports by Carrier Share Distribution Evenness, 2018. Bureau of Transportation Statistics (2019).

Airport	Code	2018			Operating Revenue (\$ Billions)							Standard Deviation Among Major Carriers			
		Enplaned Passengers	Rank	Originating Passengers	Rank	Percent Originating	Rank	Delta	American	United	Southwest*		Alaska	JetBlue*	Spirit*
							1	2	3	4	5	6	7		
Los Angeles	LAX	42,578,000	2	15,582,880	1	37%	17.4%	19.3%	15.3%	16.6%	8.1%			23.8%	0.04
Orlando	MCO	23,155,000	10	8,144,540	10	35%	15.0%	13.3%		27.4%		12.3%	10.7%	21.4%	0.07
Fort Lauderdale	FLL	17,584,000	18	6,199,580	20	35%	12.6%		8.0%	23.5%		22.6%	21.1%	12.3%	0.07
Boston	BOS	19,979,000	16	9,908,730	6	50%	14.0%	19.7%	11.9%	8.8%		31.7%		13.8%	0.09
Las Vegas	LAS	23,593,000	9	7,270,410	14	31%	9.1%	9.9%	8.9%	40.3%			9.7%	22.2%	0.14
San Francisco	SFO	27,770,000	7	10,332,410	5	37%	9.6%	9.0%	41.5%	8.7%	12.0%			19.2%	0.14
Chicago O'Hare	ORD	39,851,000	3	12,067,590	2	30%		26.1%	31.8%				4.7%	37.4%	0.14
Denver	DEN	31,341,000	5	11,621,080	3	37%	5.3%		30.5%	30.3%				33.9%	0.14
New York JFK	JFK	30,489,000	6	8,065,370	11	26%	30.4%	14.4%			4.0%	37.0%		14.2%	0.15
Seattle	SEA	23,977,000	8	9,762,520	7	41%	17.2%		7.0%	7.3%	41.9%			26.6%	0.16
Phoenix	PHX	21,603,000	13	7,857,720	12	36%	5.8%	37.0%	5.1%	36.5%				15.7%	0.18
Philadelphia	PHL	15,260,000	20	6,573,490	16	43%	5.9%	47.0%	4.0%	8.3%				34.8%	0.21
Newark	EWR	22,752,000	11	8,947,160	8	39%		6.3%	50.8%	5.0%		6.5%		31.3%	0.22
Detroit	DTW	17,412,000	19	6,318,250	18	36%	47.0%			5.2%			10.3%	37.5%	0.23
Houston Bush	IAH	21,140,000	14	5,482,490	21	26%		6.0%	53.2%					34.3%	0.27
Minneapolis	MSP	18,323,000	17	6,915,130	15	38%	52.9%	5.2%		5.8%				36.1%	0.27
Charlotte	CLT	22,264,000	12	3,962,100	30	18%	2.7%	60.2%		1.6%				35.5%	0.33
Atlanta	ATL	51,844,000	1	10,963,470	4	21%	72.7%	2.8%		10.7%			2.4%	11.4%	0.34
Miami	MIA	20,662,000	15	3,763,970	31	18%	11.7%	69.1%	6.0%					13.3%	0.35
Dallas/Fort Worth	DFW	32,780,000	4	8,927,710	9	27%	2.8%	68.3%					4.8%	24.9%	0.37

* Indicates low-cost carriers; Shaded Squares represent legacy carrier hub airports or low-cost carrier operating bases.

negotiation—no other airline's share is even in the double digits. This has also held true on a smaller scale for LAWA itself. When it operated Ontario International from 1985 to 2015 (Ornelas, 2018), Southwest was the dominant carrier, so whenever LAWA sought to enhance or expand operations there, it had to get Southwest's buy-in. Southwest, however, was only interested in investments that would improve the airport for themselves (Alvarez & Yuvienco, 2019).

Which brings up the third implication: loss of investment incentive for the airlines. Airlines are less motivated to become champions of whole-airport projects at LAX, because those projects will benefit airlines other than just themselves. This can be a negative and a positive for Los Angeles. On one hand, a major airline might not be as invested in landside improvements in Los Angeles as it might be in its fortress hub cities. For example, when Atlanta's Hartsfield-Jackson International Airport began a renovation and expansion program in 2016, they began at Delta's behest. Delta, which operates 73 percent of flights at the world's busiest airport, is fully running the airside modernization portion of the program, and it is collaborating with the city's Department of Aviation on the landside upgrades (Nelson, 2016). In Atlanta, Delta is leading the charge, but it is also calling the shots. On the other hand, LAWA does not need to fear a devastating loss of a single carrier. Charlotte's airport would cease to exist as it does today without American Airlines; without American, it would likely turn into a version of the bygone hub airports in Cincinnati (Delta, before its merger with Northwest) and Pittsburgh (US Airways). LAX would still have *four* other airlines with hubs there vying for space. This decentralization of airline power puts LAWA, not the airlines, squarely in the position of true leadership for LAX airport planning and development.

