

MICROTRANSIT IN A TRANSIT FIRST CITY: RETHINKING THE FUTURE  
OF ON-DEMAND TRANSIT IN SAN FRANCISCO AFTER CHARIOT

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## Executive Summary

Microtransit refers to shuttles with a capacity smaller than conventional public transit buses, but higher than single-occupancy vehicles, with an on-demand component to it, which means that unlike conventional transit, routes and schedules can vary. Between 2014 and 2019, Chariot was operating a fixed route flexible schedule microtransit service in San Francisco and other cities during commute times. Chariot operations raised various questions about San Francisco's transit system, and its shutdown brought new ones about the future of transit altogether.

On-demand transit services are not a new idea, be it in the United States or elsewhere. Low-technology variations of flexible transit services have been thriving throughout the world for decades, including San Francisco's now-defunct jitneys, but technological advancements brought microtransit back to the forefront of the mobility scene as a potential opportunity to rethink public transit, a declining industry in the United States.

In October 2017, after extensive talks with Chariot, the San Francisco Municipal Transportation Agency created a permit program to regulate private microtransit operations within city boundaries, setting standards for microtransit operators in terms of stop location, data sharing, competition with Muni service, accessibility, vehicle characteristics, fees, labor and driver training. Chariot was awarded the permit in early 2018, but ended operations worldwide one year after.

In a context of decreasing ridership for most transit agencies across the United States, the creation of a regulation was prompted as part of a move from the City to protect its public transportation system from potential competition. Based on the coverage of the Chariot network as of late 2018, it appears that microtransit served about 16.71% of the population already served by public transit in San Francisco and 30.57% of employment opportunities. Because it focused on connecting residential neighborhoods to downtown, Chariot's commuter shuttles targeted the densest parts of the city, which also correspond to the most profitable routes for public transit, thus threatening the financial viability of the entire system. On the other hand, had Chariot been integrated with the Muni and BART networks, it would have brought significant accessibility improvements in the city, bringing hundreds of thousands of additional jobs within reach of residents living in the Richmond, the Presidio, and several other neighborhoods. However, these employment accessibility improvements were not distributed evenly throughout the city and did not benefit vulnerable communities as much.

Interviews with stakeholders involved with Chariot in San Francisco unveiled the following for the future of microtransit in the city:

[Public agencies in San Francisco's transportation ecosystem need to agree on a shared agenda with clear goals when engaging with private innovators.](#)

Chariot operations in San Francisco brought about new challenges for the City that highlighted the existence of competing priorities within the public sector, between the SFMTA, the SFCTA and elected officials. The multiple agendas sometimes conflicted with one another or with long-term goals like the Transit First policy and its support of all high-occupancy modes – a category that microtransit fell under – making it difficult for private providers like Chariot to meet the expectations of the public sector.

Private innovation prompts reactions from the City that gravitate around the protection of its public transit operator and keeping control over the public right-of-way.

San Francisco's experience with emerging mobility has made the City weary of unintended consequences of private innovation. When engaging with emerging mobility providers, city government and advocates are primarily concerned with ensuring the protection of public transit from both a financial and operational standpoint. Some are also worried about the increase in the number of companies capitalizing on subsidized public infrastructure and advocate for a balance in the participation of private entities in transportation provision.

San Francisco remains in a paradigm that is primarily about regulation rather than fostering innovation.

After its acquisition by Ford, Chariot's relationship to the City grew into something close to a partnering relationship, with regular interactions to foster mutual understanding and collaboration on allowing microtransit to exist while addressing the concerns of both parties. The Private Transit Vehicle regulation that resulted from these talks served for the City as both a reactionary enforcement mechanism and a bargaining tool for data from the private provider, but Chariot and the City were relatively satisfied with the outcome of their negotiations.

Creating a truly partnering relationship between city government and the private sector is challenging, and Chariot was no exception. Ideally, government should be proactive in creating a regulatory environment that will leave room for flexibility and allow private entities to test and learn how to conduct a business that can benefit the city.

Chariot faced a number of challenges beyond regulation that contributed to the end of its operations.

Providing mass transit services to the public comes with labor challenges, be it fixed or on-demand. It participated to Chariot's struggle to reach profitability on its routes open to the general public, and eventually, unmet financial expectations were the reason why Ford decided to stop investing into the microtransit operator. Chariot's image as a disruptor from the tech industry also brought many hurdles that complicated its interactions with some City staff and community groups, thus making it more difficult to get support for its operations.

Rethinking transit for the future will require collaboration between the public and the private sector to move beyond business-as-usual.

Chariot's customer base is a testament to the fact that microtransit service had some features that made it more attractive than public transit in some parts of San Francisco and than single-occupancy vehicles in others. This represents an opportunity for the SFMTA to rethink its travel experience in order not only to attract ex-Chariot riders but also appeal to people who would not ride transit under the status quo. On-demand features may not have been the determining factor in making people opt for microtransit, but Chariot existence raises the question of whether on-demand transit should be part of the tools promoted by the City. By building on Chariot's achievements and challenges, San Francisco has the opportunity to rethink a future where different forms of public transit coexist and work together to meet the mobility needs of San Franciscans. In rethinking this future, the public sector should be open to building on the private sector's expertise and resources to achieve its Transit First goals.

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## 1. Introduction

Emerging mobility services have changed dramatically the transportation landscape in many places including the Bay Area over the past 5 years, with the appearance of new services on city streets that completely reshaped how people envision mobility. They also left public officials hesitant about how to go about integrating these disruptive mobility options into their transportation mix, and how these fit in the former dichotomy between private mobility and public transportation. Now, with mobility as a service, the variety of options available to city dwellers has exploded, and San Francisco saw the appearance of a new variant of public transportation on its streets: on-demand transit, or microtransit.

Microtransit refers to shuttles with a capacity smaller than conventional public transit buses, but higher than single-occupancy vehicles, with an on-demand component to it, which means that unlike conventional transit, routes and schedules can vary. There are various ways in which microtransit can be operated, and different cities present different models of microtransit. San Francisco has only had one permitted microtransit operator: Chariot. In operation from 2014 to 2019, they operated fixed, yet crowdsourced transit routes, with a flexible schedule. Routes were in service during commute times only, with some variation between the morning and the evening peak.

The issue with microtransit is that in a context of decreasing ridership for most transit agencies across the United States, transit agencies need to beware the emergence of potential new competitors that could draw riders away from public transportation. In the Bay Area alone, the Metropolitan Transportation Commission (MTC) estimates that transit ridership per capita has decreased by 11% between 1991 and 2016, with figures of -2.6% change in absolute terms for Muni over that period, but -18.6% when looking at per capita ridership (MTC, 2017). Most recent trends do not seem to indicate a meaningful long-term recovery for the San Francisco Metropolitan Transportation Agency (City and County of San Francisco, 2018). Nevertheless, this should be put in perspective with a broader downward trend for bus ridership in the region as a whole, where per capita ridership for buses decreased by 32.4% over the past 25 years (MTC, 2017).

And still, public transportation has been an official priority for San Francisco for many decades. The city's public transportation agency, the San Francisco Municipal Transportation Agency (SFMTA), is governed by Charter Section 8A, which includes a section outlining the city's so-called "Transit-First Policy". Passed into legislation exactly 45 years ago and last updated in 2007, the policy reads the following: "Decisions regarding the use of limited public street and sidewalk space shall encourage the use of public rights of way by pedestrians, bicyclists, and public transit, and shall strive to reduce traffic and improve public health and safety". This regulatory framework has been framing transportation decisions for the past decades, and while its terms have evolved, the spirit of the policy has remained true to its original purpose: placing public transit first. With the emergence of new transportation solutions, the latest version of the policy now includes a paragraph dedicated to "innovative solutions" and calling for them to "meet public transportation needs [without adversely affecting] the service provided" by Muni (San Francisco Charter, 2007; SFMTA, 2018). This legislation makes it critical for transit authorities – that is, for both the SFMTA and the San Francisco County Transportation Authority (SFCTA) – to ensure that emerging mobility services all work towards reducing private automobile use and promoting the use of higher-occupancy vehicles and sustainable transportation modes. Considering that microtransit shuttles technically fall into high-occupancy vehicles, their existence seems to be compatible with the Transit First policy so long as they do not jeopardize Muni service. Nevertheless, considering that Chariot is a private transportation provider,

it is important for city officials to make sure that their operations do not threaten the many capital investments that are being made into public transportation, and in particular that public transit ridership is not being negatively affected by microtransit.

In view of the existing regulatory environment, the SFMTA created in October 2017 a permit system for Private Transit Vehicles (PTV) operating entirely within the city boundaries, setting standards for microtransit operators in terms of stop location, data sharing, competition with Muni service, accessibility, vehicle characteristics, fees, labor and driver training. This resulted in the award to Chariot of a permit to operate in San Francisco in early 2018, the only microtransit operator in San Francisco to date (SFMTA, 2017b). Only one year after being awarded its permit to operate in San Francisco, the microtransit operator announced it would cease operations worldwide – Chariot was present in 10 cities in the United States and the Greater London in the United Kingdom.

The abrupt end of operations of Chariot in San Francisco has left many questions open, as to the viability of providing on-demand transit services in a city committed to putting public transit and other sustainable transportation modes first. The present report will aim to unveil the challenges of operating an on-demand transit service in San Francisco, and draw from the Chariot experience lessons for integrated fixed and on-demand transit planning. It will inform the SFMTA and SFCTA in their efforts to fulfill the City's Transit First goals while taking into account the new landscape of mobility, by identifying opportunities and challenges to integrate microtransit into their strategy, and what the future of microtransit should look like. More specifically, I wish to answer the following questions:

1. To what extent did the on-demand transit services provided by Chariot cater for competition against public transportation in San Francisco?
2. What factors in the on-demand transit services provided by Chariot in San Francisco could have been supportive of public transportation?
3. Is there a future for on-demand transit in San Francisco, and what could it look like?

Answering these questions would be valuable for transit authorities to understand the scale and underlying mechanisms of the potential competition that microtransit may represent for public transit as well as the levies that would promote public transit use relative to private vehicles – in line with the transit-first policy – as it would allow the City to respond to the corresponding opportunities and challenges in the way public transportation will be planned in the future. This may also open doors to revise the new PTV permit system so as to integrate both types of transit services in a way that preserves public transportation while delivering "mobility as a service" to San Franciscans.

After explaining the specificities of Chariot services while they were operating in San Francisco, the current regulatory environment and the state of research on microtransit, the present report will detail the methodology that was used to collect and analyze the data needed to answer the abovementioned research questions. The following section will attempt to unpack the potential for competition between Chariot and major public transit providers in San Francisco from a transit supply perspective, before investigating opportunities for complementarity that may have existed between them, had there been a truly integrated dual transit system with on-demand and fixed transit service. Finally, this will lead to a set of lessons learned from the Chariot case in San Francisco, followed by a discussion of recommendations for the city to approach on-demand transit in the future, and a concluding section.



## 2. Background

### 2.1. Global history of microtransit

Informal transit in the Global South and the United States in the past

On-demand transit services are not a new idea, be it in the United States or elsewhere. Low-technology variations of flexible transit services have been thriving throughout the world for decades, many of them provided by private operators under informal schemes. Robert Cervero classified these informal so-called paratransit services<sup>1</sup> into four categories: (i) minibuses and jitneys, with fixed routes, flexible schedules, and about 12-24 capacity; (ii) minibuses, similar to jitneys but only fitting 4-11 people; (iii) three-wheelers and motorcycles, mainly used as feeder services; and (iv) pedicabs and horse-carts, also equivalent to feeder services (Cervero, 2000, 2017). Cervero and Golub's global panorama of informal transit, from *peseros* in Mexico City to *matatus* in Nairobi, *robots* in Kingston or *tuk tuks* in Bangkok, attests to the fact that privately-provided flexible transit services thrived as gap-fillers in metropolitan transportation systems long before the reemergence of microtransit at the forefront of the transportation scene in developed economies (Cervero & Golub, 2007). These models of microtransit in developing countries led Cervero to advocate for the United States to adopt a liberal, market-based approach to transit, with more competition and relaxed regulations to encourage an array of transportation and price options and reduce market distortions, which he believed would lead to better outcomes for the entire transportation system (Cervero, 2001). Nevertheless, it is worthwhile noting that jitney services with informal attributes are not foreign to some American cities like New York City, where they have been flourishing for decades (Cervero, 2017; Correal & Bayer, 2019; Margonelli, 2011). Furthermore, the public sector too has started exploring the opportunities of non-fixed transit services a while ago. More than 50 North-American transit agencies were already operating flexible transit services in the early 2000s in the form of request stops, flexible-route segments, route deviation, point deviation, zone routes or demand-responsive connector service, most of them without advanced technology (National Academies of Sciences, Engineering, and Medicine, 2004).

#### Overview of microtransit in the United States

In recent years, the United States has seen the emergence of various attempts at providing technology-enabled on-demand transit services under different forms. In San Francisco, Night School tried to provide transit services late at night in 2014, when public transit was either sporadic or not in service, but the company was shut down by the California Public Utilities Commission (CPUC) after two weeks. In 2015, Leap launched an upscale shuttle service in the city, but was also shut down by the CPUC soon thereafter. The company Loup also tried to enter the San Franciscan market in 2014 and failed similarly. Chariot was the only provider that operated in the city for several years (Beyer, 2015). Beyond San Francisco, other companies tried to provide microtransit services, with varying business models and levels of success, Bridj and Via being maybe the most mediatized ones. There is limited literature to date on the state of technology-enabled microtransit, in part because the fast evolution and sometimes failure of emerging mobility services has made it hard to study their impact on the urban transportation landscape (TransitCenter, 2016). The US Department of Transportation defines microtransit as "a privately owned and operated shared transportation system that can offer fixed routes and schedules, as well as flexible

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<sup>1</sup> Cervero refers to paratransit in the global meaning of the term, which encompasses any type of carrier between a taxi and a conventional bus rather than the prevailing US definition associating paratransit with transit services dedicated to people with disabilities and seniors.

routes and on-demand scheduling. The vehicles generally include vans and buses” (Shaheen, Cohen, & Zohdy, 2016). While Chariot fell under the fixed route and flexible schedule category, AC Transit’s Flex or Via microtransit services have both flexible routes and flexible schedules.

## 2.2. San Francisco’s microtransit history

### The jitney era

San Francisco has a now forgotten but long history with private transit. Jitneys first appeared on San Francisco streets in 1914, and by 1917 they were flooding the city, after the Board of Supervisor lifted all restrictions to their operations in order to address a major strike by streetcar operators. But in the following years, the jitney fleet fell from thousands of jitneys in the late 1910s to only 120 vehicles by 1970 due to a combination of rising insurance rates, stricter regulations on where and when they could operate, as well as competition from private vehicles. While jitneys operated throughout the city in the early 20<sup>th</sup> century, in the 1970s, the remaining jitneys only operated on two routes: the busiest one on Mission Street between the Ferry Building and San Mateo County, and the second one as a connector between Caltrain and Market Street. The Mission route was severely hit by the opening of BART in 1974. In addition to increasing competition, the demise of the jitney industry was also tied to two major regulatory changes that were prompted by high public transit deficit and pressures in the city to protect streetcars from any potential competition, while jitneys lacked political power: the city stopped issuing new permits after 1972, and the passing of Proposition K in 1978 made jitney permits non-transferable. Jitneys then slowly disappeared from the city, with the last jitney operator retiring in 2016, after operating the Caltrain-Market line for decades (Cervero, Kirk, Mount, & Reed, 1995; Park, 2015; SFMTA, 2017c).

### The rise of Chariot

Chariot was launched in San Francisco in April 2014 by Ali Vahabzadeh, in an attempt to “solve” San Franciscans’ commute, based on his own experience with commuting in the city and with the goal of providing a new service faster than transit but more affordable than TNCs:

“Chariot is solving people's commute, one neighborhood at a time. The service is 2x faster than the public bus and 7x more affordable than point-to-point services like taxi, Uber, Lyft and Sidecar.” (Vahabzadeh, n.d.)

He refined his product by surveying potential future users at transit stops that suffered the most from overcrowding, resulting in rider frustration because they had to wait for several buses to pass them before being able to board one. Chariot started with very few vans, and basic features: vans, drivers, insurance, gas, and parking. The website, mobile-app, online payment system, the live tracking on a map, estimated times of arrival, the seat reservation and check-in features all got added later on. The first years of growth were organic in fashion, with survey respondents becoming the initial customer base and serving as “evangelists” who tended to promote the benefits of the service themselves. After about 3 years of operating and growing as a business, from 5 vans including one run by the founder himself to a fleet of about 200 shuttles, the company was acquired by Ford Smart Mobility in September 2016. Chariot was the first acquisition of Ford Smart Mobility and was part of the automaker’s efforts to expand its offerings and provide mobility solutions in addition to making private vehicles. For Chariot, beyond eliminating the need for new investment rounds, belonging to Ford was a great opportunity to expand their fleet easily. In the following years, they expanded to various cities across the United States as well as London.

In its most recent form, Chariot operated two types of routes: “public” and “private” ones. The latter were equivalent to commuter shuttles and spanned the Bay Area, while the former were available to the public and restricted to San Francisco only. The present report will leave out Chariot’s private routes from the analysis as it constituted a service significantly different from public transportation, as it was not available to the general public. Public routes operated on weekdays and during peak hours only. Exact operating hours varied depending on the route but on an average weekday they spanned from 6 AM at the earliest to 10 AM at the latest in the morning, and started again at 3 PM at the earliest in the afternoon and ended at 8 PM at the latest. Additionally, there were some variations between days, as some routes had slightly different operating hours on Fridays compared to the rest of the week. However, overall, core operating hours – for which all routes would be in service – were 6:30AM-9:30AM and 4:30PM-7PM.<sup>2</sup> There was no fixed schedule that would allow riders to know before ordering a ride at what exact time a shuttle would come to a given stop, but the Chariot website indicated a range of expected headways for each route, from a minimum of five minutes for the “Union Cruiser” and “SoMa Sprinter” routes in the morning and “Chestnut Bullet” in the evening, to a maximum of 50 minutes for “Potrero Pronto”.<sup>3</sup> Each Chariot vehicle had 14 passenger seats and there was no standing area. Passengers were guaranteed a seat, but when ordering a ride, they did not know how full their shuttle would be.

### 2.3. Evolution of the regulatory environment for microtransit in San Francisco

#### Microtransit regulation in San Francisco before Chariot

The regulatory environment around private transit services in San Francisco has evolved since the jitney era. In 2011, the jitney regulation was repealed from the city’s transportation code, and the SFMTA amended the transportation code with provisions for the potential future creation of permits for “non-standard vehicles”, as a placeholder in the legislation that was left dormant for a few years, until the reappearance of private transit services on the city streets brought the topic back on the city’s agenda (SFMTA, 2017a).

Under state law, the CPUC has jurisdiction over services that carry passengers on public streets and highways within California. Privately-owned services with fixed routes and schedules and door-to-door shuttle services for an individual fare fall under the Passenger Stage Corporations category. Filing fees do not exceed \$1,500, and renewal costs \$100 at most. Charter-party Carriers correspond to services that do not charge individual fares but use fares based on mileage or trip duration. They differ from taxicabs in that they do not have a meter, and the price, itinerary and list of passengers are agreed upon prior to the trip. The CPUC also has jurisdiction over Transportation Network Companies (TNCs) like Uber and Lyft. These various categories of passenger services correspond to different permits delivered by the CPUC. However, a major exception exists to these rules: transportation services provided by private carriers entirely within the limits of a single city or county and regulated by ordinance or licensed fell under the jurisdiction of the corresponding local authorities (California Public Utilities Commission, 2014; SFMTA, 2017a, 2017c).

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<sup>2</sup> Chariot determined these operating hours independently based on demand. These hours were not the result of negotiations with the SFMTA or the SFCTA.

<sup>3</sup> See Appendix 1 for details on Chariot stops, routes, operating hours and headways in San Francisco as of 2018.

### Creation of the Private Transit Vehicle regulation

Under these state-wide rules, private routes operated by Chariot – both the commuter routes and the charter business – were governed by the CPUC’s Transportation Charter Party permit. As for the routes that were open to the general public, Chariot initially operated them under a CPUC permit in the first few years. When it applied for a new permit in 2017 and had to notify the affected local public transit agency (i.e. the SFMTA), the latter objected the permit application on the grounds that all routes included in the application were within San Francisco city boundaries and that Chariot thus fell under the SFMTA’s jurisdiction rather than the CPUC’s. This is what prompted the creation of the Private Transit Vehicle regulation and the corresponding permit program by the SFMTA in October 2017 (SFMTA, 2017a, 2017c).

The cautious attitude towards emerging mobility services from San Francisco and other cities in an attempt to protect public transit operators from any potential competition is rooted in the dramatic changes undergone by the transportation landscape over the past decades, with the most recent years representing a major challenge for public transit providers because of a combination of technological, mobility and societal trends (e.g. increasing number of on-demand mobility options and new attitudes toward information communications technology) (Shaheen & Cohen, 2018). In San Francisco, this concern was formulated explicitly in numerous city policies, from the Transit First policy to the Emerging Mobility Guiding Principles and played an critical role in the design of the PTV regulation (SFCTA, 2018; SFMTA, 2017c).