3. The LAMP: Why It Is Needed and What It Is

3.1. LAMP Rationale

The Land Access Modernization Program (LAMP)'s goal is to solve airport access inconsistency

caused primarily by severe traffic congestion in the Central Terminal Area (CTA) of LAX. According to Diego Alvarez, the Director of Development and Modernization for LAWA, the CTA cannot handle more than 6,000 vehicles per hour; when it reaches that point, it reaches vehicle paralysis. So in the course of planning for the LAMP, LAWA sought to improve the passenger experience by preventing these CTA movement breakdowns, and also to be able to grow the airport passenger volume by enabling more passengers to come into the airport at one time (Alvarez & Yuvienco, 2019).

LAWA estimates that 50 percent of its air travelers are driving to and from the airport by car, and expects that number to increase (2017b). As the 2004 LAX Master Plan requires to be done annually, in 2017 LAWA conducted a Traffic Generation Report to study trends in both the CTA and the surrounding areas. Using the heaviest volume day, Friday (Alvarez & Yuvienco, 2019), as a design day, Table 2 shows traffic counts entering and exiting the CTA at peak hours. Midday figures are all close to or beyond the 6,000 maximum figure, leading to enormous delays not just in driving to the LAX property but in traveling from, for example, the entrance to the CTA near Terminal 1 around to the Tom Bradley International Terminal.

This has created a situation in which it is nearly impossible for airlines to grow at LAX. Without the LAMP, increasing the number of passengers would have increased the number of vehicle arrivals in the CTA, a facility that is already pushed to its absolute limit. And airlines have wanted to expand at LAX.

Table 2: Central Terminal Area Traffic Counts by Direction, August 2017 (LAWA, 2017a).

Date	Inbound			Outbound		
	8 AM – 9 AM	11 AM – 12 PM	5 PM – 6 PM	8 AM – 9 AM	11 AM – 12 PM	5 PM – 6 PM
08/04/2017	4,743	5,682	4,971	4,440	5,904	5,395
08/11/2017	4,829	5,416	5,297	4,530	6,252	5,937
08/18/2017	4,753	5,790	4,792	4,560	6,263	5,376
08/25/2017	4,636	5,288	4,881	4,408	5,773	5,438
Average	4,740	5,544	4,985	4,485	6,048	5,537

“We haven’t been able to grow at LAX forever,” Southwest Airlines CEO Gary Kelley said in 2018 when hoping for the planned Concourse 0 (Sumers, 2018). Similarly, United also hopes to grow at LAX, especially its international offerings. United fully utilizes its gates at LAX, but as Chief Commercial Officer Andrew Nocella commented, “I believe in Los Angeles” (Sloan, 2018). United is working with LAWA to expand its facility footprint at LAX. “It’s a race that we’re in [with the other airlines] and not to be giving up on.”

What the LAMP allows is the increase of arriving passengers to LAX through its CTA primarily by increasing and streamlining the incoming passenger capacity through placing existing services in new facilities outside the CTA. The LAMP will do this through five interconnected elements, shown below in Figure 2: the Automated People Mover (APM), the Terminal Core APM stations, the Consolidated Rent-a-Car Facility (ConRAC), the Intermodal Transportation Facility – West (ITF-West), and corresponding roadway improvements. The APM will connect all facilities together, allowing those arriving by vehicle to park at ITF – West or the ConRAC and, for the first time, allow for passengers’ arrival by public rail transit through its connection to Los Angeles Metro’s Crenshaw Line and reconfigured Green Line.

Figure 2: Map of LAMP Non-Roadway Projects (LAWA, 2019b).



3.2. Program Elements

The APM is the centerpiece of the LAMP. It is a 2.25-mile fixed-guideway, fully-automated electric-powered train running 70 feet above the CTA and areas east, as illustrated in Figure 3. Trains will run free of cost to passengers every two minutes, with a ten-minute trip duration from the ConRAC to the west terminal cores. Construction began in early 2019, with an expected completion date of 2023 (LAWA, 2019a). Once operational, the APM will connect the other planned LAMP facilities with the terminals and with each other.

Figure 3: Rendering of APM, East Station and Terminal Cores Connection (LINXS, 2019)



Arriving passengers will begin this segment of their journey at one of seven terminal cores, new structures appended to the existing terminals that provide access to the APM. Because the APM operates a new level higher than the existing departures vehicle deck, these cores are needed to access that new fourth level. Figure 4 illustrates a cross-section of one of these cores, in which a pedestrian bridge on the left side of the image crosses over the departures vehicle deck and into the core, which houses elevators, escalators, entryways from the vehicle decks, and other airport operations space. The pedestrian bridges over the vehicle decks will connect passengers to the three APM stations—west, central, and east—and the existing CTA parking facilities (LAWA, 2018c).