The permit was created after months of close collaboration between SFMTA staff and Chariot, the only private transit provider still in operation at the time. The terms of the permit included:

- i. insurance and licensing requirements in line with the California Highway Patrol and the CPUC standards;
- ii. vehicle restrictions regarding age, emission levels and maximum length;
- iii. labor standards for drivers and safety trainings;
- iv. accessibility and equity provisions to ensure equal access for people with disabilities as well as the absence of discriminatory practices;
- v. sharing data in real-time on the location of every single vehicle in service in the city, as well as ridership data;
- vi. restricting stop locations to loading zones; and
- vii. non-duplication between Muni routes and private transit routes.

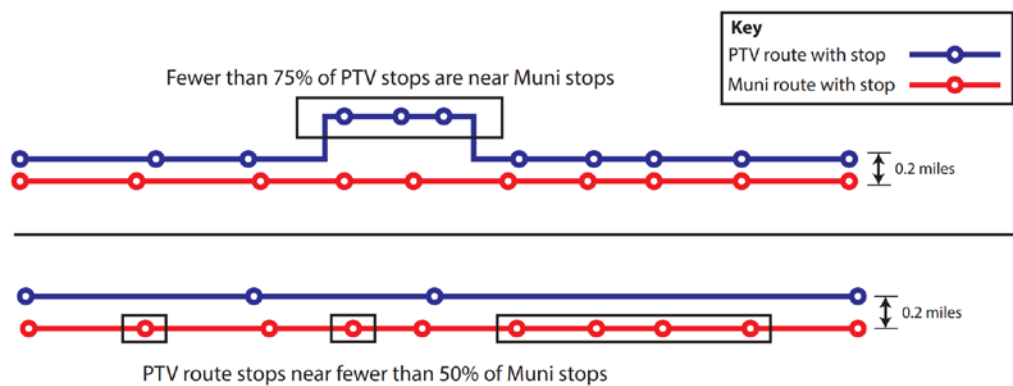


Figure 1. Private Transit Vehicle permit route duplication criteria (Source: SFMTA)

The last criteria meant that any PTV permittee had to submit a request for each new route before opening it, to undergo a screening that would verify that it did not duplicate service already provided by Muni,

based on microtransit stops' proximity to Muni stops as illustrated in Figure 1. The abovementioned permit terms and conditions were developed to meet a series of goals from the Transit First policy, Vision Zero and the Emerging Mobility Services and Technology Guiding Principles, as well as to address various concerns that Chariot operations had raised among Muni operators and the general public (SFMTA, 2017c).

#### 2.4. Measuring complementarity between transit networks

Like any new transportation mode introduced in an urban environment with existing transportation options, Chariot has not only the potential to compete with public transportation, but also, under the right circumstances, to could complement it by providing connections to new destinations. And indeed, what matters in transportation planning is not the protection of one transportation provider over another one per se, but rather the resulting mobility outcomes of a given multimodal transportation system, with its combination of multiple transportation modes and networks. Accessibility metrics are widely used in planning to model travel behavior and assess transportation demand, which can then inform analyses on the expected impact of transportation infrastructure improvements, including the equity implications of changes to transportation networks, among others. But more importantly, in the case of transit planning, transit accessibility metrics can be used to assess system performance and demand, and support service planning, even when multiple networks are operating in a single city or region (Blanchard & Waddell, 2017a, 2017b; Chen et al., 2011; Lei & Church, 2010; Polzin, Pendyala, & Navari, 2002). One major benefit of using accessibility metrics rather than more advanced models is the fine-grained analyses that they allow, with scales of analysis as small as census blocks or even parcels, compared to aggregated scales like travel analysis zones that fail to adequately represent short-distance travel patterns and behaviors that involve active transportation modes. (Chen et al., 2011) In the case of transit performance, this is particularly valuable as trips on transit always include a portion that involves either walking or biking, to get to and from transit stops and during potential transfers.

Cumulative accessibility is a metric that measures the cumulative amount of opportunities (or destinations of interest) reachable from a given origin within a certain amount of time spent traveling on the transportation network. By using time various thresholds, you can obtain an intuitive measure of the performance of the transportation system – which may include various transportation providers – with existing or planned land use patterns and assess the impact of various infrastructure improvements on mobility outcomes in the region (Blanchard & Waddell, 2017a; Chen et al., 2011). Using employment as the opportunities in the calculation of transit accessibility metrics is standard in the literature (Blanchard & Waddell, 2017a, 2017b; Geurs & Ritsema van Eck, 2001; Tomer, Kneebone, Puentes, & Berube, 2011), and is particularly relevant when looking at microtransit services like Chariot that are designed for commuters.

### 3. Methodology

This research uses a mixed-methods approach to draw the lessons from Chariot operations in San Francisco for the future of on-demand transit in the city. It builds on a quantitative comparative analysis between Chariot routes and the two main fixed transit networks in San Francisco: Muni and BART. It was complemented by in-depth qualitative interviews with 11 stakeholders familiar with Chariot operations in San Francisco. The various steps involved in data acquisition, processing and quantitative analysis were performed in the programming language Python, while qualitative data from in-depth interviews was analyzed in the software Dedoose.

#### 3.1. Static spatial analysis of service areas

At its most basic level, the potential for competition between fixed route transit services can be assessed through the extent of overlap between the service areas of various networks. In the case of public transportation in San Francisco, in an already constrained financial environment for public transit providers, competition from other mobility services can jeopardize the viability of the entire network.

Considering the host of transit providers that operate in San Francisco, many of which only serve a limited number of stops in the city because they provide connections to other Bay Area counties, the present analysis was limited to the two major public transit providers for the city: the San Francisco Municipal Transportation Agency (SFMTA) and Bay Area Regional Transit (BART). This simplification was deemed reasonable based on the fact that both operators allow most of intra-city trips – i.e. in the study area of the present report – while other providers are mainly relied upon for inter-city trips. For the sake of simplicity, Muni and BART networks were considered as a single public transit network, thus ignoring components of their operations that may generate conflicts when transferring from one provider to the other. This allowed for the direct estimation of the overall level of public transit ridership that could have been siphoned off by Chariot's on-demand routes in San Francisco, as will be detailed later.

Since Chariot provided on-demand rides on fixed routes, stop locations on their routes open to the general public were retrieved directly from their website, with information on the corresponding routes and hours of operation. Transit data for the SFMTA and BART was retrieved from the operators' respective websites in GTFS (General Transit Feed Specification) format. GTFS is a standardized format widely used by transit operators to provide access to key service information to the public – it is not meant to be used for operational purposes. Each GTFS feed is made of a set of text files, some of which are mandatory for any feed to be valid, others optional. Mandatory information includes a table with information on the transit agency, stops, routes, trips for each route, arrival and departure times at each stop for each trip, and service dates (“General Transit Feed Specification Reference,” 2019). For the three transit providers, only stops located within the boundaries of the city of San Francisco and operational during morning rush hour on weekdays were kept for the analysis. This distinction was necessary because there were some variations between the routes and stops in service for Chariot and Muni between the morning peak and the remainder of their service hours. It did not change anything for the BART stations within San Francisco. Weekday morning peak was defined as the 3-hour period between 6:30 AM and 9:30 AM, based on Chariot's core operating hours, with all its morning routes fully operational. Using stop locations from the resulting dataset for public transportation and microtransit, walksheds around stops were then created, as they constitute a good representation of transit service areas. Buffers of a quarter mile around each transit stop for both the public transit network and the microtransit network were used to draw the boundaries of service areas for both types of providers (NACTO, 2016). Areas of overlap between the

public transit and microtransit walksheds corresponded to areas in which residents or workers would be within walking distance of both types of services, and therefore, with the emergence of Chariot in an area formerly only served by public transportation, could potentially decide to opt for microtransit instead of Muni or BART.

City-wide data on population at the census block group level for San Francisco in 2015 was retrieved from the Census Bureau's American Community Survey's (ACS) API for direct processing in Python. In addition to information on San Francisco residents and their home locations and because Chariot service was designed for commuters, counts of jobs for all sectors in 2015 in San Francisco were retrieved from the Census Bureau's Longitudinal Employer-Household Database (LEHD) at the census block level. The abovementioned socioeconomic data was then adjoined to the public transit and microtransit walksheds. The ratio between the population located in overlap areas and the entire public transit service area represents an upper-bound estimate of the potential for Chariot to skim riders from Muni and BART, if all the people living in these areas used to ride public transit and they all decided to ride Chariot once it started operating in their neighborhood.

### 3.2. Assessment of accessibility improvement potential

UrbanAccess is an open source tool available as a Python library that allows to measure transit accessibility for multimodal networks combining pedestrian and transit network information, and has proven useful to perform such analyses over fragmented transit networks with multiple agencies (Blanchard & Waddell, 2017b, 2017a). As illustrated in Figure 2, UrbanAccess allows the creation of an integrated transit and pedestrian network that may include several transit agencies at a time, using GTFS and OpenStreetMap data, with nodes of the resulting network corresponding to intersections and transit stops, and edges of the network representing streets and transit right-of-way linking two nodes. Figure 2 displays the resulting integrated public transit and pedestrian network colored by travel time during morning rush, which highlights major transit arterials like Market Street as well as the BART rail network and showcases any possible connection by foot or by transit in the city.

In UrbanAccess, each node gets assigned a weight that corresponds to travel impedance, in minutes. Census block centroids are then used as origins and destinations, allowing to calculate cumulative accessibility metrics over the integrated weighted transit and pedestrian network. UrbanAccess can compute accessibility measures for any given set of opportunities, and in the present research it was used to calculate the number of jobs in the city of San Francisco (as of 2015) accessible within a given time period, and compare these metrics for a network with pedestrian and public transportation connections only, and an integrated network that would include Chariot as well. Time thresholds for commute times were taken at 15, 30, 45 and 60 minutes. These figures were chosen based on the latest average commute times in the San Francisco and beyond, which indicated that 30 minutes was a relatively standard commute duration: commute times averaged 32.4 minutes in San Francisco in 2016, and 31.6 minutes in the Bay Area as a whole. The ACS reported that 2013-2017 mean commute times stood at about 28.8 minutes for the state of California, and 26.4 on average for the entire country. Considering that it is standard to characterize commutes lasting over an hour as "extreme", other time thresholds were chosen to give an illustrative representation of standard commute times (MTC, 2018).



Figure 2. Integrated public transit and pedestrian network by travel time during the morning peak period in San Francisco

The specific steps performed by the UrbanAccess tool are summarized in Figure 3 in addition to the pre-processing needed for Chariot network data. Indeed, one challenge to perform a standard accessibility analysis for microtransit was the fact that UrbanAccess requires stop and schedule information in GTFS format as its input, and Chariot did not have a GTFS feed because it provided on-demand services. The only information publicly available for Chariot were stop locations, routes and a range of headways for each route and service period (morning or evening commute): on its website, the microtransit operators provided customers with information on how regularly shuttles might come by a given stop for a given route, e.g. for the Union Cruiser line, advertised headways were between 5 and 15 minutes in the morning. Two GTFS feeds were created for Chariot to account for two extreme cases: one where all routes would have minimal headways, and one where all routes would have maximal headways. Each GTFS table was created in Python, and the stop time table was created from scratch based on said headways as well as inter-stop travel times pulled from the Google Maps API. The respective high-frequency and low-frequency networks were then each integrated with the Muni and BART networks to assess the maximum and minimum impact that the integration of both fixed and on-demand transit could have on accessibility to employment opportunities in the city.



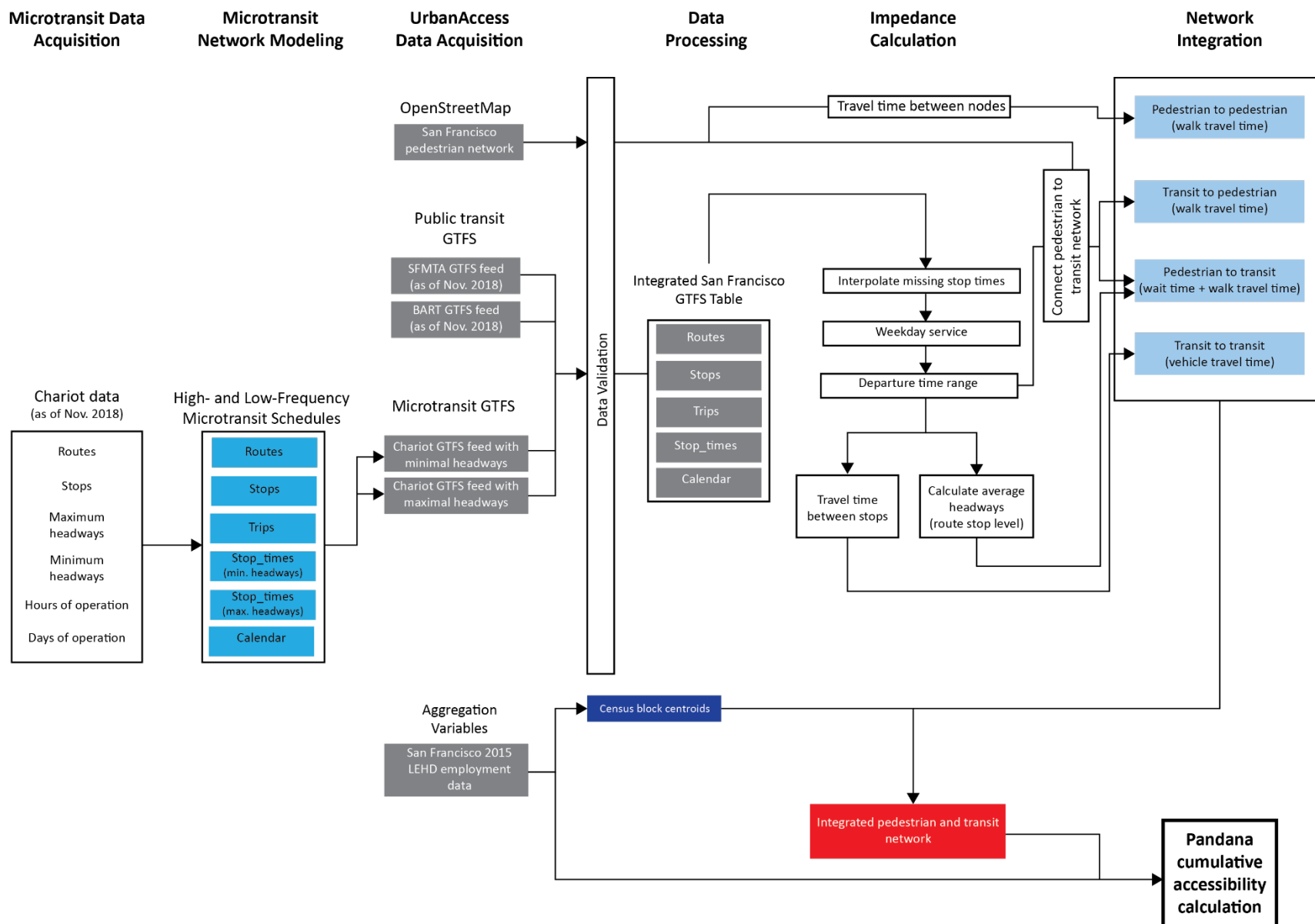


Figure 3. Flowchart summary of the quantitative methodology (adapted from Blanchard & Waddell, 2017b)

### 3.3. In-depth stakeholder interviews

In-depth interviews were conducted with 11 informants to gather a variety of perspectives on Chariot and its operations in San Francisco, from former Chariot employees to transportation regulators at the SFMTA (from its Board of Directors, the Office of Innovation, the Curb Management and Taxi & Accessible Services divisions) and the SFCTA, city officials from the Mayor's Office, transit advocates at San Francisco Transit Riders, and representatives of the general public from the SFMTA Citizens' Advisory Council. Interviews lasted about one hour and involved open-ended questions about the participant's experience with Chariot, challenges in the provision of on-demand transit services in San Francisco and the lessons that could be learned for the future of transit in the city. All interviews started with the participants reviewing and signing a consent form, followed by a brief introduction of the research and its objectives. Participants were then asked introductory questions about their organization, their personal role and how it related to Chariot and emerging mobility services in general. The core interview questions that followed varied by type of informant. The interview ended with closing general questions, and requests for recommendations of new contacts, to allow snowball sampling. No direct benefit was offered to interviewees for their participation. All quotes in the present report have been validated by their authors prior to their publication. Some names of informants were redacted to respect their privacy. Each interview was fully transcribed based on its audio recording, and then coded in the software Dedoose. Codes were used to draw major themes that emerged from interviews and guided the resulting policy recommendations at the end of this report.

## 4. Results

### 4.1. Assessing the risk for competition between Chariot and San Francisco's public transit

#### Service areas of public transit and microtransit in SF

San Francisco enjoys a wide coverage by public transit, thanks to the vast extent of the Muni network. Of its 47 square miles, about 91.3% were already covered by public transit (BART and Muni). The extent of the Chariot network was much smaller, with its morning service area spanning only 20.8% of the city. Overall, the microtransit provider served parts of the city with higher population and employment densities than those of public transit – which are equivalent to city-wide densities, because of the wide coverage of the transit network. Because it focused on connecting residential neighborhoods to downtown, Chariot's commuter shuttles served the densest parts of the city: Chariot covered parts of the city with an average population density of 35,000 people per square mile and employment density of 32,000 jobs per square mile, against San Francisco's average 32,000 residents per square mile and 23,000 jobs per square mile as of 2015. Figures 4 and 5 display the census block groups served by microtransit in the morning, and the corresponding 2015 population and employment density respectively. As illustrated by the histograms, the corresponding population and employment distributions are comparable for the two networks, but microtransit served denser parts of the city that public transit, which also covers areas of San Francisco that are very low density.

#### Potential scale of transit ridership impact

This very assessment is at the root of the concern that Chariot might have been skimming riders off of public transit: in a city so well covered by public transit in pure geographical terms, how could a new transportation provider not impact public transit ridership, and, as a consequence, its financial viability? Chariot covered about 22.8% of the Muni and BART service areas within San Francisco, and because it was located in the densest parts of the city where you find the transit routes with the highest ridership levels, this overlap represented a potential threat for the entire public transit system. The extent of overlap between the Chariot and public transit service areas provides an upper bound for the competition potential rather than a true estimate, as it does not take into account mode shares of the geographies of interest and is solely based on geographical coverage, without taking into account the potential impact that differences in level of service (in terms of frequency, stop density etc.) can have on ridership outcomes. However, beyond the respective size of overlapping service areas, what matters for ridership is the corresponding density of people and jobs that were previously served by public transit only and that Chariot then started to serve. Overall, the microtransit provider covered about 16.71% of the population served by public transit, and 30.57% of employment opportunities. These estimates give an idea of the scale of potential competition. Nevertheless, this estimate ignores the existing mode split in these service areas, and the fact that transit is competing with many other transportation modes: not all people living within walking distance from a transit stop ride public transportation to get to work. Further analyses to assess competition should incorporate current mode shares to account for the fact that some areas of great overlap may have low transit ridership in the first place. Additionally, as noted above, they do not provide a true image of competition because public transportation service area covers essentially the entire city of San Francisco. If real frequencies had been available for Chariot, it would be more relevant to compare the overlap in service areas based on level of service in the different geographies rather than mere geographical overlap.

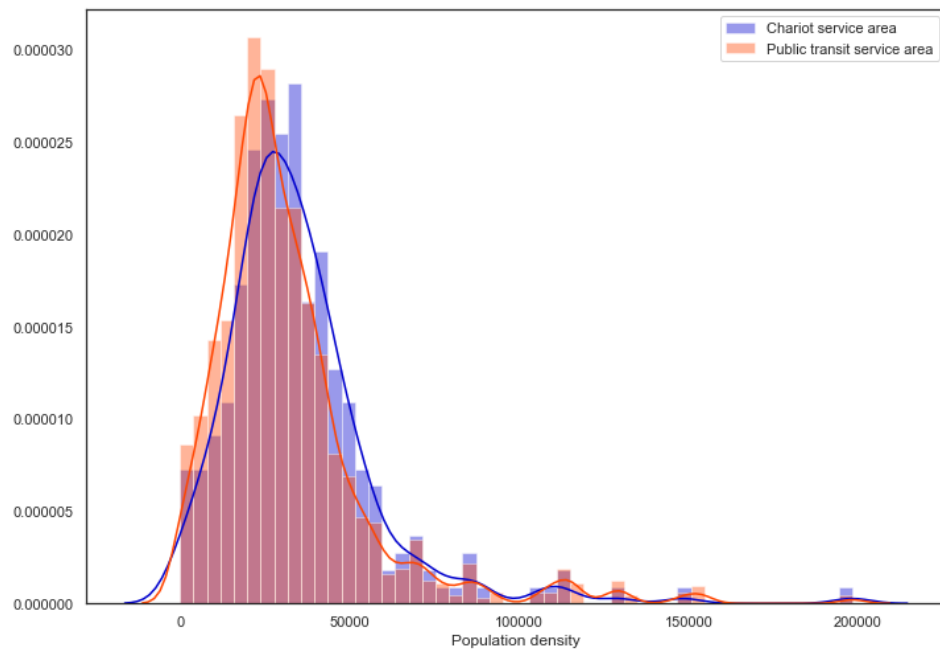
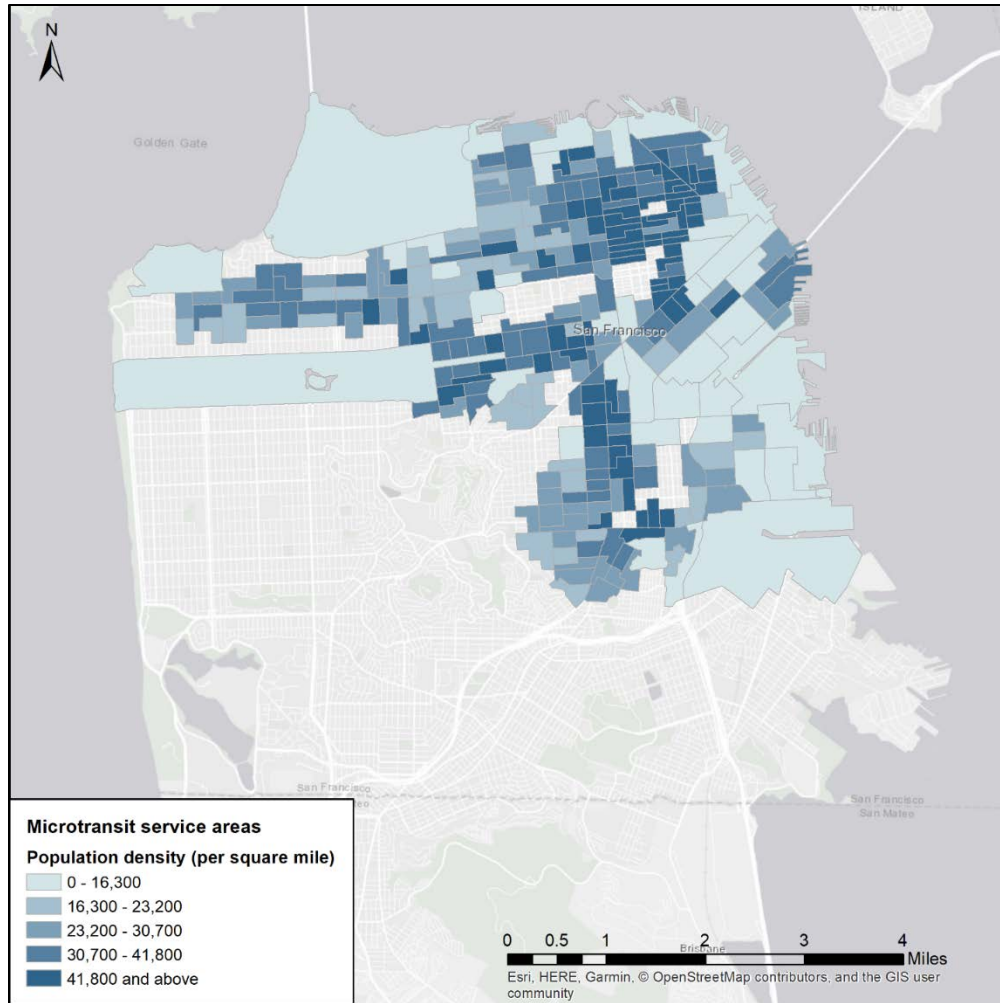


Figure 4. Population density in microtransit service and public transit areas in San Francisco

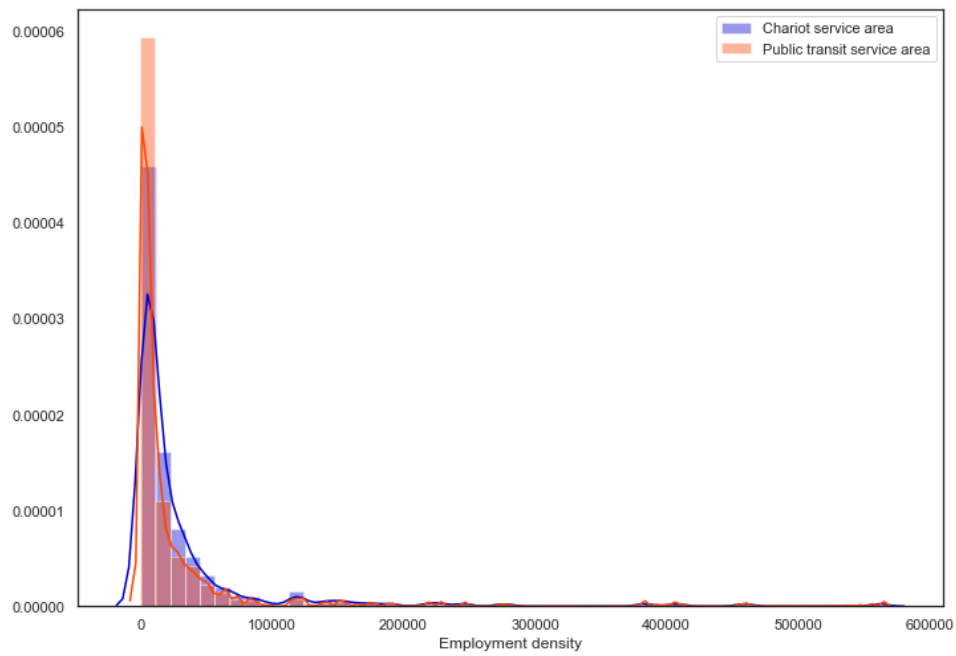
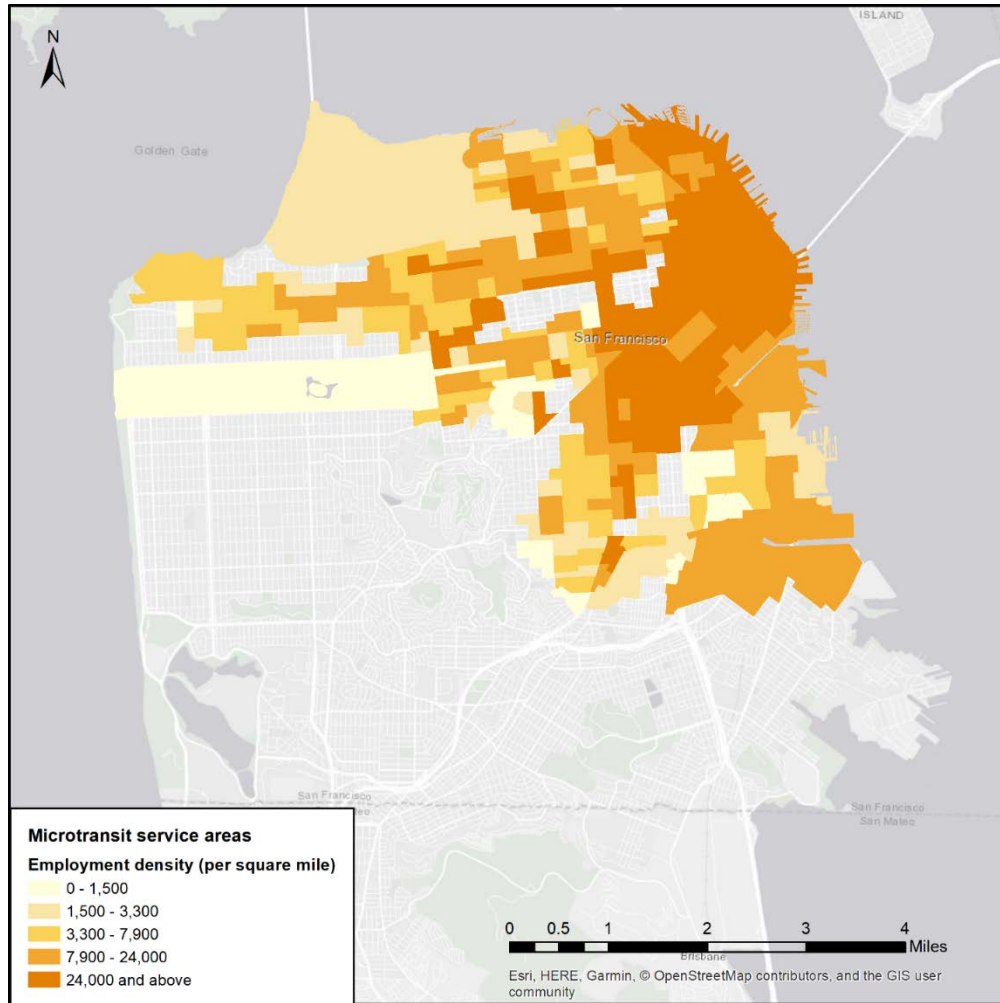


Figure 5. Employment density in microtransit and public transit service areas in San Francisco

#### 4.2. Filling the gaps in public transit: opportunities for a dual system with fixed and on-demand transit

Baseline public transit accessibility with Muni and BART as one network

When considering an intra-city transit network made of Muni and BART only, downtown San Francisco enjoys the highest accessibility levels, thanks to its abovementioned high concentration of jobs. However, the more the time threshold increases, the more the radius of the number of jobs within reach expands.

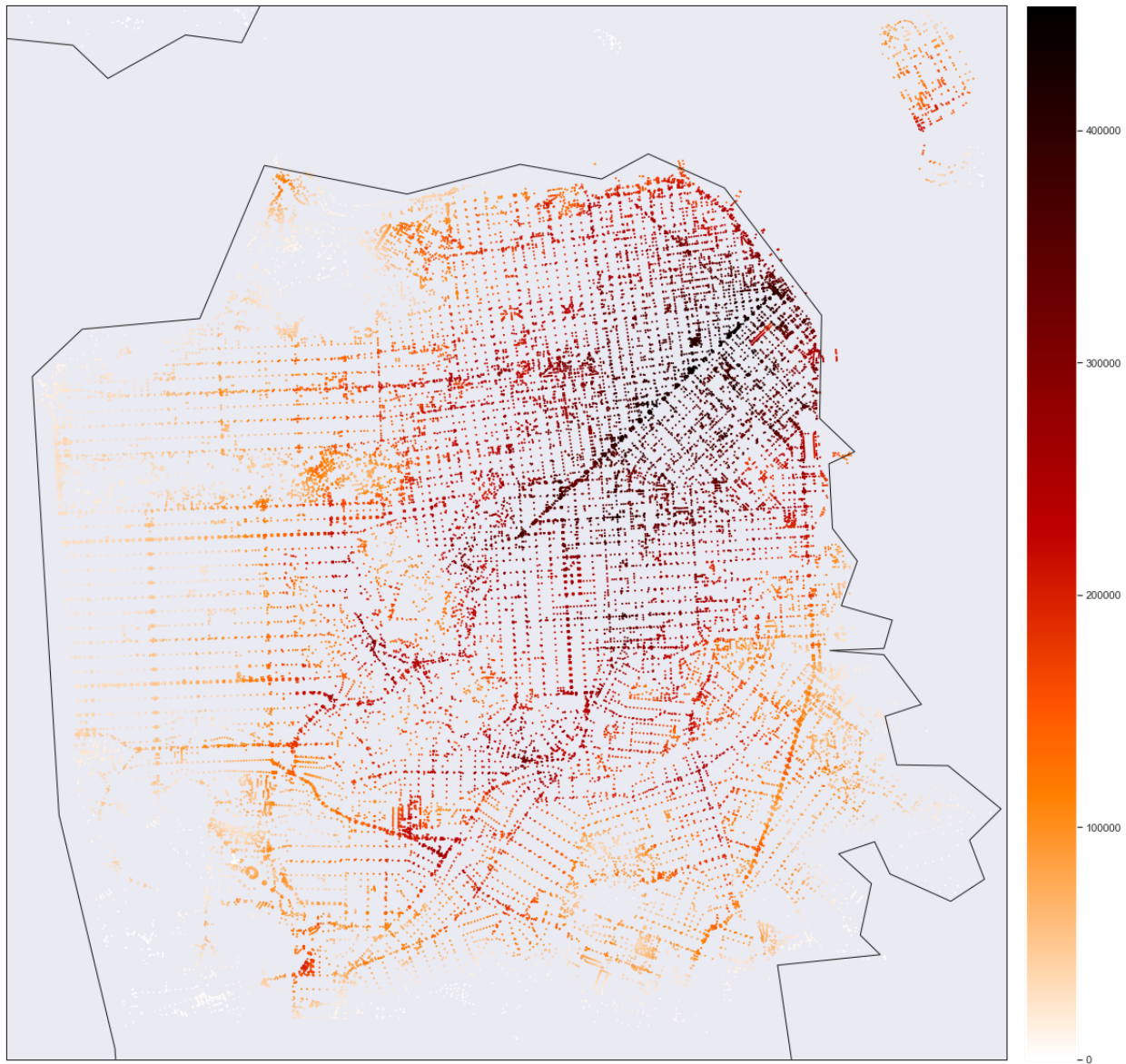


Figure 6. Accessibility to jobs within 30 minutes in San Francisco with the public transit and pedestrian network

For a 30-minute commute, areas with access to over 250,000 employment opportunities are still located in the Northeast of San Francisco but they extend well beyond downtown (Figure 6). It extends even

further with a 45-minute commute, although the very far West and far Southwest and Southeast of the city remain poorly served in terms of job accessibility.<sup>4</sup>

Transit accessibility with a mixed transit network with Muni BART and Chariot

As illustrated by the distribution of accessibility improvements for a 30-minute commute when integrating public transit with microtransit for minimal headways on Figure 7, there were significant increases in accessibility to employment opportunities for a number census blocks. This is the case for the various time thresholds and for both the high-frequency and low-frequency Chariot networks<sup>5</sup>, which suggests that the possibility for people to ride a combination of Chariot, Muni and BART made a big difference for residents in several parts of the city – if you ignore barriers to riding multiple transportation providers on a single trip.

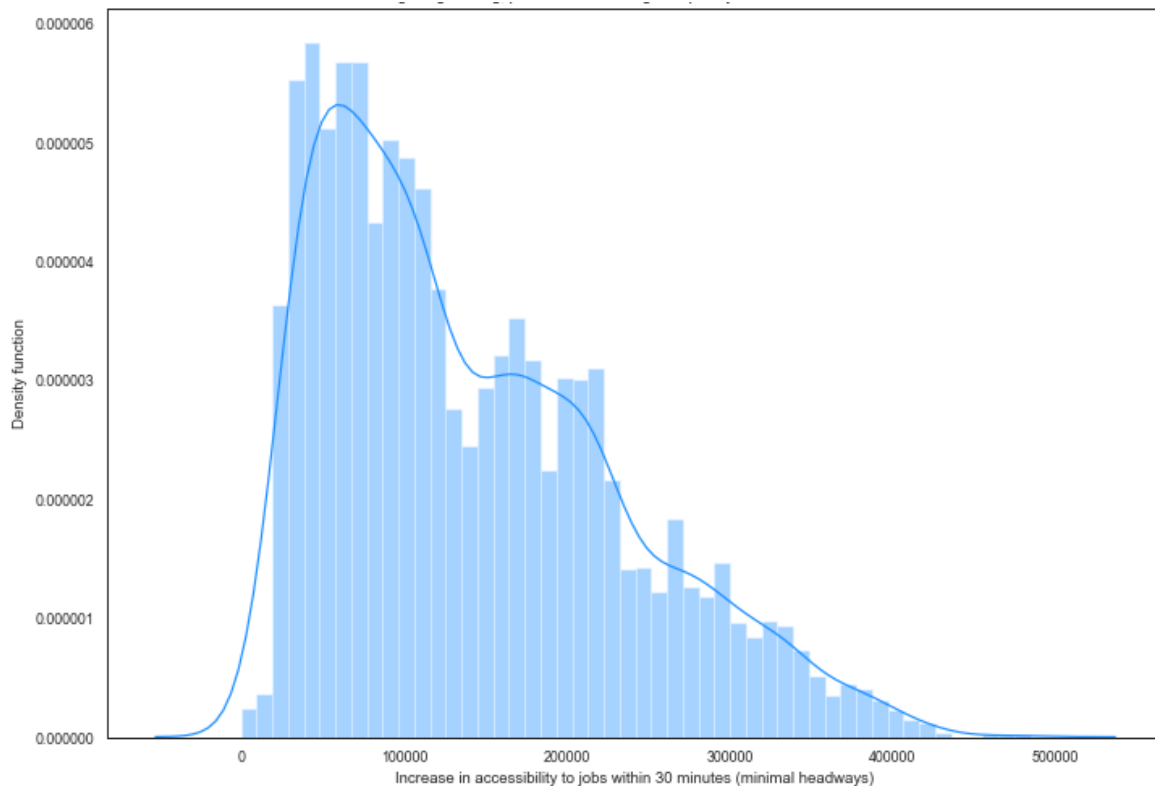


Figure 7. Census block distribution of increases in accessibility to jobs within 30 minutes when integrating public transit and high-frequency microtransit in San Francisco

The spatial distribution of results shows that when integrated with public transit, microtransit expands areas with high job accessibility well beyond the Northeastern part of the city, going out to the Marina, the Richmond, the Presidio, and the Sunset among others (Figure 8).

<sup>4</sup> See transit accessibility maps for all time thresholds in Appendix 2.

<sup>5</sup> See detailed results of changes in accessibility in Appendix 2.

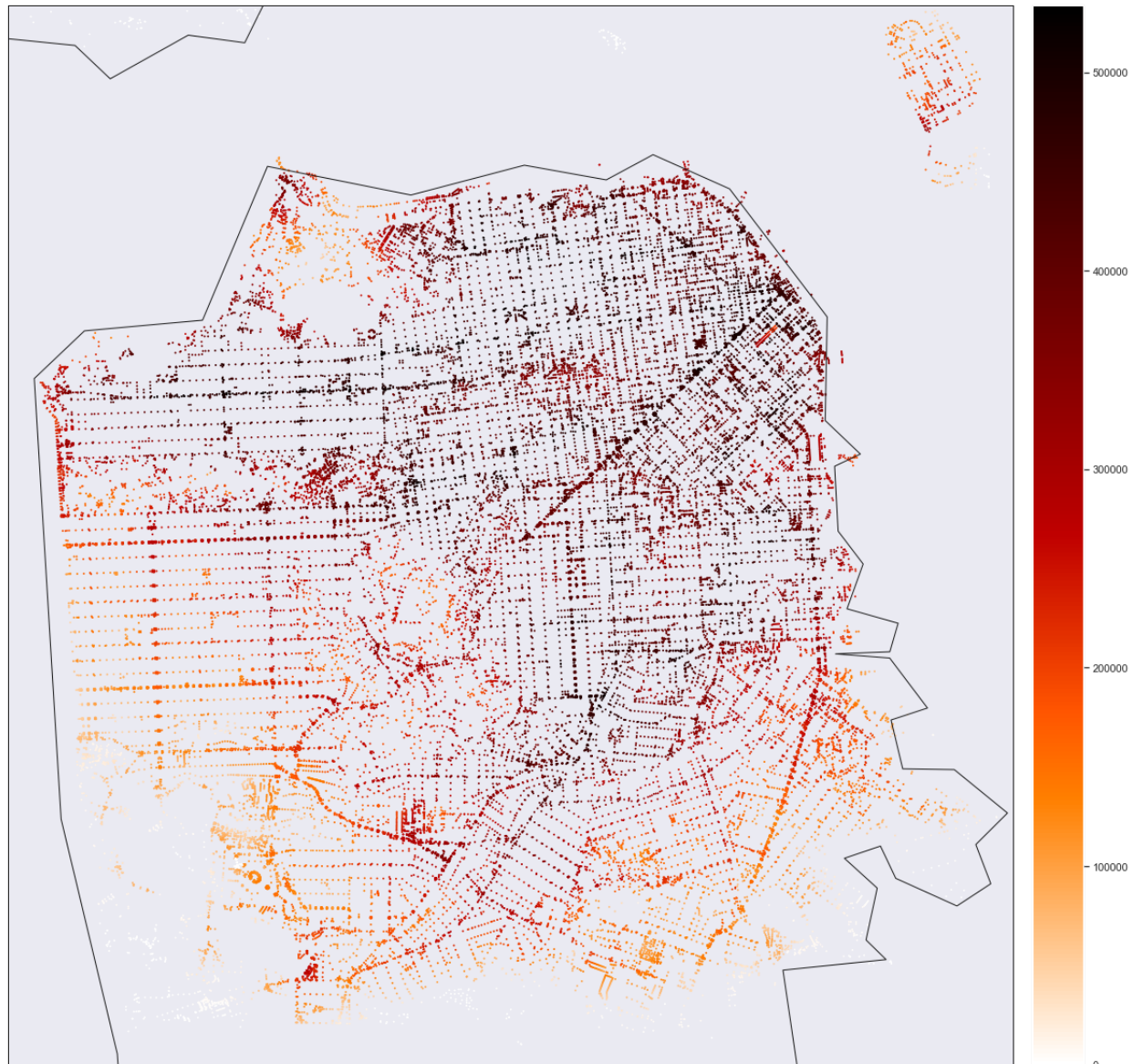


Figure 8. Accessibility to jobs within 30 minutes in San Francisco with the integrated high-frequency microtransit, public transit and pedestrian network

A closer look at the distribution of accessibility improvements for the various configurations of the mixed transit network (with high and low microtransit frequency respectively) for each neighborhood<sup>6</sup> of San Francisco reveals that the Inner Richmond and Presidio Heights were always among the top 5 neighborhoods with the greatest improvement in accessibility to jobs for the four different travel time thresholds analyzed (both in terms of median accessibility change and maximum change), be it for the high-frequency or the low-frequency Chariot network (Figure 9). The scale of the accessibility improvements is pretty significant for these two neighborhoods, with the addition of high-frequency

<sup>6</sup> Neighborhood boundaries are based on the definition of “analysis neighborhoods” established by the San Francisco Department of Public Health and the Mayor’s Office of Housing and Community Development, as opposed to planning districts, because they correspond better to common real estate and residents’ definitions of the city’s neighborhoods. See Appendix 2 for a map of neighborhood boundaries.