Figure 4: Proposed Cross-Section of a Terminal Core (Austin Commercial & LAWA, 2019).



From there, the APM heads east, arriving first at the Intermodal Transportation Facility – West, a 4,700-stall parking garage with additional airport facilities. After the ITF-West, the APM will continue east to Airport Metro Connector Station, which will interface with LA Metro’s Aviation/96th Street Station on its new light-rail Crenshaw Line as well as other bus service. Finally, the APM will arrive at its eastern terminus at the ConRAC. ConRAC will bring all existing rental car facilities that serve LAX, which are presently strewn about the general airport area at disparate facilities, under one roof. Most importantly, it will eliminate the need for current rental car shuttle buses that add to the vehicular traffic in the CTA (LAWA, 2018e).

Lastly, the roadway improvements in the area are mostly related to interfacing the ITF-West and ConRAC with the existing street grid, as well as removing the existing facilities for rental car company lots and shuttles. In the CTA, the main roadway improvement will be the elimination of ground-level crosswalks between the parking facilities and the terminals; pedestrians will now use the bridges that connect the APM stations to the terminal cores.

3.3. Concurrent Projects

The LAMP is part of a \$14-billion overall LAX Modernization Project, \$8.5 billion of which will

be going to airside improvements. Many of these are terminal renovation projects, which are largely financed by the airlines but will be coordinated by and ultimately owned by LAWA. Most other airside projects are runway improvements and flight operations enhancements. Additionally, LA Metro is constructing its new Crenshaw Line, an 8.5-mile light rail route that will run from the Expo Line south via a connection to the APM to the Green Line just south of LAX. The Crenshaw Line is slated to open in mid-2020 (Hymon, 2018).

4. Airport Funding

4.1. Past and Present of American Airport Funding

Long before aviation accounted for \$2.6 trillion in global economic activity, aviation regulation took its cues in the early days from maritime regulation (Horonjeff, McKelvey, Sproule, & Young, 2010, p. 18). The Federal Government did not enter the airport finance foray until 1946 with the Federal Airport Act, which instituted the prohibition of any special tax on aviation facilities, fuel, operations, or businesses of which the proceeds are not entirely used for aviation purposes. The Eisenhower administration later federalized air traffic control in 1957 by creating the Federal Aviation Agency, which became the Federal Aviation Administration (FAA) upon the advent of the US Department of Transportation. Later, the Airport and Airway Revenue Act of 1970 allowed excise taxes on tickets, passengers, and fuel, and it redirected the tire tax on airplane tires from the Highway Trust Fund to the new Airway Trust Fund (Horonjeff et al., 2010, p. 23); additionally, it provided that airports must be publicly-owned to receive federal aid.

Beyond the existence of a trust fund and the prevention of revenue diversion, the US airport finance structure is vastly different from highway finance. Whereas highways are largely managed by the states, nearly all US airports are managed either by municipal governments or regional airport authorities; only Alaska, Hawaii, and Rhode Island manage airports at the state level (Horonjeff et al., 2010, p. 16).

This is likely attributable to the Federal Airport Act of 1946, which allowed federal grants to be issued directly to municipalities.

Today, the Airport and Airway Trust Fund (AAFT) provides all FAA funding for facilities and equipment, research and development, and the Airport Improvement Program (AIP). It also provides 91 percent of the operations budget, the balance of which is made up from the General Fund (FAA, 2018). Through the AIP, the FAA can allocate AAFT funds through grants to public agencies that represent airports in the National Plan for Integrated Airport Systems (NPIAS), covering between 75 and 80 percent of awarded project costs (FAA, 2019). LAWA elected not to use any AIP grants for LAMP; the planning group felt that the restrictions embedded in the grants would have impeded their flexibility in project design and limited their ability to creatively finance the projects (Alvarez & Yuvienco, 2019).

4.2. Past Issues with Funding at LAX

Los Angeles has a dramatic history in airport finance, much of which came during the period of no growth at LAX between the 1984 Olympics and the latest modernization project. In his book *Globalizing L.A.: Trade, Infrastructure, and Regional Development* (2004), Steven Erie provides a superb account of how Los Angeles Mayor Richard Riordan attempted to solve an annual budget deficit of between \$200 million and \$300 million by first attempting to privatize LAX and later trying to divert revenue from the Department of Airports (LAWA's predecessor agency). During his years as mayor 1993-2001, Riordan essentially sought to bleed dry both the airport and harbor departments, believing that it would not only solve the budget crisis but increase city revenue. Privatizing LAX, Riordan felt, would allow the city to gather annual lease payments. This was all happening at a time when LAWA was looking to expand LAX, a plan that was met with intense community and environmental opposition (Erie, 2004, p. 179).