Chariot to the transit network giving access to an additional 315,900 employment opportunities (neighborhood median) within 30 minutes for residents of the Inner Richmond compared to relying on fixed transit only, and 294,400 for Presidio Heights.<sup>7</sup> Regardless of the integrated network configuration and travel time threshold considered, it is worth noting that there was great variability in the distribution of accessibility improvements from one neighborhood to the next, and even within a single neighborhood.

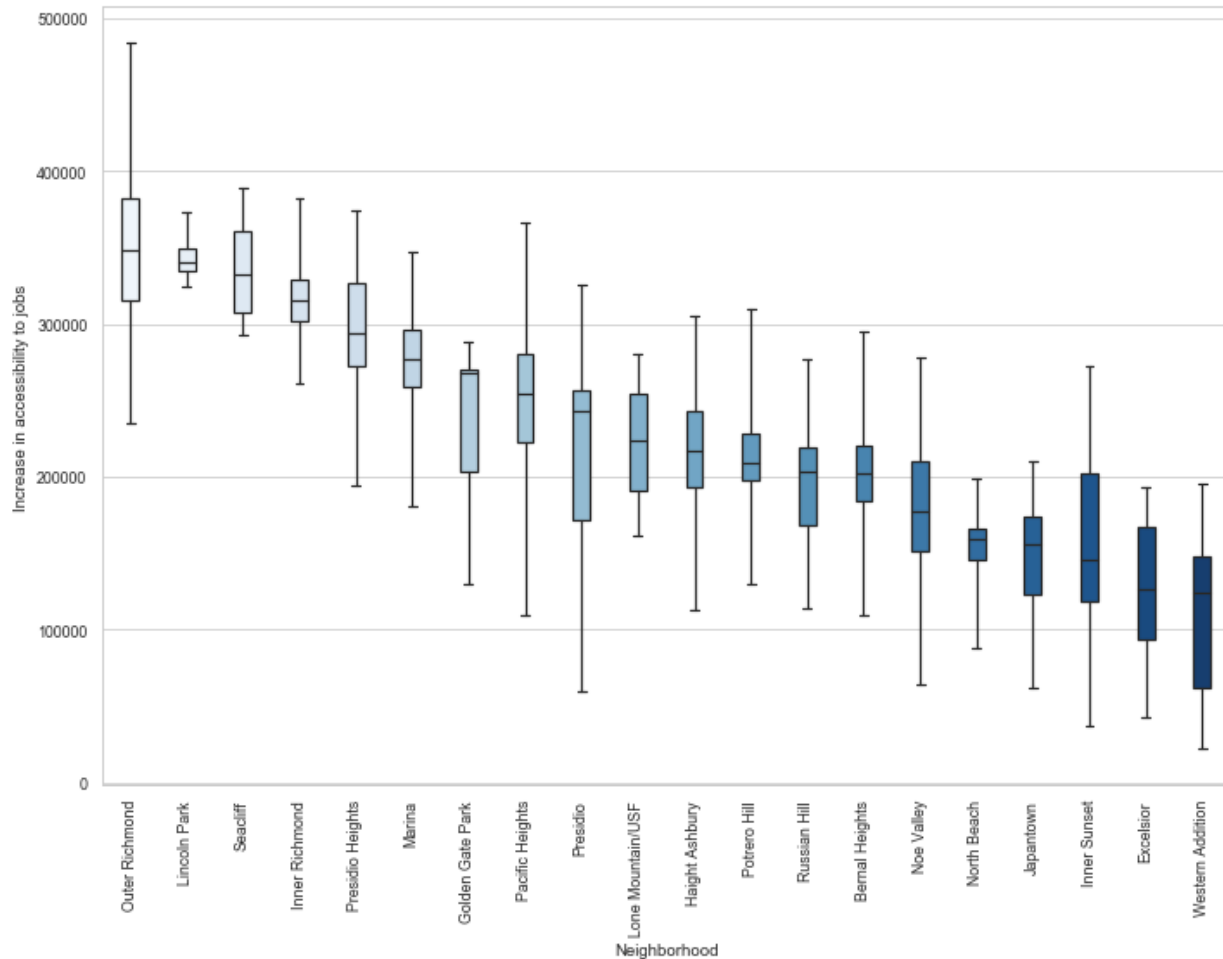


Figure 9. Distribution of increases in accessibility to jobs within 30 minutes for San Francisco neighborhoods when integrating high-frequency microtransit and public transit<sup>8</sup>

As part of Plan Bay Area 2040, the Metropolitan Transportation Commission created an equity framework with the aim of analyzing the impact of future scenarios on disadvantaged communities, referred to as “Communities of Concern”. The definition of a community of Concern is based on a set of disadvantage factors from the census at the census tract level: minority, low-income, limited English proficiency, elderly, zero-vehicle household, single-parent family, people with a disability, and cost-burdened renter. To be flagged as a community of concern, a census tract needs to either (i) exceed both threshold values for the low-income and the minority shares, or (ii) exceed the threshold value for low-income as well as thresholds for three or more other variables (MTC & ABAG, 2017). Based on this definition, transportation

<sup>7</sup> See Appendix 2 for detailed accessibility changes by neighborhood.

<sup>8</sup> For legibility purposes, only the 20 neighborhoods with the greatest median were displayed on this graph. See Appendix 2 for the full list of accessibility changes by neighborhood.

outcomes for communities of concern are particularly critical, as low-income households with low car ownership may depend heavily on public transit for their everyday trips, including getting to and from work. The quality of transit service is therefore likely to deeply affect their quality of life, and reduced commute times would be extremely beneficial to these already vulnerable communities. However, it appears that for commute times of 30 minutes or more, median increases in accessibility to jobs were lower for communities of concern than they were for the rest of the city (see below), be it for the high-frequency integrated microtransit and public transit network, or for the low-frequency network. Moreover, maximum accessibility improvements were also lower in communities of concern than elsewhere. When breaking communities of concern by level of vulnerability, the variability of accessibility increases was much greater for the lowest class of communities of concern than other categories (see Appendix 2 for detailed distributions by travel time and network type).

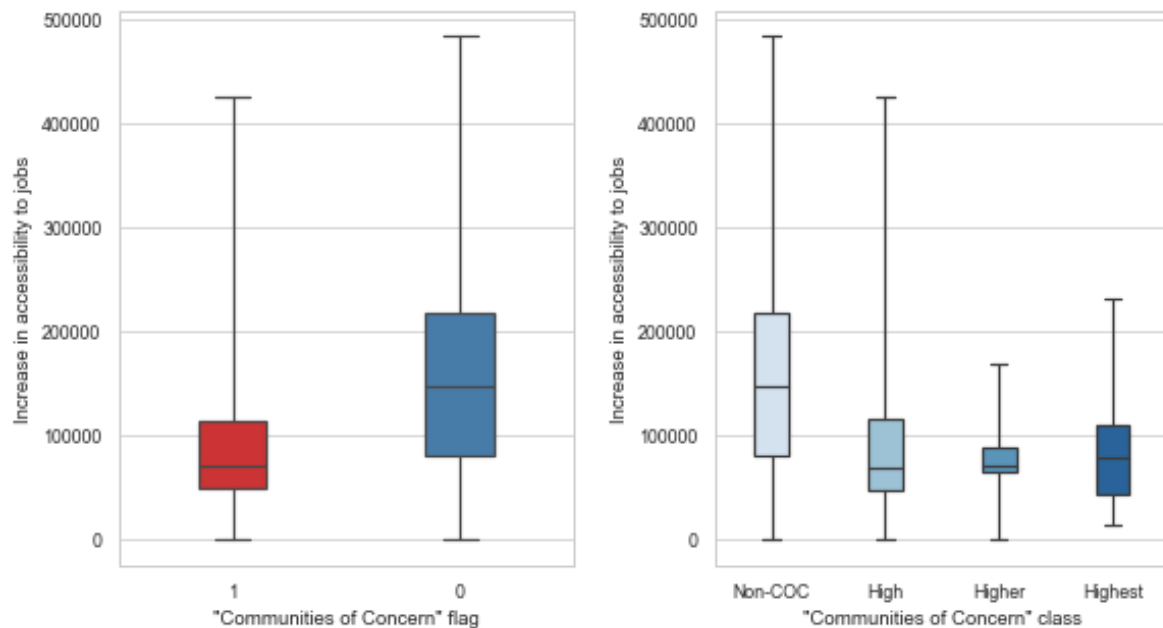


Figure 10. Distribution of increases in accessibility to jobs within 30 minutes for San Francisco’s communities of concern when integrating high-frequency microtransit and public transit

This analysis of accessibility improvements from integration between public transit and microtransit in San Francisco seems to indicate that Chariot could have had a transformative impact on the city’s transportation system. However, these changes were not evenly distributed across the city, and did not seem to impact vulnerable communities as much as the rest of the city. While some of the stakeholders from the public sector did not seem to understand the extent of the potential transformational impact that Chariot could have for the city, they were very aware of the fact that their impact was unevenly distributed in the city, and mentioned several times their worry that Chariot “cherry-picked” profitable locations in the city rather than serving everyone. The next section will dive into the underpinnings of Chariot’s time in San Francisco from the perspective of various transportation stakeholders, and draw lessons for the future of microtransit.

### 4.3. Unveiling the Chariot story

#### Aligning competing priorities within San Francisco's transportation ecosystem

##### *The multiple agendas of the public sector*

The City of San Francisco has a host of stakeholders from the public sector with varying levels of oversight over the transportation system, from city officials to transportation regulators, transportation operators and other political figures. Each of them has a different agenda when it comes to microtransit and emerging mobility services more broadly, and when faced with the need to regulate Chariot's public routes and adopt a clear position on privately-operated microtransit services in the city, it became necessary to align the multiple agendas that the city's complex governance structure allowed to coexist.

When it comes to interactions with a private mobility provider like Chariot, although bound by the same overarching goals for the city, different offices within public entities assume different roles and they have short and medium-term priorities. In the case of Chariot, they interacted directly with the SFMTA and the SFCTA as part of the drafting of the PTV permit legislation, but also with members of the city's Board of Supervisors, in an attempt to align Chariot's vision and goals for San Francisco with the City's own goals and values. Safety, equity, accessibility and sustainability within the transportation system were goals shared across the board among public stakeholders, but in addition to that, public infrastructure use, transit efficiency and enforcement were also priority items on the SFMTA's agenda when it comes to emerging mobility, as it is tied by its role as transit operator and regulator of the city's right-of-way. On the other hand, the SFCTA's is not bound by the same immediate constraints when it comes to thinking about emerging mobility. This is the main reason why both agencies had diverging objectives in how they envisioned the relationship between the City and private mobility providers like Chariot. The SFCTA has more freedom to adopt a risk-taking approach, or at the very least an innovation-fostering attitude when it comes to promoting shared rides – and is thus more susceptible to engage in pilot programs – than its counterpart agency, whereas the SFMTA is busy with day-to-day operations and addressing more immediate concerns of its constituents regarding Muni's service quality, in addition to regulating the use of city streets. As Warren Logan, Senior Transportation Planner responsible for managing emerging mobility at the SFCTA, put it:

One of the big coordinating efforts between the SFCTA and the SFMTA was that I would take a step back during the negotiations for the PTV regulation, to make sure that both agencies were on the same page regarding goals for regulation.

All public agencies within San Francisco have to abide by the city's charter and its Transit First policy, which includes encouraging the use of all sustainable modes, from active transportation to high-occupancy modes. This means that Transit First is not limited to transit only and should support private mobility providers like Chariot that offer alternatives to driving a private vehicle. However, making it easier for people who would not otherwise ride public transit to use other shared modes is still highly contentious in the city – in part because agencies have different agendas. While microtransit is seen by some as an opportunity to reduce car trips, it is seen by others as a risk to skim riders from profitable transit routes, which will end up harming the overall viability of the public transit system and threaten less profitable yet vital routes for vulnerable, transit-dependent households.

##### *Understanding Chariot's priorities in San Francisco*

The way that Chariot's plans in San Francisco are depicted varies a great deal depending on who you ask and what aspects of the Chariot business they focus on.

Chariot was not a public transit operator and was therefore not held by the same standards of serving everyone like public agencies receiving federal funding do, as explained by one city official:

We have to think about our city holistically. We have federal regulations that we have to abide by when it comes to changing transit lines, to make sure that we are benefitting all of the communities in the city, not just one community. We have to really balance everything. It was interesting to listen to Chariot because obviously they were not beholden by those types of regulations. You know, between a risk-taking tech entrepreneur and thoughtful careful planners and engineers at the SFMTA, there's a big personality difference.

Free from this equity mandate, Chariot was free to choose how to prioritize its service to the public. Since they were not obligated to blanket the entire city evenly with public routes, they started with the ones that had the most crowdfunding support, as a way to gauge interest and secure initial riders at the same time. This resulted in the routes that Chariot were known for, ferrying commuters from select residential neighborhoods to downtown, with few stops in the middle. With this configuration, Chariot did not serve the entire city, and was criticized for not being equitable for that reason. However, serving the entire city was never their main ambition. This cultural difference between the private operator and the expectations from some city staff and activists came through in several conversations as a reproach. Former Chariot staff interviewed mentioned several times that efficiency was at the core of what they were trying to achieve in the city: addressing a latent need from San Francisco commuters for more efficiency and convenience that Muni was not in a position to achieve for various reasons. To Chariot, this meant being fast and reliable, and offering some additional connections that would remove the need to transfer to get from certain neighborhoods to downtown. This meant significant reported time savings on their riders' commute.

The fact that Chariot started a public-facing commuter shuttle service in San Francisco is not foreign to its founder having been frustrated with his own commute when he was working a regular job downtown. But over the years, Chariot diversified its business model, changed how it was launching and financing new routes, added routes for employers that went beyond San Francisco's boundaries, as well as charter services. While this can be seen as a way for the company to increase its profit margins, the fact that the microtransit operator kept running public routes despite their unprofitability tells an interesting story. The private routes and the charter business did start as a way to cover the costs of the public routes, but the gap between the losses on the public routes and the profit margins on the private side of the business could have made Chariot pivot entirely to business-to-business model. And yet, it did not. Knowing that, one could say that "it was noble from them to provide publicly-accessible services" in addition to their charter business, as one interviewee said. Chariot's public routes were public-facing, and they represented how the company started in San Francisco. And because running a service very similar to Muni came with a lot of operational and public relations challenges compared to running a private shuttle service under CPUC regulation, the outside perception of the importance that the company gave to growing the public side of its business in the later months was somewhat overestimated. One senior data analyst who used to work there said even though Chariot's service to the public was what publicized the company, public-facing microtransit became a secondary objective over time, and it ended up playing more of an experimental role, almost a learning platform for Ford. Interestingly enough, this was also the impression that some of the transportation regulators ended up having: that Ford was more interested in gathering information than running operations – which could have something to do with the long-term vision they had for Chariot initially, i.e. eventually moving towards running an autonomous microtransit

system. This is quite a typical scenario for San Francisco, considering how the city has been increasingly used as a test bed for emerging mobility services.

### Reacting to private innovation

The response from the public sector to Chariot services was dictated by one overarching attitude: protection. This meant both protecting current public transit operations as well as protecting the public sector's hegemony over the public right-of-way.

#### *Protecting public transit*

The major concern voiced by stakeholders from the public sector as well as some advocates was that privately-provided microtransit services represented a risk to public transit operations. In its negotiations with Chariot, protecting Muni ridership was therefore one of the SFMTA's top priorities, as a transit operator. Ensuring that Chariot would not hinder Muni operations was a non-negotiable: the SFMTA therefore sought to make sure that Chariot would not use bus stops and load or unload in the way of public buses, as it could slow down Muni service. This made the route duplication criteria one of the main points of contention in the negotiation. This public transit protection mantra has interesting consequences in attitudes towards Chariot and the opportunities it could create for the city. Because concerns about ridership loss and safe operations by private operators are so deeply entrenched in regulators' minds, interviews with city regulators unveiled internal contradictions about whether crowding relief on routes that are already overcapacity is desirable altogether. The common understanding that some Muni lines cannot carry more people in the current state of the transit system is always counterbalanced by the constant expectation that private operators would get in the way of transit vehicles or operate in an unsafe manner compared to Muni-trained drivers. Additionally, the fact that such crowding relieving would be seen as opportunistic and cherry-picking passengers off of the most profitable transit lines is results in regulators not supporting it.

#### *Keeping control over the public right-of-way*

Chariot also prompted reactions from the public sector and advocates that pertained to broader questions about the role of the private sector in the city's transportation system. Some interviewees showed strong skepticism towards privately-provided mobility services in general, exacerbated by the fact that the public has no way of forcing private operators to share information equivalent to a public records request for public agencies, which could lead to less transparency in the planning process. Beyond that, the growing role of the private sector in the transportation landscape is seen by many as a substantial risk regarding equity in transportation, because private companies are not held to the same standards as agencies receiving federal funds, which need to serve the entire population. Whereas public agencies cannot remove service to certain communities, private investors are much more likely to withdraw, should a particular service not be profitable – like Chariot did – potentially leaving communities with no fallback option if the public sector is absent, Susan Vaughan, activist and member of the SFMTA's Citizens' Advisory Council warns:

If you privatize transportation, that's not good because neighborhoods are going to be left behind. Some demographics are going to be left behind, because [these companies] are private, they don't get federal funding, they don't have to serve every demographic.

Additionally, the predominance of private operators in some aspects of transportation could lead to profit-driven monopolistic or oligopolistic behaviors in the future once competition is eliminated or reduced. Venture capital-backed companies do not have real incentives to deliver services in an equitable way nor at a realistic price point – which is exacerbated by the fact that they are capitalizing on subsidized public infrastructure – and they may lock in users and raise prices later without being held to the same accountability standards as public operators. Fair competition between transportation operators and modes would require the city to set common goals and principles around what the city needs.

#### *Innovation and the regulation paradigm*

San Francisco's history with private mobility providers is a complicated one. City regulators have long been frustrated by the fact that they could not rule over TNCs, which fell under the CPUC jurisdiction. Commuter shuttles ferrying tech employees in large buses were also the source of a lot of public discontent in recent years, with a perception of the city being taken over by private capital. In this context, permits have therefore been the one-size-fits-all tool relied on by San Francisco regulators to deal with emerging mobility that fell under their jurisdiction. Chariot was no exception, as Warren Logan explains it:

That paradigm, in and of itself, is one of the challenges for not just Chariot, but also micromobility in general, and all emerging mobility: that in some ways, we have a toolset that we're very comfortable using. It's called regulation. What is newer to local government are public private partnerships.

#### *The evolution of Chariot's relationship to the City*

Chariot's relationship to the city evolved over time. The beginnings of Chariot followed the disruption model, with operations starting in a somewhat rogue way and an attempt to gather as many users and as much data as possible to inform their business. Because there was no regulation in place that applied to its intra-city service when it first launched, Chariot was able to operate in a gray area in its early days and decided to simply follow CPUC guidelines. Its approach and relationship to the city changed dramatically when Ford came in – for the better – and the company became more ready to engage with the city. Even before being regulated, Chariot got relatively proactive in collaborating and knowledge-building with the SFMTA and the SFCTA by helping the agencies understand their goals, challenges, operations, their value proposition for the city, as well as their ideas as to how the city could support them. They participated in the Emerging Mobility Evaluation Report and provided input that helped define the guiding principles and performance metrics for the guiding principles, even providing the SFCTA with data on their operations. When talks about the PTV regulation started, Chariot brought in staff to interact with regulators on a weekly basis and worked in close collaboration with them to design the PTV permit. More recently, they were also in active talks with supervisors in vulnerable communities with transit deserts to discuss the possibility of partnering with the city to provide first and last-mile connections to fixed transit as well as key destinations like hospitals and supermarkets at a very reduced price, with the help of state funds to subsidize the service.

The fact that Chariot got to the negotiations table and had a say in how its permit should be could seem surprising to some. Even though the SFMTA had the regulatory power, they needed to find the right balance in how strict and prescriptive they would be towards the single microtransit operator, because Chariot could have decided to add a route that would cross county lines and escape the SFMTA's

jurisdiction and oversight. This is the reason why the design of the permit was the result of negotiations rather than a regulation that only aligned with public priorities. During permit negotiations specifically, Chariot interacted directly with staff from the SFMTA's Office of Innovation, as well as the Taxi and Accessible Services department and the Curb Management department, each of which with its own priorities.