In an effort to maximize this revenue diversion, the Riordan administration looked to the federal government and the FAA for relief from the restrictions on what revenue they could take in, especially

from concessions. Instead of granting this relief, the FAA actually intensified those restrictions. During this time, Riordan had also instructed LAWA to nearly triple its landing fees at LAX, which drastically irritated the airlines, who then put all their upgrade plans at LAX on hold. They paid the fees under protest so they could continue operations at LAX, until the Riordan administration finally relented and reduced the fees (Erie, 2004, pp. 182–183).

5. Financing LAMP

5.1. Division of Financing

The LAMP, if it goes on to have its intended effects, will decrease congestion on the surface streets surrounding LAX for airport goers and the general public alike by shifting would-be vehicle trips to the APM above and its outlying connected facilities. But to be clear, this is not the stated or intended purpose of the LAMP; nor can it be. As Diego Alvarez of LAWA explained, the “cleanest way to realizing the LAMP” was to keep all components directly connected to LAX airport operations (Alvarez & Yuvienco, 2019). All funding for the LAMP is specifically LAWA funding. So while the Crenshaw Line and 96th Street Station are concurrent and connected projects, LA Metro will finance them entirely with no contributions from LAWA.

In its early design stages, Metro experimented with bringing the Crenshaw Line onto airport property, instead of its off-property alignment that is under construction. LAWA told Metro that under those proposals it could only pay for the station, because even though the right-of-way would be on airport property and would bend westward specifically to serve airport passengers, the train would primarily be serving passengers traveling North-South in Los Angeles County and not specifically and exclusively to LAX.

Oakland International and Dulles International airports faced the same issue in their respective rail connection projects. When Oakland installed a cable APM from the Bay Area Rapid Transit (BART)

system, the Port of Oakland paid only for the station on airport property; BART financed the rest of the system and operates it (Alvarez & Yuvienco, 2019; Gosling, Wei, & Freeman, 2012). The Metropolitan Washington Airports Authority and Washington Metro took a similar approach in connecting Dulles by rail to downtown Washington, 26 miles to its east. Again, the airport financed only the terminal station on its property; Washington Metro financed the entire remainder of the line, even though in that case the line will terminate at the airport (Alvarez & Yuvienco, 2019; "Dulles Corridor Metrorail Project," 2019).

LAWA and Metro took a nuanced version of this same approach. Instead of ceding control of the on-airport rail to the local transit agency, LAWA opted to finance the APM itself, join it to the Crenshaw Line running about a mile east of the CTA, and keep the finances entirely separate from Metro. While this approach adds a connection to the APM for airport goers, it also gives LAWA complete control over the APM and its operation, so that it can focus solely on serving airport customers and not on how best to compromise with the transit-traveling public. It also gives Metro a more-direct Crenshaw Line route for non-airport travelers, who Metro expects to constitute the vast majority of Crenshaw Line ridership: Metro's travel demand forecast for 2035 projects airport trips will represent only two percent of total trips (LACMTA, 2014). To serve those 1,600 to 1,800 trips, LAWA will finance and operate the APM station that links up to the Metro 96th Street Station, and Metro will finance the connected rail station separately and operate it as part of its overall network of rail and buses (Alvarez & Yuvienco, 2019).

5.2. Methods of Project Delivery

Much of the LAMP's financing is intertwined with its project delivery methods. Both the APM and the ConRAC used design, build, finance, operate, and maintain (DBFOM) contracts, a form of public-private partnership. LAWA cites four advantages to using the DBFOM method of financing and contracting:

1. It transfers some of the risks to the developer and encourages the developer to mitigate those risks.

2. It incentivizes the developer to innovate and streamline processes between design, construction, and operations.
3. It promotes on-time, high-quality project delivery.
4. It aligns all phases of the construction and operations process to ensure "decisions add around the guest experience" (LAWA, 2018a).

Table 3 shows all components on the LAMP and details the expected date of completion, the component's budget, the method of project delivery, and the contractor. LAWA awarded the APM's contract to LINXS, a joint venture of nine companies, through a systematic approach ranking three potential contractors on technical elements and cost; LINXS ranked first in technical score and proposed the lowest cost of delivery. The contract agreement covers five years of design and construction and 25 years of operations and maintenance. Financed through a combination of airport revenue bonds, existing airport revenue, and Passenger Facility Charges (LAWA, 2019a), the contract provides for LINXS to finance the construction costs, the first 25 years of operations and maintenance (indexed to inflation), and the cost of this financing. LAWA will dispense six milestone payments during construction, and annual availability payments during operations and maintenance (LAWA, 2018a). LAWA's organizational responsibilities for the project post-contracting include delivering project real estate, completing enabling projects like relocation and utilities, and facilitating interagency and interproject cooperation. Design and construction will cost \$1.95 billion, and the total contract is for \$4.9 billion ("Los Angeles approves \$4.9bn automated people mover contract," 2018).

For the ConRAC, L.A. Gateway Partners beat out three other competitors to secure unanimous approval from the Los Angeles City Council and LAWA Board of Airport Commissioners for a \$2.0 billion, 28-year contract for the facility's construction and operation (LAWA, 2018e). L.A. Gateway Partners is a consortium of 11 companies collaborating to bring the project to fruition ("Los Angeles City Council gives nod for \$2bn car rental facility at LAX," 2018). In awarding the contract, LAWA announced that L.A. Gateway Partners is committed to an environmentally-friendly project, supporting local businesses,

Table 3: LAMP Financing and Delivery Methods by Component (LAWA Meeting Presentations, LAWA Fact Sheets, Final Environmental Assessment, 2017).

Project	Delivery Date	Budget (\$ millions)	Method of Delivery	Contractor	Contract Length	Notes
Automated People Mover (APM)	2023	\$4,950	DBFOM	LINXS (ACS Infrastructure Development, Balfour Beatty, Dragados USA, Flatiron, Fluor, HDR, HTNB and HOCHTIEF PPP Solutions)	30 years (5 years design and construction; 25 years operations and maintenance)	Largest contract in the City of Los Angeles's history.
Intermodal Transportation Facility – West (ITF- West)	2021	\$209	DB	Swinerton Builders	2 years	Architecture of the ITF- West must match the APM's mid-century modern design. A temporary shuttle will transport airport travelers between the ITF- West and CTA from 2021 until APM opens in 2023.
Consolidated Rental Car Facility (ConRAC)	2023	\$2,028.3	DBFOM	L.A. Gateway Partners (Fengate Capital Management, PCL Investments USA, MVI Finance, PCL Construction Services, PGAL, AC Martin Partners)	28 years	LAWA has approved contracts for relocation to ConRAC from all four of the largest rental car parent companies: Avis-Budget, Enterprise Holdings, Hertz, and Advantage. Fox, DR Rental Car, and Sixt have also signed ConRAC contracts.
<i>Terminal Cores:</i>						
Terminal 1	2020	Part of Terminal 1.5 Project	Privately Built	Southwest Airlines	Included in Terminal Lease	Southwest will finance the construction of its Terminal Core in "Terminal 1.5," which will serve its operations in that future extension, in Terminal 1, and in Terminal 0 if realized.
Terminal 2 and 3	2021	Part of Terminal Renovations	Privately Built	Delta Airlines	Included in Terminal Lease	Delta Airlines previously operated out of Terminal 5 but convinced LAWA to allow them to relocate to Terminals 2 and 3 so that they could control their own access to the APM.
Terminal 4 and 5	2022	Part of Terminal Renovations	Privately Built	American Airlines	Included in Terminal Lease	
Terminal 5.5, between Terminals 7 and 8, and the Tom Bradley International Terminal	2021	\$336.5	DB	Austin Commercial	3 years	The core for Terminal 5.5 will serve Terminal 6. The core in Terminals 7 and 8 is collaboratively planned with the United Airlines-financed renovation of Terminals 7 and 8, however, unlike the other cores, LAWA is financing the core itself.
Roadway Improvements	<i>Included as relevant to other projects</i>					

("DB" is design-build; "DBFOM" is design-build-finance-operate-maintain)

and the ongoing training and development of its workforce over the entire contract.

The Intermodal Transportation Facility – West also uses partnership financing. Swinerton Builders won a \$209 million design-build contract for the ITF-West project (LAWA, 2018d). Some of the terminal cores are also design-build financed, although these projects are distinct from the rest of LAMP in that some are financed through the airlines themselves. LAWA has contracted out to Austin Commercial the \$336-million construction of three terminal cores: one core between Terminal 5 and 6, one core at the Tom Bradley International Terminal, and one renovated core at Terminal 7. American Airlines will finance the core serving Terminals 4 and 5, Delta will finance the core at Terminals 2 and 3, and Southwest will finance Terminal 1's core. The ability to secure direct access to the APM through one of these cores motivated Delta to move its LAX operations to entirely new terminals (Alvarez & Yuvienco, 2019).

5.3. The Color of Money

Through the use of public-private partnerships and airport revenues, LAWA has financed the LAMP entirely exclusive of local or state general fund tax revenue. This approach brings with it all of the advantages LAWA cites that I mention earlier. It also comes with a sacrifice that is common in public-private partnership financing: a loss of public transparency (Siemiatycki, 2009). A comparison with the APM project at Oakland International Airport shows why in the case of LAX the advantages outweigh this loss.

The Oakland Airport Connector is a partnership between Oakland International Airport and BART, both of which are public agencies. Upon awarding construction contracts in 2010, BART released the entire financial composition of the project (BART, 2010). This included specific amounts of funding from different local, state, and federal sources, the commitment status of those funds, and the targeted use of those funds. While this transparency provided an important public-information benefit, it also posed a

substantial cost: the Oakland Airport Connector experienced dramatic delays in the financing process, which drove up the overall cost of the project and delayed its realization (Gosling et al., 2012).