#### *Regulation as an enforcement mechanism*

Regulation for emerging mobility services is not always centered around fostering innovation. In the case of Chariot, it was primarily used as an enforcement mechanism, not an innovation enabler – in line with the overall concern about protecting public transit. This was also the result of how Chariot came about: by disrupting the city's transportation landscape with the ambition of “reinventing” mass transit rather than asking permission first. For the SFMTA, the PTV permit was the best way of exerting control and partnership over Chariot operations. It was also a way of ensuring that Chariot embraced the SFMTA's values and lived up to them. Enforcement was the primary motive for the regulation because the SFMTA had been receiving numerous complaints about Chariot operations in the past years regarding their stopping behavior mainly: the two main things were about the use of Muni stops and double-parking. Additional concerns included passenger loading or unloading in dangerous locations or in people's driveways, as well as the use of restricted streets – streets whose use is forbidden to vehicles exceeding a certain passenger capacity. Alexander Jonlin, a Transportation Planner in the SFMTA's Parking & Curb Management team who was involved in the design of the PTV permit, describes enforcement issues that existed prior to the permit and are specific to modes that the SFMTA does not have jurisdiction over:

In my team, we were tasked with dealing with other large passenger private transportation vehicles, which mostly meant tour buses and casino buses, things like that. But then that also meant Chariot. And because we don't have any kind of regulatory authority over any of those modes, then it was really just answering complaints and forwarding the complaint onto the company and trying to do something. But at the end of the day, we couldn't really do anything than forward the complaints [to the company].

The PTV permit finally gave to the SFMTA the leverage to enforce the rules that they had been receiving complaints about in the past, without any tangible way of pressuring the microtransit operator. By the time Chariot was granted their PTV permit, they were already trending towards legal locations for their stops and were about two-thirds complying. Thanks to the permit, there was a significant drop in complaints, and the SFMTA also had a way of monitoring and enforcing the use of restricted streets. In sum, for the city, regulation is a great instrument tool to address problematic behaviors that they previously had no leverage on. Additionally, the delivery of a permit is in itself a bargaining tool for the SFMTA to push on specific asks: it allows them to take advantage of that expectation to ask for more while withholding the permit, rather than delivering it and then having to revoke it later on through a more complicated process.

Chariot acknowledged the fact that in their early years, they had taken advantage of the lack of enforcement of certain traffic regulations to operate in a way that made the most sense to them, from an operational standpoint, and provide a fast service. The increased scrutiny that comes with the regulation of emerging mobility services brings about new operational challenges, that included for instance the need to redesign routes to remain off capacity-restricted streets, which made it harder for them to be flexible and deliver the value-proposition that they were trying to bring before the regulation was in place.

However, they lamented the fact that there was a double standard when it comes to enforcement. They were under the impression that the city pays extra attention to certain players in the mobility industry while turning a blind eye to others, mentioning for example the fact that even though they are private operators, taxis are not treated by regulators with the same zero tolerance as emerging mobility services. Taxis double parking or staging in illegal locations do not get the same scrutiny from the SFMTA than companies like Chariot when it comes to enforcement of traffic laws and safety standards. This may be related to the lower bargaining power that the taxi industry has compared to VC-backed companies. Chariot was also under the impression that the stand taken by some city stakeholders was sometimes motivated by the fact that it was easier politically for the city to hammer on companies labeled as “tech”, especially when these companies stand out, as do the bright blue Chariot vans, TNCs, or Google buses.

#### *Regulation as a bargaining tool for more data*

The city’s experience with other tech companies and emerging mobility providers has also shaped in large part its approach to data from the private sector. The SFMTA is frustrated by missing out on the data that private operators have because they could learn from it and it could help them improve transit service, while understanding how valuable this data can be to companies whose business depends on it. Data sharing is contentious in early-stage industries for this very reason: any information has the potential to be used by competitors and threaten the company altogether. In this context, it might be desirable to design creative regulations that protect critical data from public records requests. In the case of the PTV regulation, live data on the location of every Chariot vehicle was requested as part of the permit. On one hand, it served enforcement purposes because it allowed the SFMTA to enforce the use of restricted streets – though the quality of the data did not allow to verify curb behavior very precisely, because the precision of the location could not be precise enough. On the other hand, this data was also useful to give the SFMTA some information about volumes, which was especially of interest for streets with transit lanes. However, the city seems to not have the capacity to fully handle all of the data it wishes for: the amount of data that the SFMTA received daily was a lot to handle. Additionally, they did not end up using it for planning purposes – despite this specific use being referred to by multiple staff wishing for more data sharing. This echoes the impression that Chariot staff had regarding the city’s demands for data: the city did not seem to have a particular purpose for the data other than having access to it – which could be seen as a political win over a tech company, as explained by a former data analyst at Chariot:

I felt like they really wanted our data, but I didn’t feel like they were doing anything with it. Just so that could say they had our data.

Additionally, they mentioned that the SFMTA seemed to have difficulties moving away from a transit service mindset, in the particular data that they would ask for.

Nevertheless, it is worthwhile mentioning that the SFMTA only received ridership data very recently, in the form of stop-level information about boardings and alightings, which could be of use in terms of understanding better microtransit demand and adapting public transit service consequently. One missed opportunity was the fact that they waited before doing the travel behavior survey because they wanted to wait and conduct the survey across all permitted transportation modes at the same time, but the end of Chariot operations now precludes them from understanding why microtransit riders opted for that service rather than other transportation options.



*The dangers of reactionary regulation*

City staff involved in the creation of the PTV permit recognized and lamented the fact that the regulation was the result of a reactionary process and wish they had taken more of a partnership approach. Permitting is the go-to for the City but staff recognizes that “there is a need for evolution within civic regulation”, as the SFMTA Innovation Strategist Danielle Harris put it, because permits are very prescriptive and do not foster innovation in their current form. They leave limited room for permitted companies to test, fail, learn and adjust. And that is what happened to Chariot once they obtained the PTV permit, as mentioned by the former data analyst:

After the SFMTA made it harder to launch routes, our existing routes got grandfathered in, so we were terrified of losing them, so we’d just keep them on life support. (...) I feel like we got more cautious because of the SFMTA and Ford.

More broadly, creating a permit without the appropriate knowledge of operations has the potential to hinder innovation and prevent emerging services to evolve and achieve the goals set by the city that they have the potential to achieve. In the case of Chariot, one example of an operational “pain point” exacerbated by the PTV regulation related to the limited amount of curb space available in the city for passenger loading and unloading. Chariot stops were located in curb locations so heavily used already that allowing them to use Muni stops like members of the commuter shuttle program could have been an option considered to help them not have to double park.

City staff is aware of the pitfalls of reactionary regulation and alternatives to standard permitting are in the works. These alternatives would take the form of an authorization that would allow for a shared learning experience by letting companies test concepts and business models to see if people are interested, if it could be profitable, but above all, learning about impacts, which would inform more mature regulation in the future to ensure safe operations. Nevertheless, regulators tend to agree on the fact that the PTV permit was relatively good, as it gave clear incentives that aligned with the SFMTA’s goals while providing flexibility for operations to evolve and allowing the enforcement of illegal behaviors.

While this is work in progress, the Chariot experience has shown that the public sector remains in a paradigm that is primarily about regulation rather than success. In addition to protecting Muni ridership, the SFMTA’s priorities in the negotiations with Chariot were to understand why people might opt for microtransit rather than public transit – especially considering that several routes had alignments very close to that of Muni –, adapt the existing legislation to allow Chariot to exist and provide extra connections to the public without their operations hindering Muni operations. This is what led to the various provisions of the PTV permit regarding route duplication and data sharing. But performance was not at the core of the regulation’s goals, and neither is helping innovating services be successful. Progress towards Transit First goals and mobility as a service were not really measured by regulators adequately. This was pointed out for the PTV regulation but also applies to the general approach taken by the city towards private innovation. Warren Logan explained:

When we are approached by a private entity, we say: “How might we regulate you?” And if we know how to regulate you and reduce impacts, then we’re good. The metrics for success for regulation do not necessarily identify whether or not we are helping that service be successful.

Opportunities of partnership are therefore often disregarded, even if some city officials think that some of these innovations could have a value-added for the city. This leads to the city missing opportunities that could otherwise stem from innovation.

#### *Achievements of the PTV regulation*

Whether one thinks that permitting was the right approach in the case of microtransit or not, it would be unfair to ignore what the PTV permit achieved. Curb management was a great concern for the SFMTA, both from a transit operations standpoint and from a safety standpoint, and the PTV permit led to a significant drop in complaints, as Chariot was very cooperative and quickly complied with the new rules. Even Chariot considered that the route duplication criteria was a win for both parties, as it allowed the SFMTA to officially declare that Chariot did not compete with Muni based on that criteria and that it was not using Muni stops, while Chariot had protected its operations and kept some flexibility to create new routes in the future. This meant that Chariot would no longer threaten to hinder Muni operations, which was a non-negotiable for the SFMTA. Additionally, SFMTA staff pointed out that the permit gave incentives as to what the agency was trying to achieve, including by offering permit fee remissions for serving communities of concern, or providing first and last-mile connections to public transit.

#### *The challenges of creating a proactive partnering relationship*

Cities like San Francisco have learned from past experiences – especially with Uber and Lyft – that they need to be proactive. Nevertheless, proactive partnerships from day 1 require a tremendous amount of additional work from both parties to understand each other's goals, challenges, and perspectives for a successful relationship that will also be well accepted by the public. You need a foundation of trust to build on, to be able to work in all parties' best interest. From the private sector's perspective, engaging into these conversations about partnering with cities requires them to make sure that regulators are not making unreasonable asks with the sole aim of sinking the company. Private companies should also strive to prove that they will not commit to certain things that they would later not be able to abide by. In the case of Chariot and San Francisco regulators, close collaboration was allowed by weekly meetings with staff from both sides, which encouraged mutual understanding of each other's challenges, goals and ambitions, but also push the public sector to do better and question business-as-usual. This level of understanding was critical to figure out what how to design a regulation that was enforceable and had enough "teeth" for the SFMTA to enforce it. This is not to say that their relationship was perfect. However, the fact that the PTV regulation came from extensive talks between the public and the private sector is encouraging, compared to a strictly top-down regulation design.

Having a truly partnering relationship instead of choosing the regulatory approach was nonetheless not really an option in the case of Chariot. Though the permit system was created in partnership with the SFMTA, it was part of a reactive process because Chariot launched directly, without reaching out to the SFMTA first, as explained by one interviewee:

I think that in a lot of ways, the permit process that came about was a result of how Chariot came about. They did launch in a "launch first, ask permission later" kind of way that we see from a lot of the tech companies.

However, had they asked for permission instead, they would have been greeted with strong skepticism as to how their service would become profitable and dissuaded from doing it altogether by some city officials, unless they found public financing and were targeting underserved communities. The idea of a proactive approach from day 1 remains quite unlikely because SFMTA staff would not have been

encouraged by management to put that much time and energy into testing something perceived to compete with Muni, rather than focusing on Muni itself. This suggests that leaving the regulation paradigm would require a major cultural shift from the public sector.

#### *Leaving room for flexibility*

For private companies that are trying to innovate and learn the business, it is essential to have the flexibility needed to test, fail, and learn from their mistakes to allow service to evolve and improve over time. Nima Rahimi, former Associate Counsel on Chariot's Legal and Government Strategy team and the person in charge of managing their labor, government and public relations, pointed out that regulation is needed to protect public interest and balance the challenges that innovation brings, while recognizing the opportunities that come with it:

I think you need to have regulations protecting the public interest, and I also think you need regulations that balance the benefits that innovation brings to the table. It's important to recognize the public good that comes with innovation, so you don't want to suffocate it when it's early on. Give it room to grow while also maintaining healthy regulations that protect the public interest, that give government regulators insight as to what the company is doing, how they're doing it, where the government can improve its own services to meet the challenges that an innovative idea may be shedding a light on. (...) Common sense regulation that protects the public while also balancing the benefits of innovation and providing important flexibility is the needle to thread and it's not an easy one.

The PTV regulation attempted to provide that flexibility to Chariot by including provisions that allowed them to expand their service. However, some city staff mentioned that the fact that they needed to seek approval from the SFMTA for any new route may have somewhat constrained Chariot's ability to innovate. With the PTV regulation, Chariot became very protective of its original routes because they had built their operations and ridership around them. This customer base was even more critical because they made little efforts towards customer acquisition for public routes (for financial reasons), and because any change to stops caused a disruption to Chariot operations and led to a drop in its ridership. This echoed the experience of Chariot staff mentioned earlier, noting that the end of Chariot's startup days and the beginning of the SFMTA regulation put an end to the microtransit testing days, and that the operator completely stopped testing things, because "it was just too much effort for [them] to devote to those public routes". In a way, corporate priorities and processes and regulation may have stifled innovation.

#### *Challenges for Chariot*

Regulation was not the only source of challenges for Chariot to grow in San Francisco, and in fact, it may have been secondary in leading to the end of the microtransit company's operations in the city.

#### *Labor aspects of transportation service provision*

The rigidity of existing public transit operations is closely tied to labor challenges faced by the transportation industry in general, and the SFMTA in particular. The agency has faced a lot of backlash for its poor performance in the past year and the fact that it did not offer as much service as was normally scheduled, due to a driver shortage that had been foreseen (Brinklow, 2019; Swan, 2018). This driver shortage is due to a combination of factors, attributed by the SFMTA to poor planning of driver hiring and training ahead of time, while the Transport Workers Union Local 250-A attributes it to the fact that being

a transit operator is “not an attractive job anymore”, in Roger Marengo’s words, the union’s president. In a context where the SFMTA is not able to deliver scheduled transit service, even going beyond what is seen as “business-as-usual” could be particularly hard, without the appropriate funding mechanisms. Even without taking the current transit operator shortage into consideration, interviewees indicated that the SFMTA would have limited flexibility to rethink its service in a truly nimble way. The agency is bound by contracts with its drivers union that hamper its ability to adapt operations and decide to innovate on its service in-house. If the SFMTA were to alter significantly service to conduct a microtransit pilot for example, it would need to meet with union representatives to discuss practical labor implications for drivers, as explained by a city staff member:

It’s a significant change in the function of an operator in terms of coach size. It’s not a consistent ‘stop here, at this time, for this many hours’, it’s a scattered approach based on demand and I think that the flexibility of the operations doesn’t align with the consistency of our labor contracts.

In a context where the SFMTA struggles with driver hiring and retention, such conversations could prove very complicated.

Chariot’s approach to labor was an unusual one for an emerging mobility provider. The company decided early on to treat drivers as employees because there was a clear employer-employee relationship between Chariot and its drivers – with a formal training, uniforms, daily orders given to drivers by their hierarchy, etc. This fact singled out Chariot in the emerging mobility industry, where companies like Uber or Lyft did not choose the same path. It also addressed some of the supervisors’ priorities mentioned by Danielle Harris:

The Board of Supervisors were very focused on making sure that livable wages, labor protections and employment opportunities were provided by businesses within San Francisco, which was great because it aligned with our Labor Guiding Principle for emerging mobility.

Drivers were also unionized and while it was still operating in San Francisco, Chariot worked in close collaboration with the Teamsters Local 665, the union for drivers working at private companies. The microtransit operator went even further than that, by ensuring that after their shutdown, former drivers would be paid through mid-March, keep their healthcare benefits through April, and be set to secure employment elsewhere in the city: with the Mayor’s Office, the Teamsters, as well as local non-profits, they coordinated a training program that would help drivers get their Class B license and organized job fairs for them. As emphasized by Nima Rahimi, this was a reflection of Chariot’s commitment to investing in the local workforce:

About half our drivers live in San Francisco, we invested in training our drivers to get their commercial driver’s license (which has helped folks get good, paid, union jobs post-shutdown; 95% or more and re-employed), and agreeing to a collective bargaining agreement that paid a living wage and full benefits for each driver plus contributions to family plans. And honestly, every company in San Francisco should be reflecting San Francisco values as a matter of course, investing in the community, not taking advantage of it. Should be table stakes for doing business in San Francisco.”

Though less publicized and of smaller scale than the SFMTA, Chariot had its own labor challenges: surprisingly, Chariot staff mentioned that driver shortage was also an issue for them. Although they were

not limited in the number of vehicles that they could deploy around the city thanks to the extensive fleet of Ford shuttles, they were not able to hire and train drivers as fast as they would have wanted to:

We had more than enough vehicles. There was never a vehicle shortage, it was a driver shortage. (...) We were always short of drivers, even with the training program to get their commercial driver's license.

It is also interesting to note that Chariot drivers were only trained and operating on a single route, implying that microtransit operations were not as flexible as one would imagine, compared to conventional fixed transit. This seems to indicate that Chariot's labor-related issues were very close to those experienced by the SFMTA and are exacerbated by the challenging financial implications of providing a mass transit service to the public at a low cost, as will be detailed later.

#### *The pitfalls of innovation branding*

San Francisco may be both the first place that comes to mind when thinking about urban innovation, but it is also a challenging one for this very reason. In a city used as a test bed by many urban innovators, the general public and city officials are very cautious about welcoming innovation to the city, because they are well aware of the potential unintended consequences that can stem from innovation. For Chariot, this translated into challenging relationships to various stakeholders. The image of "tech" companies constitute another obstacle to a partnering relationship between the City and private urban innovators, as some community groups and city staff were fundamentally opposed to what they see as "tech". This made concessions to companies like Chariot – a technology-enabled service – a political risk for city officials, because in the city's political landscape, some people are not willing to engage in any partnership with private innovators and do not care whether private services succeed or not. In this polarized context, Chariot was often associated with companies like Uber, Lyft, Amazon or autonomous vehicle companies – which became even clearer when District 3 Supervisor Aaron Peskin drafted the regulation to create a gross sales receipts tax on all of these companies and initially included Chariot, the only of them to contribute financially to the city through its permit fees. Regardless of Chariot's actual contributions or impact on communities, once they got labeled with that "tech" label and seen as disruptors capitalizing on the city, it became very hard for public figures to show any support to them. The disruptor image made Chariot start on the wrong foot, and using the motto "Mass Transit Reinvented" may have contributed to that image. Nima Rahimi explained:

Any give by the MTA to Chariot was perceived by concerned community members as a giveaway: "another giveaway to tech!". That really wasn't what we were trying to do, and I don't think we did a good job of explaining to the public what we were trying to do in San Francisco. (...) There was a perception, rightly or wrongly, that we were there to disrupt and privatize public transit. And that, per se, at a minimum, from the beginning, started us on the wrong foot.

This underlying opposition to "tech", and, more broadly, private innovation, sometimes translated into broader generalizations about Chariot providing an elitist, two-tiered transportation system, fueled by past experiences with luxury microtransit companies like Leap, based on the fact that Chariot fares were more expensive than Muni – even though Chariot argues that daily rides on their public routes and commuter benefits brought costs down to less than \$3 per ride. Other alleged misconceptions included the perception that Chariot had a predator behavior similar to that of jitneys in the past, cannibalizing Muni routes and picking up passengers ahead of Muni buses. This illustrated the misunderstanding of

some features of the Chariot service, considering that that behavior was not possible for a microtransit service with fixed stops and seat booking required ahead of time for all passengers.

On the other hand, the fact that they were a unionized company helped make up for some of the bad disruptor image that they suffered from, because of the public trust that the Teamsters benefitted from in San Francisco, and because so few tech companies provide their drivers with benefits and treat them as employees. However, it was not enough: once public trust was lost, it became almost impossible for Chariot to win it back, which brought numerous hurdles for their public routes offering. Overall, building the support for Chariot that would have allowed a fruitful partnership with the city would have required a lot more work with neighborhood groups, district supervisors, the mayor's office, the union, and any public agency with authority over various parts of the business, which may be an outreach effort too big for a company still focused on learning how to best operated. Gaining that support in San Francisco is also more challenging than in cities like Los Angeles and others where the public sector and the general public are more open to the idea of partnering with the private sector.

#### *Financing mass transit for the public*

The end of Chariot was not a surprise to any of the stakeholders, as the profitability of transportation services open to the public has always been an issue. City regulators are well aware that public transit runs at a loss, which is why Chariot's shutdown was foreseen by city regulators. They point to the microtransit operator's business model as the only reason for their demise, not regulation.

Chariot tried to address these financial challenges through different pricing strategies, and they started raising their fares with peak and off-peak rates, while trying to remain cheaper than TNCs. Another option to bring down costs would have been to increase the size of their vans, which ultimately was disregarded as they would not have qualified as vanpools anymore. But the long-term vision at Ford for the viability of microtransit was to switch to autonomous shuttles eventually. When Ford decided they were not willing to put more money and effort into reaching that timeline, they stopped Chariot operations worldwide. When it comes to private companies, expectations for financial returns are much more time sensitive than they would be for a publicly-provided service, as described by Nima Rahimi:

We didn't go out of business in the traditional sense, like money ran out and we couldn't operate anymore. I think the challenge with a startup is: how long are you willing to invest in a company before it becomes profitable?