This level of financial specificity was not possible for the LAX LAMP, because LAWA allocated the financing of the APM and ConRAC to the private sector consortiums as part of the DBFOM agreement. In these contracts the financing structures are proprietary to the bidders. Consequently, the financials that LAWA provides are related only to the contracts. For example, in LAWA's Comprehensive Financial Report for Fiscal Year 2018, Chief Financial Officer Ryan Yakubik provides only two specific financial figures related to LAMP: the 2018 expenditure of \$167.9 million in LAMP-related project costs, and the corresponding 2017 expenditure of \$50.1 million (LAWA, 2018b). While this is notably less detail than BART presented in Oakland, this is a sacrifice worth making; the Los Angeles people mover has begun on time, without much opposition, and with most of the financial and delivery risks transferred to the private sector. This is especially important in the context of the LAMP, because a delivery delay with the APM would render all other landside investments impractical until completion of the APM.

6. Discussion of Landside Airport Finance in the United States

6.1. Present Strengths

The FAA's emphasis on maintaining airport revenue for direct airport use parallels with how federal gasoline tax revenue is traditionally reserved for roadway uses. As such, airport revenue acts in some ways as a user fee, in that nearly all money spent by the passengers on direct airport expenses is kept for maintaining and enhancing their air travel experience. Without these safeguards in place, it is likely that over the course of many political regimes the many governments that operate airports would fall to the allure of using their airports as cash registers, as Mayor Riordan attempted to do with LAX in the 1990s.

This also incentivizes airlines to lend their extensive political capital and financial capacity to airports, especially in this age of mergers and consolidations. Airlines are indeed powerful companies, four of which control an inordinate amount of the nation's air passenger volume, but they need the airports for their bottom-line success, just as the airports need the airlines for their own success. The restrictions on revenue diversion promote a more trusting relationship between airlines and airports, encouraging airlines that their investments will not be spent in ways they did not intend.

6.2. Present Weaknesses

The most related downside to this, however, is that it isolates airport operators from their parent governments and their counterpart organizations at similar levels of government in other segments of the transportation arena. The prohibition of what in this case I will call revenue *sharing* precludes airports' and aviation's true involvement in regional planning. If how we collect and spend public money is the essence of policy, then airports are entirely not part of their regional plans. This can cause inefficiencies and pose hardships. In Los Angeles more broadly, it has taken LA Metro nearly four decades since the groundbreaking of the Blue Line to connect to LAX; even then, the Green Line will still bend some trains toward the South Bay instead of fully combining with the Crenshaw Line. Combining the two lines and running the southeastern portion of the green line as a stub would be much more efficient for travelers destined for the airport and would likely increase demand, but without an incentive from the airport it is politically untenable (Hyman, 2018). It might be more realistic if LAWA were able to have a say—politically and financially—in the decision-making process.

Similarly, there has been no financial incentive for highway planners to integrate LAX into the freeway system. At the smaller scale, LAWA was unable to finance the offramp from the 105 Freeway into the Sepulveda Tunnel that runs underneath part of the airfield, because that interchange serves not only airport travelers but the public at large (Alvarez & Yuvenco, 2019). It is a ramp that runs into a tunnel that takes cars to the CTA. Indeed, it is also a ramp from a freeway to a major state highway, but it would

not be difficult to imagine that in a world without LAX neither the ramp nor the entire portion of that freeway east of the 405 Freeway would exist at all. If the airport were a private corporation then this would be a reasonable scenario for which to advocate, but both the airport and the freeway are *public* installations; they should be not only allowed but encouraged to collaborate.

7. Policy Recommendations

LAX is an interesting case study because of its size, its relationship to every major domestic air carrier, and its significant role in the nation's second-largest region. Unlike the New York region, which is served by three major airports—JFK, LaGuardia, and Newark—LAX bears the vast majority of its region's air traffic. This means that the stakes are extraordinarily high for this airport in all facets of its operations. Landside access is no exception, and in a region with explosive growth, it provides a testament to what can be done but also to what could have been done before to avoid its present dilemmas.

In considering LAX's landside planning efforts and how the lessons here might be applied to planning at other airports around the United States—especially in growing regions—I put forth the following two policy recommendations:

- A. *The LAMP's public-private partnership financing should serve as a model for airport landside improvement programs.* Not all public-private partnerships are successful. Many of them, especially brownfield projects, have been highly controversial (Rall, Reed, & Farber, 2010). But the LAMP, a brownfield project, provides a model for how to intertwine many projects into one program through financing. For growing regions without the ability to fully relocate their airports, most landside improvement projects will be brownfield projects, and those airports will be able to look toward the LAMP as an example of financing in a way that ensures the airport will not bear responsibility for one component's failure bringing down an entire program. While the

LAMP is only in its early construction phase, all financial signs point toward a delivery that, at the very least, insulates LAWA and the public from most of the risk. Ultimately, the LAMP should improve the quality of experience for air travelers and, as a byproduct, improve the quality of life for those in the airport's surrounding areas.

B. *Airport planning should continue evolving toward a more passenger-centered approach.* While revenue diversion prohibitions ensure that airport spending will be kept for enhancing the air travel experience for travelers, it fails to consider the full extent of an air traveler's trip. Inevitably, nearly every such trip begins with a walk and then most often a vehicle, be it a private car, a shared car, or transit. The way the United States structures airport finance promotes the mentality that air travel happens only once one's car traverses the threshold of the airport's property and into the terminal loop, but in reality, that trip begins sometimes hours beforehand. With the LAMP, LAWA has shown how this structure can be molded to be more passenger-centric, but the structure nonetheless remains a barrier for these types of projects. The way humans experience air travel is not confined to how quickly we get through the security checkpoint but includes both the trip to the airport and the convenience of accessing it.

8. Conclusion

Considering the many obstacles and disincentives in its way, the LAX Landside Access Modernization Program is a remarkable project. The LAMP will at its core expand the airports available intake capacity, without actually expanding the airport's true footprint. And it will do so not by expanding existing capacity but by creating a new mode of to-airport travel entirely. Its origin-destination air passenger volume makes LAX is one of the greatest ground trip generators of its era, not just in Los Angeles but in the United States. Its status as not only a regional but a national cultural icon is

well established. But, as with any significant destination, it can only be of value if it offers sufficient access. And what should not be lost in this near-herculean achievement is that it is *decades* overdue.

The LAMP is an important and needed move toward enhancing airport access and improving the air traveler experience, but it is important to take stock of what this project is in reality: a slightly-more-than-two-mile air train, two big parking garages, a few roadway shifts, and a walkway to a Metro station. In a region that has arguably the world's greatest highway system, a region that has built over 100 miles of light rail and opened more than 530 miles of commuter rail in that same timeframe (Manville et al., 2018), a region that literally carved up a mountainside to expand the 405 Freeway through the Sepulveda Pass (Nagourney, 2017), this project is as *small* in scope as it is large in its importance. Yet it has taken LAX reaching its literal landside capacity—and the prospect of hosting another Olympic Games—to enhance its landside access. This delay cannot be attributed to a regional ineptitude; rather, this must be seen as a glaring signal for needed adjustments in American airport access policy and finance.

References

- Alvarez, D., & Yuvienco, R. (2019, May 3). *Phone Interview* [Phone].
- Austin Commercial, & LAWA. (2019). LAX Terminal Cores. Retrieved May 3, 2019, from <http://www.laxterminalcores.com/>
- Bachman, J. (2016, February 2). This Is Why No Airline Will Ever Dominate LAX. *Bloomberg*. Retrieved from <https://www.bloomberg.com/news/articles/2016-02-02/this-is-why-no-airline-will-ever-dominate-lax>
- BART. (2010, May 24). *Oakland Airport Connector Executive Decision*. Retrieved from https://www.bart.gov/sites/default/files/docs/07-22-10_Oakland_Airport_Executive_Decision_Document.pdf
- Dulles Corridor Metrorail Project. (2019). Retrieved May 27, 2019, from <http://www.dullesmetro.com/>
- Erie, S. P. (2004). *Globalizing L.A.: Trade, Infrastructure, and Regional Development*. Stanford, Calif: Stanford University Press.
- FAA. (2018, October 15). Airport & Airway Trust Fund (AATF). Retrieved April 17, 2019, from <https://www.faa.gov/about/budget/aatf/>
- FAA. (2019, April 9). Airport Improvement Program (AIP) Grant Histories [Template]. Retrieved April 17, 2019, from https://www.faa.gov/airports/aip/grant_histories/
- Final Environmental Assessment*. (2017). Los Angeles International Airport Landside Access Modernization Program.
- Gosling, G. D., Wei, W., & Freeman, D. (2012). *Case Study Report: Oakland International Airport BART Connector* (p. 46). Mineta Transportation Institute.
- Horonjeff, R., McKelvey, F. X., Sproule, W. J., & Young, S. B. (2010). *Planning and Design of Airports* (Fifth). New York: McGraw Hill.
- Hymon, S. (2018, December 3). Metro Board to consider operating plan for Crenshaw/LAX and Green Lines. Retrieved May 24, 2019, from The Source website: [//thesource.metro.net/2018/12/03/metro-board-to-consider-operating-plan-for-crenshaw-lax-and-green-lines/](http://thesource.metro.net/2018/12/03/metro-board-to-consider-operating-plan-for-crenshaw-lax-and-green-lines/)
- LACMTA. (2014). *Staff Report to Metro Board: Airport Metro Connector*. Retrieved from <https://www.scribd.com/document/229914903/Airport-Metro-Connector>
- LAWA. (2017a). *Traffic Generation Report*. Retrieved from <https://www.lawa.org/en/lawa-our-lax/studies-and-reports/traffic-generation-report>
- LAWA. (2017b, May). *LAX Modernization at a Glance*. Retrieved from <https://www.lawa.org/-/media/lawa-web/projects-and-reports/files/modernization-at-a-glance---factsheet.ashx?la=en&hash=07DF801946C18F41FBCA1F7967E2B222B2FA368E>