Ford decided that it had been too long. But considering that the financial challenges of Chariot were the only reason why they closed, most people do not see Chariot's end of operations as a sign per se that microtransit failed. Without mechanisms in place to have public funds support schemes targeted at the general public, the private sector has limited ability to deliver its value proposition to the city: this is why Chariot stopped focusing its public routes and diverted most of its resources to private routes and its charter business. As explained by former Chariot staff, marketing was one example of that shift in priorities: "We weren't getting that much money from customers [on public routes], so none of our marketing efforts were really focused on the public side of things". In the absence of public subsidies, they were exploring innovative funding schemes targeted at employers and businesses to fund routes and then open remaining seats to the general public. Though this may have been an opportunity for a more financially viable business model, the company closed before having time to fully develop this approach. Other alternatives they could have opted for would have been to monetize different aspects of their

service and sell it to both cities and the private sector, be it the Chariot dispatching system, route design, data, driver hiring, driver training, fleet management, operations management, or a combination thereof.

Funding is a critical piece when it comes to mass transportation, especially for the survival (and even more for the expansion) of public transit, which is why cities are so protective of their public transportation ridership and so cautious when it comes to investing in experimental services, for the following reasons explained by one city official:

We always have to ask ourselves: if we're gonna do this, then what are we not gonna do? So if we're going to spend the money trying to figure out an on-demand route, where is that money coming from? And a lot of times, the answer would be: it comes from that specific grant from the MTC, or the SFCTA, or a federal grant that allows us to do that. Those money choices are tricky. If we do this, what can't we do here? Where does the money come from? How are we gonna shift to make that work? And you never want to take something away from people who've arranged their lives around it.

Furthermore, another concern expressed by advocates was the monetization of the public right-of-way by private entities, arguing that narratives around the shared economy hide a broader trend where more and more private companies try to build their operations around public infrastructure without paying their fair share. Considering that street infrastructure is highly subsidized, private mobility services should contribute higher amounts than they do now. Advocates therefore wished there was a mechanism for the SFMTA to get more revenue from private entities capitalizing on public infrastructure – although the agency is now limited in its ability to get money from private operators by state law. Chariot mentioned that the amount of the yearly PTV permit fee for San Francisco was much higher than for any other city, especially considering that the permit program only included Chariot and that administration costs were therefore low. But overall, the contentiousness of the monetization of public space by private companies goes well beyond Chariot: any large company is seen as a major threat compared to smaller operators, like self-entrepreneurs driving jitneys in the past, in large part because of the greater bargaining power that large private capital has.

### Rethinking transit for the future

While one might say that Chariot “failed”, interviews indicated that it was primarily for financial reasons pertaining to Ford's priorities regarding its portfolio of mobility ventures. But if the service was valuable for some people and convinced them to switch from a private vehicle (be it their own or a TNC), what could the City of San Francisco learn from it?

#### *Private initiative as an opportunity to move away from business-as-usual*

Private companies often constitute a catalyst for change, especially in a context where the public sector is constrained financially and focused on addressing more immediate concerns about the existing system. Public routes may not have been Chariot's priority as much as being profitable, but it did try to fill a gap for certain people who did not ride transit, thus addressing a latent demand. Chariot deployed between 65 and 87 shuttles around the city, depending on the day of the week and ridership levels, and provided over 10,000 rides per week on its public routes, and even more on private ones. In a city plagued by congestion made worse by TNCs, with about 5,700 TNC vehicles driving around the city during peak times and providing about 170,000 vehicle-trips within San Francisco on a typical weekday (SFCTA, 2017), the

benefits of replacing these trips by higher-occupancy modes are clear. They are also in line with the Transit First policy, and Chariot's support of these goals could have been acknowledged by the City. Of course, not all trips were taken away from private vehicles: in some neighborhoods like the Richmond, internal surveys of Chariot riders did show that the majority of them would ride public transit otherwise, whereas in the Marina, 75% of them said they would drive or take a TNC ride. But the fact that some people chose Chariot over public transit even if fares were slightly higher is indicative of some potential improvements that Muni could have made to offer a travel experience as appealing as Chariot was to some San Franciscans. Various interviewees mentioned the current struggles of the SFMTA with public trust, and that the City should therefore be proactive in showcasing that they are testing new things. There is strong interest from the general public in seeing the city try new things, to meet people's needs and to expand, as called for by Steve Pepple:

We oftentimes don't think that the SFMTA is growing the level of service that it should. We [SF Transit Riders] are definitely pushing as advocates for SFMTA, BART, AC Transit, SamTrans, all of the transit operators that work through San Francisco to take more of a growth mindset and not just stay with the status quo level of service, but think about creative ways of getting the budget and investment in infrastructure to serve even more people.

The emergence of services like Chariot that disrupt standard operations should be seen as an opportunity to rethink public service provision, and not a mere disturbance of the status quo. The challenge will be to overcome the current atmosphere of resistance to change, which constitutes one of the main barriers to transit transformation (TransitCenter, 2016).

#### *Building on private innovation as a learning opportunity*

Understanding travel behavior remains a major challenge for the City and having access to additional data sources is seen as an opportunity to inform planning decisions, from transit service delivery to capital improvements. Warren Logan explained why it matters:

If I could just ask one question from any of the users of these different emerging mobility services, I would ask why. Why is it that they made this choice instead of something else? And what would have been their next choice if this hadn't been available? (...) And the reason I bring that up is because when you get the answer to these two questions, I believe we [the government] are better equipped to develop multimillion-dollar capital improvements across the city. (...) I can provide capital improvements for existing behavior, to make existing people feel safer and more accommodated, but that doesn't necessarily speak to the people who are not there already.

This is the reason why data is at the center of many concerns of regulators: they see it as a missed learning opportunity. Existing travel data usually only allows to describe existing patterns, but it does not provide information about latent demand or travelers relying on less sustainable modes. This explains why the City uses regulation as a leverage to obtain more data, as mentioned earlier. In the case of Chariot, poor timing and external circumstances prevented the City from conducting a travel behavior survey of Chariot riders as planned, and understand better why they opted for Chariot. However, Chariot's experience regarding the City's requests for data indicates that this urge to require data reporting from private operators – which is also a standard recommendation from academics on public transit transformation (Shaheen & Cohen, 2018; TransitCenter, 2016) – should be balanced with awareness of the technical capacity needed to harness this data. Additionally, if private data is to be valuable, it should be requested



with a clear purpose for its use, be it to support impact evaluation or system performance monitoring, track compliance, or inform service planning and capital improvements.

But whether cities find a way of partnering with private entities on data sharing in a way that protects private business or not, they could learn from other aspects of microtransit service. As mentioned by Steve Pepple, design consultant and current Vice-Chair of the advocacy group San Francisco Transit Riders: private companies are usually very good at understanding people's needs by leveraging their data and testing inventive marketing techniques. This could represent a great opportunity for public-private partnerships, as public agencies could learn more about people's needs by building on private expertise. The customer base of Chariot indicates that they provided a service that responded to a certain need. Now that Chariot is gone, this should be seen as an opportunity for the public sector to take the lessons learned from Chariot operations and see how they can integrate some aspects of the service into the existing public system, be it fully operated by the City or contracted out. This represents an opportunity to capture the Chariot riders that would not want to get on a bus for some reason. Over the entire network, Chariot estimated through in-house surveys that between 25 and 35% of their San Francisco riders would have taken public transit otherwise, while others would have taken a car, and TNC, biked or walked. The city knows very well that for people to give up on their cars, there needs to be a mix of options. The fact that Chariot may have helped people move around without owning a car needs to be recognized and used as a lesson as to what is appealing to people who ride transit and people who don't. At the very least, questioning the status quo might allow to meet the needs of former Chariot riders and ensure that they do not turn to less sustainable transportation options – a concern voiced by some Supervisors of the neighborhoods that benefitted the most from Chariot accessibility improvements in recent conversations with the SFMTA and the SFCTA. Staying in a paradigm where the public sector is worried about losing riders but does not adapt to gain new riders is not the right approach. As Steve Pepple emphasized it:

I think it's kind of asking the wrong question to only think of [microtransit] as whether it's competitive. I would look at it, in terms of whether what Chariot is offering is appealing to people and how we can make that a public transportation solution. Or maybe we're going to realize that we'll never be able to offer that experience, but how do we set ground rules in place so that that system is not siphoning off riders from public transportation?

Chariot innovation has brought up questions about transit service provision that the SFMTA had not yet been focusing on in the past – or at least were not top priorities on the agency's agenda. The City should take this as an opportunity to learn from Chariot's achievements and shortcomings, see how they translate to the existing public transit system but also what they mean for the city's transportation system as a whole and the promotion of Transit First goals. The following section will detail what aspects of microtransit were found valuable by interviewed stakeholders and could constitute the basis for the future of transit service in San Francisco.

#### *Rethinking a future with public transit and microtransit*

"What should transit look like in the future?" All interviewees were asked this question in order to gauge what service characteristics drew the most interest from various groups but also organizational arrangements that would be necessary to make their vision a reality, building on Chariot's experience.

Chariot may not have had the ambition to run an entire transportation system, but it attempted to solve specific challenges faced by some commuters. Speed and reliability were the main reason why people

would choose to ride microtransit. This was exacerbated by concerns about overcrowding along some core Muni lines, which sometimes forced riders to wait for the next bus. Time constraints can be very sensitive for commuters, as missing a bus and getting late to work could cost someone their job. Pricing was also mentioned as an important factor, especially when compared to the cost of driving and parking downtown or ordering a TNC ride at peak times. The fact that it allowed to avoid transfers for some trips also played a role for some people. Finally, perceived safety and overall cleanliness were cited as reasons why certain Chariot riders preferred the microtransit service over riding public transit. Although a formal survey of Chariot riders would be necessary to fully understand what decisions factors played into their choice of Chariot over other transportation modes, it is worthwhile noting that neither the Chariot app nor the on-demand aspect of the service were mentioned as key features by any of the interviewees.

Now that Chariot has stopped operating in San Francisco, the SFMTA not only has the opportunity to get back the riders who had left fixed transit for microtransit, but also to learn from Chariot what other dimensions of the travel experience they should improve to gain new riders among private car drivers and TNC users. Chariot's customer base indicates that they filled a certain need, and addressing it could be part of the City's Transit First mission of increasing the share sustainable trips. The quality of travel experience can be understood in terms of various dimensions, from time performance, price, comfort, safety, perceived safety, seamlessness from one trip segment to the next, choice between various transportation options, technology, overall customer experience. Some of these aspects are related, and some overlap: time performance includes frequency, speed as well as reliability, but also relates to the on-demand (or fixed) dimension of transit service; a well-designed app can improve seamlessness and customer experience, but also reliability of the real-time information provided to customers; comfort includes notions of crowding and overcrowding, and contributes to customer experience as well; etc. Considering the main points that interviewees mentioned, the most immediate aspect that public transportation in San Francisco could improve to cater to former Chariot riders would not necessarily be to start an on-demand transit, but to focus on improving its overall time performance, as called for by TransitCenter (TransitCenter, 2016) and pointed out by Steve Pepple:

I see a lot more potential in cities that are less dense. I think if we look at San Francisco, the on-demand nature is not as important as frequency and speed. So [SF Transit Riders] would like to see much increased headways in the service that is already running, because if there's a bus coming every 3 minutes, you don't really need on-demand.

Therefore, offering more frequent service on routes that suffer from overcrowding would be the most straightforward way to improve the comfort of passengers traveling on these routes, while making their trips faster and more reliable because they would be able to get on the first bus stopping by them. Price differences do not matter as much considering that public transit remains the cheapest motorized transportation option within San Francisco. The SFMTA could explore other potential improvements to existing transit service and consider expanding service to areas with the most microtransit ridership, now that they have received stop-level ridership information from Chariot. However, it is important to acknowledge the current driver shortage experienced by the SFMTA, which already prevents them from delivering all scheduled service and would make frequency increases and other operational changes relatively challenging in the short term.

Beyond improvements to public transit to provide a better travel experience, interviewees discussed the concept of microtransit itself and how it could fit in the future of transportation for San Francisco. The

idea of on-demand transit was not rejected altogether, but the idea of a service targeted at major trip generators (e.g. the University of California system, the Academy of Arts, the Zuckerberg General Hospital, major employers etc.) that would work in a way similar to paratransit, with flexible routes and a flexible schedule, was more appealing. Maybe it is in part due to the fact that these services are seen as less similar to Muni service, and therefore, less of a threat to public transit. While this option might be the most straightforward way of operating microtransit in the city for a private operator, it would not benefit the general public in the same way and would represent a missed opportunity regarding the creation of an integrated transportation system fulfilling the city's Transit First goals.

In sum, there is disagreement among different groups in San Francisco as to whether microtransit could be part of the future of the city. While not fundamentally opposed to microtransit per se, the public sector remains in a mindset dictated by current challenges in running the existing transportation system and sees microtransit as a potential bonus rather than a groundbreaking transportation solution. The idea of providing solutions appealing for people who are not willing to ride public transit remains contentious, because it is seen as an opportunity for some subsets of the population to isolate themselves from the rest and create a two-tiered transportation system, which would be in contradiction with the city's equity goals.

#### *Redefining the roles of the public and the private sector*

Chariot has once again illustrated the fact that financing transportation for the public is very challenging. Learning takes time, and time is money. For Chariot, the learning phase took too long and resulted in the end of the company. But the story of Chariot has also demonstrated that since finances were the main barriers to its success, microtransit could very well resurface in San Francisco one day. This raises the question of who would be best positioned to provide that service in the future.

There is interest from the City itself to try microtransit (especially as a potential solution to replace all the short trips served by TNCs), mainly led by the SFCTA, which was actively looking at pilot opportunities: before Chariot closed, the company was in talks with the SFCTA and Supervisors of Districts 10 and 11 about bringing a pilot with about 6 microtransit routes to the Excelsior and the Bayview that would connect vulnerable communities to BART stations, healthcare facilities and grocery stores. The rides on these routes would have been heavily subsidized in order to offer very low fares, and they were hoping to fund the service through state funds. According to several interviewees, such a configuration, with the private sector focusing on bringing microtransit service to less dense areas with vulnerable communities and limited transit service is the most likely to get the attention and support of City regulators.

Whether targeted at communities of concern or not, providing microtransit would be an opportunity to add one more option to the city's transportation mix, thus offering a range of services more likely to match the needs of as many people as possible while supporting San Francisco's Transit First goals, as emphasized by city staff:

It's good to have multiple transportation options, because anything that we can do that helps people who live in San Francisco or have moved to San Francisco to not bring a car or buy a car is a win overall.

Running a public microtransit service would also allow the City to mesh it with the rest of the transit system in the adequate way, while keeping the service safe and accessible. Because of the day-to-day operational challenges experienced by Muni to run a transportation system that serves everyone in a city

with a challenging geography, there is skepticism among some City staff that anyone else could do things better than Muni while playing by the same rules: serving the entire population in an equitable, accessible, and safe way. This belief is in line with the looming mistrust of private mobility providers in San Francisco coming from some City staff and advocates. However, significant challenges remain for the public sector to provide on-demand transit themselves. Labor implications would be challenging to address: with the current driver shortage and the very strong union, it is hard to ask operators to do more. Vehicle size was also mentioned as a potential issue. Additionally, the SFMTA is strained by its limited resources, and if it were to put time, money and effort into running a microtransit service in-house, it would do so at the expense of other things. As Danielle Harris best summarized it:

There is an essence of risk, and a need for additional effort. Managing a transit service is extremely challenging, so to add a layer of additional investment to innovate in that service is a huge ask, as we are already pretty strained in terms of resources.

Some also argue that the main issue lies the fact that the SFMTA is not ready to move away from its current way of operating:

We see a lot of system and service thinking from in the agency, and about the system that is already there. Could public transportation do that as well as some of the private companies that are working in the space? I think they can, but they're gonna have to really shift how they do things to get there.

Others argue that the SFMTA does not have the capacity to do it yet because they do not have the expertise necessary for on-demand transit operations at this point. In any case, because of the public backlash that the SFMTA has been facing lately on other issues, SFMTA top management is also relatively risk-adverse, and sees the public willingness to experiment as low.

On the other hand, Chariot made clear how complicated it would be for a private company to provide microtransit services to the general public without support from the public sector. This support could take various forms, depending on the level of collaboration between private innovators and the city, but ultimately, it would mean having a public-private partnership. This represents an opportunity to fill the existing gaps in San Francisco's transportation system that Chariot unveiled, with the public sector and the private sector working hand-in-hand to truly integrate microtransit with public transit and improve transportation outcomes for the city. Nima Rahimi agrees that this was a missed opportunity:

From the start, Chariot should have approached MTA and looked for a public-private partnership that addressed the three following areas: de-stressing corridors that were over capacity, feeding into transit hubs as a first mile/last mile solution, and decreasing operating costs for underutilized corridors. See the Chariot/King County partnership called Ride2, where Chariot operated the vehicles, supplied the drivers, and developed the tech but all under King County Metro's stewardship and branding.

Advocates argue that this would be the ideal configuration, with cities focusing on the core of the transportation network, and private companies supporting them by investing in the first and last-mile – an opinion shared by academics (TransitCenter, 2016). According to internal Chariot surveys that estimated that 25% of riders on their San Francisco public routes were either going to BART or Caltrain, Chariot was already providing valuable first and last-mile connections to some transit riders. The benefits

of integration between public transit and microtransit were further highlighted by the job accessibility analysis in the present report, which shows that Chariot did improve accessibility to employment opportunities for many parts of the city when combined with BART and Muni as a single public transportation network. However, the fact that there was no coordination between the three operators may have prevented many San Franciscans from enjoying these benefits, as transferring from one to another meant potentially walking, having to wait because schedules were not coordinated, but also paying the entire fare for each provider. Considering that the SFMTA is not as nimble as private companies like Chariot, public-private partnerships around microtransit could entail significant challenges for private providers willing to partner with the public sector but with shorter timelines to reach profitability, as pointed out by one interviewee:

Chariot just moves a lot faster than the SFMTA. The number of permits, contracts, negotiations that would have to be put in place to make [a public-private partnership] happen is long, and too long perhaps for a company like Chariot to wait for.

In this perspective, it is important for the City to embrace opportunities of public and private collaboration. While the public sector is best positioned to ensure that the City's policy goals are supported, private companies can help in a variety of ways. For the SFMTA, partnering with the private sector could augment public subsidies and help meet specific needs that would otherwise be too complicated to meet on their own because of budget constraints while harnessing the benefits of new technologies making transit easier to use. Contracting out certain aspects of service delivery to private providers could relieve the transit agency from devoting time and resources – both financial and technical – to figuring out themselves how to develop some features already offered by the private sector (California Transit Association, 2015). For private providers, getting public funding could guarantee the profitability of their service. Public oversight would also address equity and accessibility concerns, including concerns about provider stability and pricing behavior, while holding the private sector accountable and meeting safety and labor standards.

The actual design of such an integrated transit and microtransit system are still up for debate regarding procurement arrangements, routing and scheduling characteristics, branding, pricing, funding mechanisms, etc. Various options were discussed with interviewees, including contracting the service out, similar to paratransit, creating a circulator connecting people to rail lines, or replacing low-frequency local bus routes. In any case, the variety of these schemes made clear that rethinking transit in San Francisco will require close collaboration between the public sector and the private sector, and extensive outreach to community groups and advocacy groups to ensure that the future transportation system meets the need of San Franciscans.

As for a configuration where the private sector would provide microtransit on its own, the multiple parallel business models that Chariot tested showed that it could be possible if targeting employers, businesses, or other types of large trip attractors ready to fully fund routes. This option was mentioned by some city officials, but it does not hold the potential of a true out-of-the-box rethinking of mass transit for the public.

## 5. Discussion of results

The present report discussed the challenges and the opportunities that came from Chariot operations in San Francisco, and what this could mean for the provision of on-demand transit services in the future. It first assessed to what extent Chariot competed for riders with the two main public transportation providers in the city, SFMTA and BART, by providing an approximation of the overlap between their service areas, before estimating the potential benefits from integrating the three transportation networks in terms of accessibility to jobs. The results of this quantitative analysis are undermined by serious data limitations on Chariot operations that are not only related to its on-demand features but also to the limited amount and quality of data that was shared with the city while they were operating. Furthermore, the analysis performed relied on a data format – GTFS – that was designed with fixed-schedule transit in mind, and not on-demand, thus limiting the accuracy of microtransit modeling. This analysis was therefore meant as an illustration of the potential of Chariot, to showcase how transformational it could be and provide estimates of the impact that it could have had on the city – be it by competing with public transit or by supporting it.

Considering that Chariot stopped operating in early 2019, ending the analysis there would have been of little interest to the San Francisco transportation community. The end of Chariot raised a number of questions about the viability of microtransit in general, and what would be needed to bring it back to San Francisco. Although stakeholders showed interest for on-demand transit, many obstacles remain to reach an agreement on what it should look like the future, and how to make this vision a reality in San Francisco. Because of the short timeline between the end of Chariot operations and the completion of the present report, saturation was not reached from the interviews that were conducted in this short timeframe. The present report would have benefitted from including the perspectives of former microtransit drivers and representatives of the union for drivers of private transportation providers in order to better understand the labor implications of the service. Hearing from city officials outside of the SFMTA and the SFCTA, for instance staff from the Mayor’s Office working on transportation and innovation, or District Supervisors, would have also been good to explore how closely the city’s high-level policy goals were actually aligned with the priorities of the SFMTA as transit operator and regulator, and identify what actors in the public sector would be most susceptible to champion changes to the status quo in the transportation system. Lastly, getting insights from shared mobility experts – be it academics or people that were involved in other microtransit experiments in the country – on Chariot’s operations in San Francisco would have been beneficial to see how the lessons they learned elsewhere translated to Chariot and what were the challenges and opportunities specific to San Francisco’s context in their opinion. However, by telling Chariot’s story from a variety of perspectives and unveiling the priorities of the different stakeholders, the present report set the stage for an open conversation about what the path forward should be for San Francisco regarding microtransit, to fill the gap left by Chariot:

Why don’t we take the lessons learned with other private operators and look at the limits we have in public operators and see the opportunities we have to integrate these ideas into the system that exists successfully? Because the need has been there. The need is there.

## 6. Conclusion

The present report discussed the challenges and the opportunities that came from Chariot operations in San Francisco, and what this could mean for the provision of on-demand transit services in the future. It first assessed to what extent Chariot competed for riders with the two main public transportation providers in the city, SFMTA and BART, by providing an approximation of the overlap between their service areas. Although the limited coverage of Chariot compared to the two transit providers resulted in a limited potential for the microtransit operator to skim transit riders, city government remains deeply concerned with protecting the financial viability of its transit operations, which prevents some of its agencies from considering opportunities to engage with the private entities other than to regulate them. The fact that microtransit significantly improved employment accessibility for San Franciscans when combined with public transit illustrates how remaining in a paradigm about regulation can lead to cities missing out on opportunities. The present report's findings underscore the need for collaboration between public and private transportation providers. It is in both parties' best interest to support each other and share resources rather than bringing the other down.

The twists and turns of Chariot in San Francisco demonstrate that many barriers to a proactive partnering relationship between the City and private innovators remain, be it for microtransit or other types of emerging mobility. When it comes to Chariot, the City's position was not dictated by how it could support shared rides, be it through Muni service or not, but framed around concerns about protecting public transit and addressing operational constraints.

To foster a fruitful dialogue with the private sector, the City first needs to align competing priorities between the various agencies that have jurisdiction over that particular business as well as elected officials, to be able to engage with private entities with clear policy goals and metrics to measure success in achieving these goals. This will constitute the basis for an open conversation where each party is clear about what their aspirations are, what their vision for the city is, and what challenges they are facing, thus allowing a proactive solutions-oriented approach to innovation rather than a reactive one. In the case of Chariot, this was made difficult by the fact that the company started operating without talking to the City first, which prevented the SFMTA, the SFCTA and other city officials from adopting a truly forward-looking approach to microtransit. Instead, they adopted a protective, reactive position that was meant to protect the existing transportation system, because Chariot came after a host of other transportation innovators that resulted in the City being frustrated from not being able to regulate the adverse impacts of some emerging mobility providers outside of its jurisdiction. What resulted from both Chariot's disrupting behavior and the City's protective agenda was regulation, San Francisco's go-to reaction to private innovation. For the City, the PTV permit was primarily an enforcement mechanism as well as a bargaining tool for more data. Fostering innovation was a marginal concern for regulators. Not all of Chariot's challenges in San Francisco came from regulation. The company also struggled to figure out how to balance the labor aspects of operations – and the high costs that came with it – with reaching profitability for its public routes. It confirmed a lesson well-known to the public sector: mass transit runs at a loss. The ability for Chariot to navigate the public opinion and make strategic alliances with stakeholders within city government was hampered by its image as a disruptor trying to “reinvent” mass transit, and therefore perceived as a threat to public transit.

Since the end of Chariot operations was dictated solely by unmet private financial expectations, San Francisco should not come to the conclusion that microtransit is a bad idea based on Chariot's experience.

Looking forward, the City should use Chariot's experience as a learning opportunity to rethink how it operates public transit, what features made microtransit appealing to Chariot riders, and how to integrate those features in the transit experience. Findings from both stakeholder interviews and the accessibility analysis indicate that Chariot's appeal did not come from its on-demand attributes but rather from the connections it provided to specific parts of the city and its time performance, which is tied to both frequency and reliability. Moreover, the microtransit operator built on some of the weaknesses of Muni service, including overcrowding on some routes, which further hampered the perceived reliability of buses for transit riders. All this seems to indicate that even though Chariot did innovate by providing an app-based on-demand high-occupancy service to the public, its impact was less tied to innovation than filling gaps in existing transit service. The City should therefore start by acknowledging the shortcomings of its transit service and attempt to address them to meet the needs of its constituents. Since there is interest in experimenting with new ways of providing transit, the City should also engage in an exercise to rethink the transit experience as a tool to meet San Francisco's long-term goals, and be open to partnering with the private sector as appropriate to build on the expertise of private innovators to better serve San Franciscans. The practical details of what the future of transit should look like will need a combination of research, community outreach, and extensive talks with emerging mobility providers to shape a transportation system that helps meet San Francisco's Transit First goals.



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# APPENDICES

# Appendix 1. Chariot 2018 San Francisco routes

Table A1-1. Chariot route information for San Francisco as of 11/15/2018.

Route name	Time of operation	Stop name	Latitude	Longitude	Stop sequence	Max. headway (minutes)	Min. headway (minutes)
California Dreamin' A	6:15-9:30 AM	3881 California (near Arguello)	37.786	-122.459	1	15	10
		3641 California (near Parker)	37.786	-122.454	2		
		3149 California (near Presidio)	37.787	-122.446	3		
		2843 California (near Divisadero)	37.788	-122.441	4		
		2429 California (near Fillmore)	37.789	-122.434	5		
		2101 California (near Laguna)	37.790	-122.429	6		
		675 California (near Quincy)	37.792	-122.406	7		
		233 Sansome (near California)	37.793	-122.401	8		
		155 Sansome (near Bush)	37.792	-122.401	9		
		50 Beale (near Market)	37.791	-122.396	10		
California Dreamin' B	6-9:30 AM	3881 California (near Arguello)	37.786	-122.459	1	15	10
		3641 California (near Parker)	37.786	-122.454	2		
		3183 California (near Presidio)	37.787	-122.446	3		
		2843 California (near Divisadero)	37.788	-122.441	4		
		2429 California (near Fillmore)	37.789	-122.434	5		
		2101 California (near Laguna)	37.790	-122.429	6		
		64 8th St (near Market)	37.778	-122.414	7		
		775 Brannan (near 7th St)	37.774	-122.403	8		
		475 Brannan (near 4th)	37.779	-122.396	9		
		545 2nd (near South Park)	37.782	-122.393	10		
		299 2nd (near Folsom)	37.786	-122.397	11		
Chestnut Bullet	3-8 PM	88 Howard St (near Spear)	37.792	-122.392	1	20	5
		135 Main (near Howard)	37.791	-122.394	2		
		240 Front (near California)	37.794	-122.399	3		
		Levi's Plaza	37.802	-122.403	4		
		1450 Lombard St (near Franklin)	37.801	-122.426	5		
		1650 Lombard (near Octavia)	37.801	-122.429	6		
		2010 Chestnut (near Fillmore)	37.801	-122.436	7		
		3318 Divisadero (near Chestnut)	37.800	-122.443	8		
		655 Beach (near Hyde)	37.807	-122.420	9		
		401 North Point (near Mason)	37.807	-122.414	10		
		189 North Point (near Grant)	37.807	-122.409	11		

Route name	Time of operation	Stop name	Latitude	Longitude	Stop sequence	Max. headway (minutes)	Min. headway (minutes)
Chestnut Bullet A	6:15-10 AM	3173 Broderick St (at Chestnut)	37.800	-122.444	1	15	7
		2159 Chestnut (near Steiner)	37.801	-122.439	2		
		1995 Chestnut (near Fillmore)	37.801	-122.436	3		
		3255 Laguna (near Lombard)	37.801	-122.431	4		
		2860 Polk (near Francisco)	37.803	-122.423	5		
		Levi's Plaza	37.802	-122.402	6		
		Embarcadero Center	37.795	-122.400	7		
		155 Sansome (near Bush)	37.792	-122.401	8		
		666 Beach St (near Hyde)	37.807	-122.420	9		
Chestnut Bullet B	6:15-10 AM	3173 Broderick (at Chestnut)	37.800	-122.444	1	15	7
		2159 Chestnut (near Steiner)	37.801	-122.438	2		
		1995 Chestnut (near Fillmore)	37.801	-122.436	3		
		3255 Laguna (near Lombard)	37.801	-122.431	4		
		2860 Polk (near Francisco)	37.803	-122.423	5		
		Embarcadero BART	37.794	-122.397	6		
		50 Beale (near Mission)	37.791	-122.396	7		
		400 Howard (near Fremont)	37.789	-122.396	8		
		666 Beach St (near Hyde)	37.807	-122.420	9		
Geary Galloper	3:30-8 PM	2335 Golden Gate Ave	37.777	-122.450	1	15	6
		149 Fulton (Civic Center)	37.780	-122.416	2		
		775 Brannan St (near 7th)	37.774	-122.403	3		
		595 Bryant (near 4th)	37.780	-122.398	4		
		359 Bryant (near 2nd)	37.783	-122.393	5		
		135 Main St (near Mission)	37.791	-122.394	6		
		222 Sansome St (near Pine)	37.792	-122.401	7		
		650 California (near Kearny)	37.793	-122.405	8		
		2206 Sacramento St. (near Laguna)	37.790	-122.429	9		
		2404 California (near Fillmore)	37.789	-122.434	10		
		2740 California (near Divisadero)	37.788	-122.440	11		
		3200 California (near Presidio)	37.787	-122.447	12		
		3580 California (near Spruce)	37.786	-122.453	13		
		325 Arguello (near Cornwall)	37.785	-122.459	14		
		3744 Geary (near 2nd Avenue)	37.781	-122.459	15		
		4200 Geary (near 6th)	37.781	-122.464	16		
		4750 Geary (near 12th)	37.781	-122.470	17		
		5538 Geary (near 19th)	37.780	-122.479	18		
		6150 Geary (near 25th)	37.780	-122.485	19		
		6740 Geary (near 32nd)	37.780	-122.492	20		

Route name	Time of operation	Stop name	Latitude	Longitude	Stop sequence	Max. headway (minutes)	Min. headway (minutes)
Great Haight	6:30-9:30 AM	1859 Haight (near Stanyan)	37.769	-122.453	1	15	9
		1611 Haight (near Clayton)	37.770	-122.449	2		
		1437 Haight (near Masonic)	37.770	-122.446	3		
		1053 Haight (near Baker)	37.771	-122.440	4		
		342 Divisadero (near Oak)	37.773	-122.437	5		
		610 Fillmore (near Fell)	37.775	-122.431	6		
		624 Laguna (near Ivy)	37.777	-122.426	7		
		870 Market (near 5th)	37.785	-122.407	8		
		735 Market (near O'Farrell)	37.787	-122.404	9		
		607 Market (near 2nd)	37.789	-122.402	10		
		333 Market (near Fremont)	37.792	-122.398	11		
		246 2nd St (near Folsom)	37.786	-122.397	12		
		358 Brannan (near Jack London)	37.781	-122.393	13		
		412 Brannan (near 3rd)	37.779	-122.395	14		
		888 Brannan (near 8th)	37.772	-122.405	15		
Great Haight	4:30-7:30 PM	777 Brannan (near 7th)	37.774	-122.403	1	25	14
		595 Bryant (near 4th)	37.780	-122.398	2		
		359 Bryant (near 2nd)	37.783	-122.393	3		
		135 Main (near Mission)	37.791	-122.394	4		
		428 Market (near Fremont)	37.791	-122.399	5		
		570 Market (near 2nd)	37.790	-122.401	6		
		732 Market (near O'Farrell)	37.787	-122.404	7		
		844 Market (near 4th)	37.785	-122.407	8		
		450 Hayes (at Octavia)	37.777	-122.424	9		
		836 Hayes (near Fillmore)	37.776	-122.430	10		
		944 Fell (near Pierce)	37.775	-122.434	11		
		1430 Haight (near Masonic)	37.770	-122.446	12		
		1604 Haight (near Clayton)	37.770	-122.449	13		
		1852 Haight (near Stanyan)	37.769	-122.453	14		
Mission Possible	6:30-9:30 AM	3395 Mission (near Eugenia)	37.742	-122.422	1	30	25
		1423 Sanchez (near Duncan)	37.746	-122.429	2		
		1151 Sanchez (near Jersey)	37.751	-122.430	3		
		3751 24th St (near Chattanooga)	37.752	-122.427	4		
		995 Valencia (near 21st)	37.757	-122.421	5		
		699 Valencia (near 18th)	37.762	-122.422	6		
		383 Valencia (near 15th)	37.767	-122.422	7		
		777 Brannan (near 7th)	37.774	-122.403	8		
		475 Brannan (near 4th)	37.779	-122.396	9		
		371 Bryant (near 2nd)	37.783	-122.393	10		
		Hills Plaza	37.790	-122.391	11		
		Market & 2nd	37.789	-122.401	12		

Route name	Time of operation	Stop name	Latitude	Longitude	Stop sequence	Max. headway (minutes)	Min. headway (minutes)
Mission Possible	4:30-7:30 PM	24 South Park	37.782	-122.394	1	30	30
		500 Brannan (near 4th)	37.778	-122.397	2		
		888 Brannan (near 8th)	37.772	-122.405	3		
		360 Valencia (near 15th)	37.767	-122.422	4		
		696 Valencia (near 18th)	37.762	-122.422	5		
		1016 Valencia (near 21st)	37.757	-122.421	6		
		3782 24th (near Church)	37.752	-122.427	7		
		1270 Sanchez (near Clipper)	37.749	-122.429	8		
		3330 Mission (near Virginia)	37.743	-122.421	9		
Pacific Rush	6:15-10 AM	2689 Jackson (near Scott)	37.792	-122.439	1	12	7
		2477 Jackson (near Steiner)	37.792	-122.436	2		
		2275 Broadway (near Fillmore)	37.794	-122.435	3		
		1989 Broadway (near Laguna)	37.795	-122.430	4		
		1715 Broadway (near Franklin)	37.795	-122.426	5		
		1565 Broadway (near Polk)	37.796	-122.422	6		
		1549 California (near Polk)	37.791	-122.420	7		
		675 California (near Quincy)	37.792	-122.406	8		
		50 Beale (near Mission)	37.791	-122.396	9		
		500 Howard (near 1st)	37.788	-122.396	10		
		246 2nd St (near Folsom)	37.786	-122.397	11		
		358 Brannan (near 3rd)	37.781	-122.393	12		
		414 Brannan (near 4th)	37.779	-122.396	13		
Pacific Rush	4:30-7:40 PM	595 Bryant (near 4th)	37.780	-122.398	1	20	10
		359 Bryant (near 2nd)	37.783	-122.393	2		
		135 Main (near Mission)	37.791	-122.394	3		
		222 Sansome St (near Pine)	37.792	-122.401	4		
		650 California (near Kearny)	37.793	-122.405	5		
		1480 Larkin (near Sacramento)	37.792	-122.419	6		
		1958 Polk (near Pacific)	37.795	-122.422	7		
		1750 Vallejo (near Gough)	37.796	-122.426	8		
		2000 Broadway (near Laguna)	37.795	-122.430	9		
		2300 Pacific (near Webster)	37.794	-122.433	10		
		2802 Jackson (near Scott)	37.792	-122.441	11		
		427 Presidio Ave. (near California)	37.788	-122.447	12		



Route name	Time of operation	Stop name	Latitude	Longitude	Stop sequence	Max. headway (minutes)	Min. headway (minutes)
Potrero Pronto	6:30-9:30 AM	552 Precita (near Florida)	37.747	-122.410	1	50	18
		1349 Rhode Island (near 24th)	37.753	-122.401	2		
		1001 Rhode Island (near 22nd)	37.757	-122.402	3		
		803 Rhode Island (near 20th)	37.760	-122.402	4		
		1301 18th (near Texas)	37.763	-122.396	5		
		975 16th (near Missouri)	37.767	-122.396	6		
		333 Townsend (near 4th)	37.777	-122.396	7		
		607 Market (near 2nd)	37.789	-122.402	8		
		333 Market (near Fremont)	37.792	-122.398	9		
		1 Market (near Spear)	37.794	-122.395	10		
		345 3rd St (near Harrison)	37.783	-122.398	11		
		182 3rd St (near Howard)	37.785	-122.401	12		
Potrero Pronto	4:8 PM	50 Market Street	37.794	-122.396	1	30	30
		428 Market (near Fremont)	37.791	-122.399	2		
		30 New Montgomery (near Stevenson)	37.788	-122.402	3		
		116 New Montgomery (near Mission)	37.787	-122.400	4		
		413 Townsend (near 5th)	37.775	-122.398	5		
		20 Missouri (near 16th)	37.766	-122.397	6		
		1640 17th (near Carolina)	37.765	-122.400	7		
		610 Rhode Island (near 18th)	37.762	-122.402	8		
		858 Rhode Island (near 20th)	37.760	-122.402	9		
		1022 Rhode Island (near 22nd)	37.757	-122.402	10		
		2734 24th (near Hampshire)	37.753	-122.407	11		
		431 Precita (near Alabama)	37.747	-122.411	12		
		2212 23rd St. (near Rhode Island)	37.755	-122.402	13		
		2838 24th (near Bryant)	37.753	-122.409	14		

Route name	Time of operation	Stop name	Latitude	Longitude	Stop sequence	Max. headway (minutes)	Min. headway (minutes)
Richmond Racer	6:15-10 AM	7127 Geary (near 35th)	37.780	-122.496	1	12	7
		6699 Geary (near 31st)	37.780	-122.491	2		
		6037 Geary (near 24th)	37.780	-122.484	3		
		5501 Geary (near 19th)	37.780	-122.478	4		
		4843 Geary (near Funston)	37.781	-122.472	5		
		4141 Geary (near 6th)	37.781	-122.464	6		
		3575 Geary (near Arguello)	37.781	-122.458	7		
		2929 Geary (near Collins)	37.782	-122.451	8		
		735 Market (near 3rd)	37.787	-122.404	9		
		607 Market (near 2nd)	37.789	-122.402	10		
		50 Beale (near Market)	37.791	-122.396	11		
		246 2nd St (near Folsom)	37.786	-122.397	12		
		372 Brannan (near 3rd)	37.781	-122.394	13		
		448 Brannan (near 3rd)	37.779	-122.396	14		
		888 Brannan (near 8th)	37.772	-122.405	15		
		13 9th St. (near Market)	37.777	-122.416	16		
		Lone Mountain Circle Lot	37.779	-122.452	17		
		640 Parker Ave (near McAllister St)	37.776	-122.453	18		
SoMa Express	6:15-10 AM	2477 Chestnut (near Broderick)	37.800	-122.444	1	15	5
		2149 Chestnut (near Steiner)	37.801	-122.439	2		
		3117 Steiner (near Filbert)	37.798	-122.437	3		
		2518 Buchanan (near Pacific)	37.793	-122.431	4		
		2001 California (near Octavia)	37.790	-122.427	5		
		1765 California (near Franklin)	37.790	-122.423	6		
		100 5th St (near Mission)	37.783	-122.406	7		
		320 4th St (near Folsom)	37.782	-122.401	8		
		475 Brannan St (near Zoe)	37.779	-122.396	9		
		333 Brannan (near S. Park)	37.781	-122.393	10		
		299 2nd (near Folsom)	37.786	-122.397	11		
SoMa Sprinter	4-8 PM	8 10th St (near Market)	37.776	-122.417	1	15	10
		777 Brannan St (near 7th)	37.774	-122.402	2		
		475 Brannan (near Zoe)	37.779	-122.396	3		
		333 Brannan (near Stanford)	37.781	-122.393	4		
		736 Mission (near Jessie Square)	37.785	-122.403	5		
		868 Mission (near 5th)	37.783	-122.406	6		
		1512 California (near Larkin)	37.791	-122.419	7		
		1910 California (near Gough)	37.790	-122.426	8		
		2130 Jackson (near Buchanan)	37.793	-122.430	9		
		2632 Fillmore (near Broadway)	37.794	-122.435	10		
		3030 Steiner (near Filbert)	37.797	-122.437	11		
		3318 Divisadero (near Chestnut)	37.800	-122.443	12		