- LAWA. (2018a). *Contract Award for the Automated People Mover at LAX*. Retrieved from http://lawa.granicus.com/MetaViewer.php?view_id=4&clip_id=484&meta_id=33404
- LAWA. (2018b). *LAWA Comprehensive Financial Report*.
- LAWA. (2018c, January 19). Terminal Cores. Retrieved May 22, 2019, from <https://www.lawa.org/en/news-releases/2018/news-release-10>
- LAWA. (2018d, July 11). Board of Airport Commissioners Awards \$209M Design-Build Contract to Swinerton Builders for Intermodal Transportation Facility - West. Retrieved May 24, 2019, from <https://www.lawa.org/en/news-releases/2018/news-release-83>
- LAWA. (2018e, October 31). Los Angeles City Council Approves \$2B ConRAC Contract. Retrieved May 24, 2019, from <https://www.lawa.org/en/news-releases/2018/news-release-107>
- LAWA. (2019a). APM Fact Sheet. Retrieved May 24, 2019, from <https://cloud1lawa.app.box.com/v/APM-FAQ>
- LAWA. (2019b). LAMP Fact Sheet. Retrieved May 24, 2019, from https://www.lawa.org/-/media/lawa-web/connecting-lax/lamp-business/lawa_factsheet.ashx?la=en&hash=0C3D7657ACF8E75706BE8359AD4285C53F07EE23
- LAWA. (2019c, January 31). Structure Demolished in Preparation for Construction of the LAX Automated People Mover. Retrieved May 24, 2019, from <https://www.lawa.org/en/news-releases/2019/news-release-08>
- LAWA. (n.d.). LAX: Just the Facts. Retrieved May 24, 2019, from <https://www.lawa.org/en/history/lax-history/just-the-facts>
- LINXS. (2019). Image Gallery. Retrieved May 24, 2019, from LAX Integrated Express Solutions website: <http://www.lalinxs.com/gallery.html>
- Los Angeles approves \$4.9bn automated people mover contract. (2018, April 13). Retrieved May 24, 2019, from Airport Technology website: <https://www.airport-technology.com/news/los-angeles-approves-9bn-automated-people-mover-contract/>
- Los Angeles City Council gives nod for \$2bn car rental facility at LAX. (2018, November 2). Retrieved April 18, 2019, from Airport Technology website: <https://www.airport-technology.com/news/los-angeles-nod-lax/>
- Los Angeles Conservancy. (2019). Theme Building, LAX. Retrieved May 22, 2019, from <https://www.laconservancy.org/locations/theme-building-lax>
- Manville, M., Taylor, B., & Blumenberg, E. (2018). *Falling Transit Ridership: California and Southern California*. 83.
- Nagourney, A. (2017, December 22). Los Angeles Drivers on the 405 Ask: Was \$1.6 Billion Worth It? *The New York Times*. Retrieved from <https://www.nytimes.com/2016/12/20/us/los-angeles-drivers-on-the-405-ask-was-1-6-billion-worth-it.html>

- Nelson, N. (2016, May). Delta Passengers Plug in as Atlanta Int'l Begins Terminal Modernization Plan. *Airport Improvement Magazine*. Retrieved from <https://airportimprovement.com/article/delta-passengers-plug-atlanta-intl-begins-terminal-modernization-plan>
- Ornelas, E. (2018, April 8). The Evolution of Ontario Int'l Airport (OIAA). Retrieved May 24, 2019, from Inland Empire Regional Chamber website: <https://www.iechamber.org/news/evolution-ontario-intl-airport-oiaa>
- Rall, J., Reed, J. B., & Farber, N. J. (2010). *Public-private partnerships for transportation: a toolkit for legislators*. National Conference of State Legislatures.
- Siemiatycki, M. (2009). Delivering Transportation Infrastructure Through Public-Private Partnerships: Planning Concerns. *Journal of the American Planning Association*, 76(1), 43–58. <https://doi.org/10.1080/01944360903329295>
- Sloan, C. (2018, September 13). How United's Working to Right the Ship: UA Leaders Speak. Retrieved May 24, 2019, from The Points Guy website: <https://thepointsguy.com/news/how-uniteds-working-to-right-the-ship-an-interview-with-ua-leaders/>
- Sumers, B. (2018, December 6). How Southwest Airlines Looks to Grow in Los Angeles. Retrieved May 24, 2019, from Skift website: <https://skift.com/2018/12/06/how-southwest-airlines-looks-to-grow-in-los-angeles/>
- US Census Bureau. (2019). American FactFinder - Results. Retrieved May 22, 2019, from <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk#>