Route name	Time of operation	Stop name	Latitude	Longitude	Stop sequence	Max. headway (minutes)	Min. headway (minutes)
Union Cruiser	6:15-10 AM	3131 Fillmore (near Pixley)	37.798	-122.436	1	15	5
		2075 Filbert (near Webster)	37.798	-122.434	2		
		1785 Union (near Octavia)	37.798	-122.429	3		
		1569 Union (near Franklin)	37.798	-122.425	4		
		1265 Union (near Larkin)	37.799	-122.420	5		
		1083 Union (near Leavenworth)	37.799	-122.417	6		
		709 Union (near Powell)	37.800	-122.411	7		
		511 Clay (near Sansome)	37.795	-122.402	8		
		220 Davis (near Sacramento)	37.795	-122.398	9		
		50 Beale (near Mission)	37.791	-122.396	10		
		500 Howard (near 1st)	37.788	-122.396	11		
		246 2nd St (near Folsom)	37.786	-122.397	12		
		358 Brannan (near 3rd)	37.781	-122.393	13		
		414 Brannan (near 4th)	37.779	-122.395	14		
Union Cruiser	4-7:40 PM	589 Bryant (near 4th)	37.780	-122.398	1	20	10
		57 Stillman (near 2nd)	37.782	-122.396	2		
		181 2nd St (near Howard)	37.787	-122.399	3		
		85 2nd St (near Mission)	37.788	-122.400	4		
		333 Market (at Fremont)	37.791	-122.399	5		
		242 California (near Battery)	37.793	-122.399	6		
		1630 Powell (near Green)	37.800	-122.411	7		
		1150 Union (near Leavenworth)	37.799	-122.418	8		
		1580 Filbert (near Franklin)	37.799	-122.426	9		
		1816 Filbert (near Octavia)	37.799	-122.429	10		
		2000 Filbert (near Buchanan)	37.798	-122.433	11		
		2360 Filbert (near Steiner)	37.798	-122.438	12		
West SoMa Direct	6:30-9:45 AM	3351 Divisadero (near Francisco)	37.801	-122.443	1	18	14
		3131 Fillmore (near Pixley)	37.798	-122.436	2		
		1857 Filbert (near Laguna)	37.799	-122.430	3		
		1575 Filbert (near Franklin)	37.799	-122.425	4		
		2325 Van Ness (near Vallejo)	37.797	-122.424	5		
		1565 Broadway (near Polk)	37.796	-122.423	6		
		1720 Sacramento (near Polk)	37.791	-122.421	7		
		39 Fell Street (near Van Ness)	37.776	-122.419	8		
		320 10th St (near Folsom)	37.773	-122.412	9		
		885 Brannan (Near 8th)	37.772	-122.405	10		
		651 Brannan (near 6th)	37.776	-122.400	11		
		475 Brannan (near 4th)	37.779	-122.396	12		
		333 Brannan (near 2nd)	37.781	-122.393	13		
		247 2nd (near Folsom)	37.786	-122.397	14		

<b>Route name</b>	<b>Time of operation</b>	<b>Stop name</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Stop sequence</b>	<b>Max. headway (minutes)</b>	<b>Min. headway (minutes)</b>
West SoMa Direct	4-7 PM	500 Howard (near 1st)	37.788	-122.396	1	20	20
		448 Brannan (near Zoe)	37.779	-122.396	2		
		778 Brannan (near Gilbert)	37.774	-122.402	3		
		888 Brannan St (near 8th)	37.771	-122.405	4		
		281 9th St	37.774	-122.412	5		
		250 Larkin (near McAllister)	37.780	-122.417	6		
		1496 Larkin (near Sacramento)	37.792	-122.419	7		
		2098 Polk (near Broadway)	37.796	-122.422	8		
		1580 Filbert (near Franklin)	37.799	-122.426	9		
		1860 Filbert (near Laguna)	37.799	-122.430	10		
		2234 Filbert (near Fillmore)	37.798	-122.436	11		
		3318 Divisadero (near Chestnut)	37.800	-122.443	12		

# Appendix 2. Accessibility analysis

Figure A2-1. Integrated high-frequency microtransit, public transit and pedestrian network by travel time during the morning peak period in San Francisco.



Figure A2-2. Accessibility to jobs within (a) 15, (b) 30, (c) 45, and (d) 60 minutes in San Francisco when integrating public transit with high-frequency microtransit.

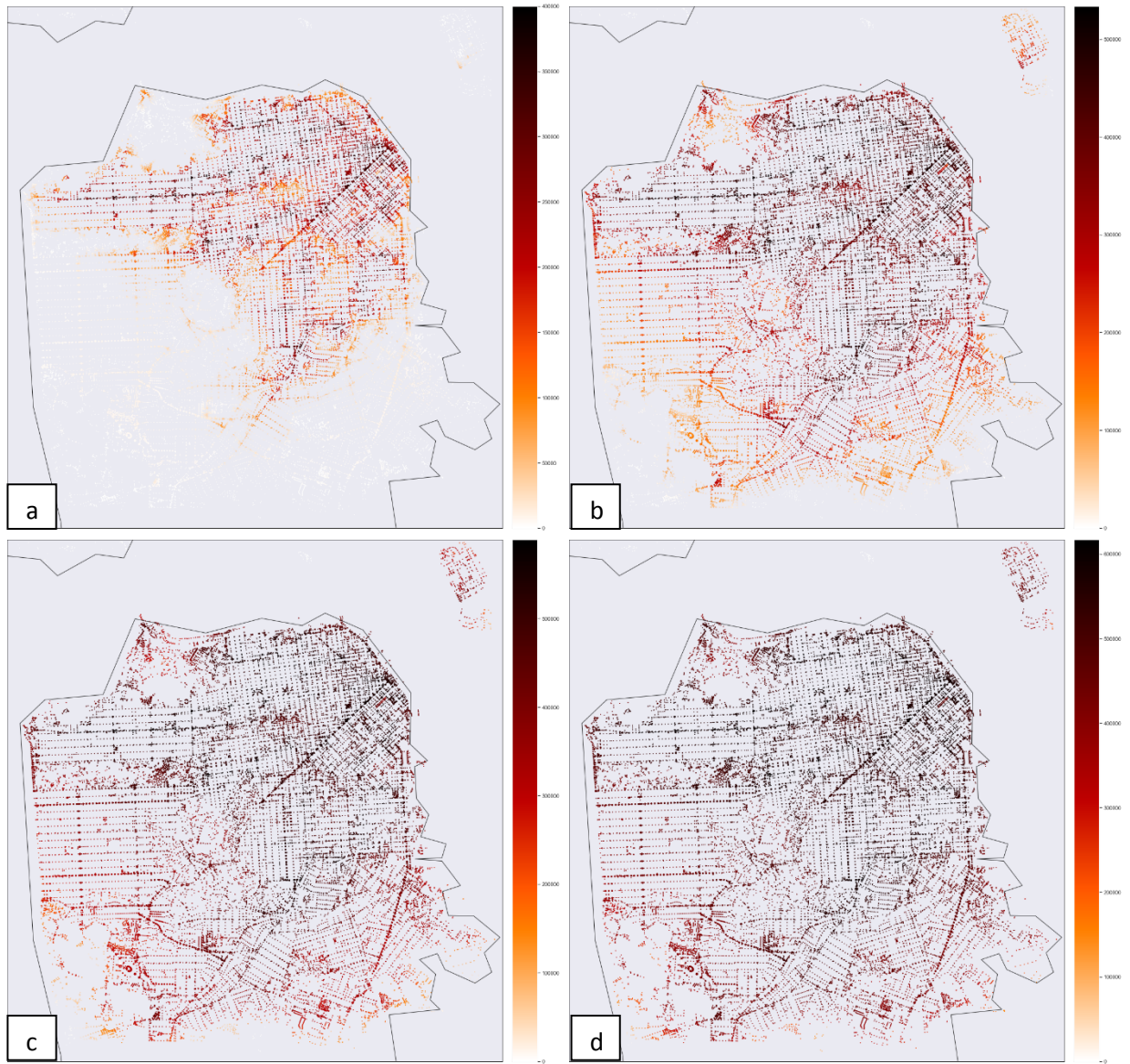


Figure A2-3. Accessibility to jobs within (a) 15, (b) 30, (c) 45, and (d) 60 minutes in San Francisco when integrating public transit with low-frequency microtransit.

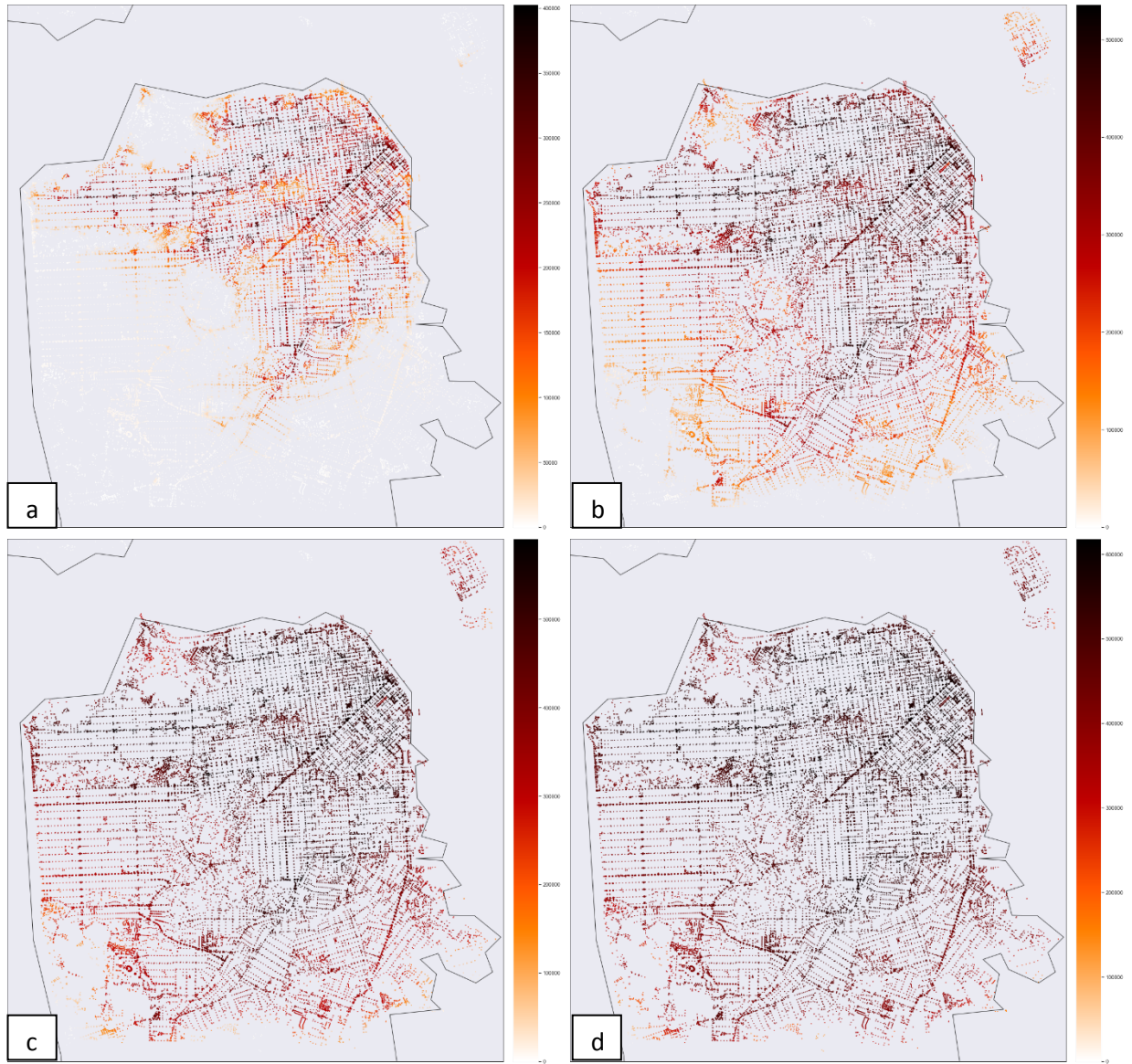


Figure A2-4. Changes in accessibility to jobs within (a) 15, (b) 30, (c) 45, and (d) 60 minutes in San Francisco when integrating public transit with high-frequency microtransit compared to public transit only.

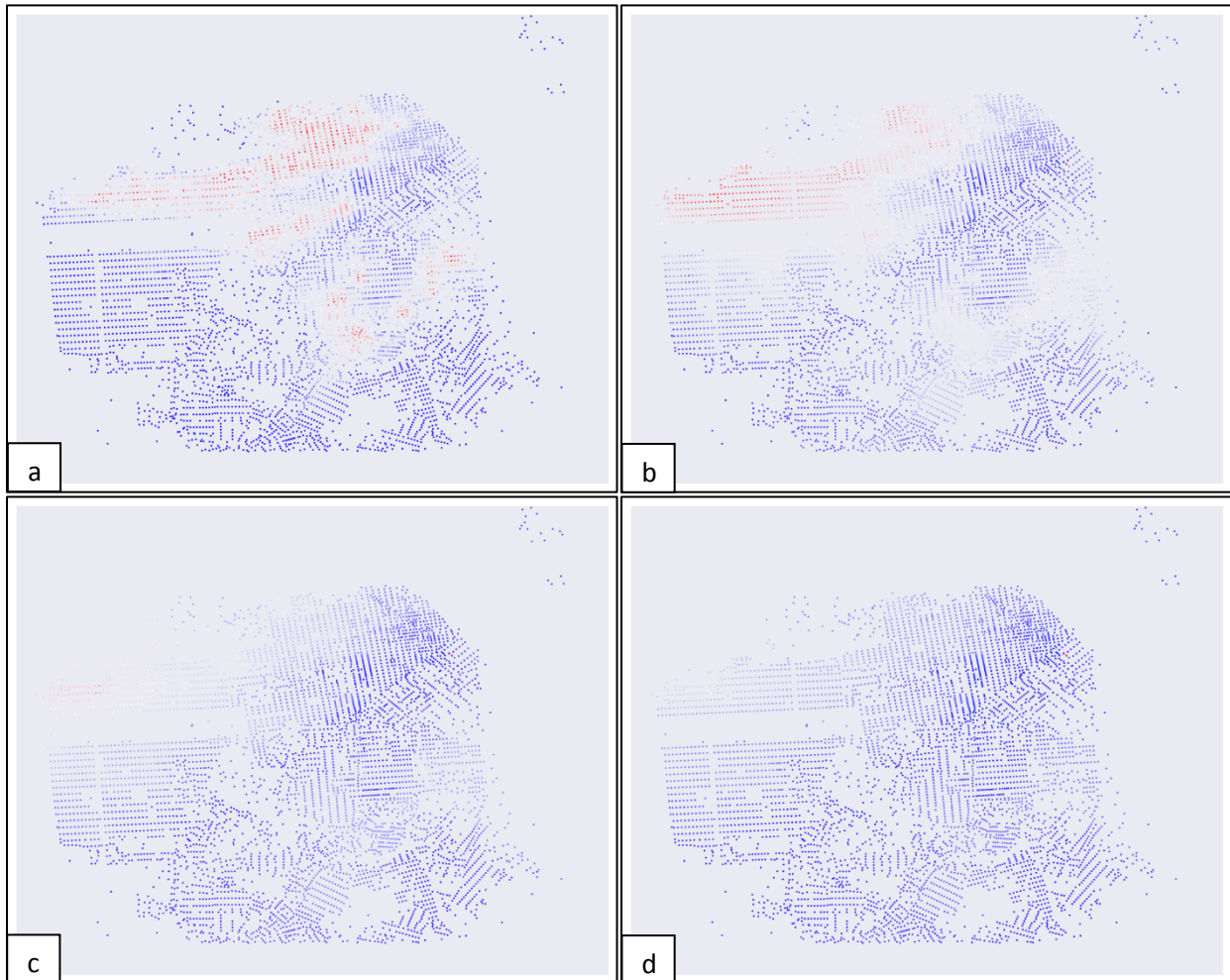




Figure A2-5. Changes in accessibility to jobs within (a) 15, (b) 30, (c) 45, and (d) 60 minutes in San Francisco when integrating public transit with low-frequency microtransit compared to public transit only.

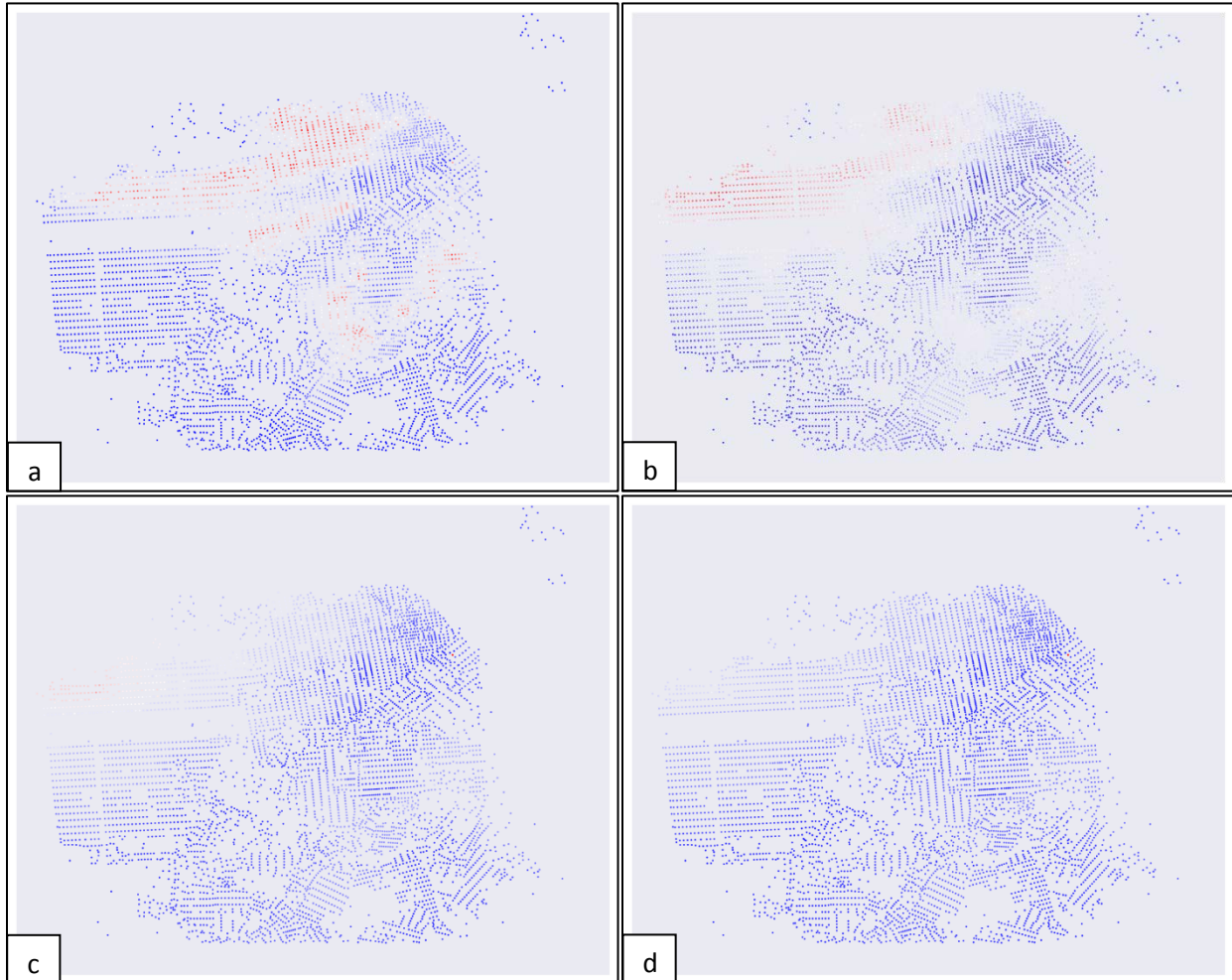


Table A2-1. Accessibility to jobs within San Francisco by public transit only.

Neighborhood	Median transit accessibility at the block level				Maximum transit accessibility at the block level			
	Time thresholds				Time thresholds			
	15 min.	30 min.	45 min.	60 min.	15 min.	30 min.	45 min.	60 min.
Bayview Hunters Point	6,100	106,200	281,000	384,900	17,100	241,800	388,000	465,900
Bernal Heights	10,900	204,500	362,400	446,700	40,500	294,900	427,100	495,200
Castro / Upper Market	43,900	299,600	432,200	499,100	148,300	387,700	491,400	543,500
Chinatown	125,800	331,900	448,100	511,000	195,500	387,000	487,500	540,500
Excelsior	4,800	134,700	311,600	408,500	16,200	256,200	401,700	476,200
Financial District / South Beach	176,400	376,600	480,300	535,200	268,400	444,000	528,300	571,100
Glen Park	9,000	231,400	385,400	464,000	34,300	297,800	430,500	497,800
Golden Gate Park	8,900	104,300	289,100	391,700	17,800	155,200	329,900	422,300
Haight Ashbury	23,700	234,100	385,600	464,100	53,200	313,400	441,100	505,800
Hayes Valley	59,800	316,300	442,600	506,800	162,500	391,800	493,900	545,400
Inner Richmond	13,300	136,100	309,700	406,700	22,500	189,600	349,900	437,100
Inner Sunset	14,600	163,700	337,800	428,200	30,100	278,800	417,700	488,200
Japantown	28,000	253,800	395,800	471,700	52,000	304,800	432,300	499,100
Lakeshore	3,500	48,000	238,000	353,300	8,100	124,500	308,800	406,600
Lincoln Park	3,400	25,300	165,800	295,400	4,700	37,900	204,700	326,100
Lone Mountain / USF	19,200	197,200	355,600	441,600	33,900	269,800	409,600	482,100
Marina	13,500	177,500	335,900	426,400	58,300	273,800	407,400	480,500
McLaren Park	2,100	77,500	263,300	372,000	3,400	88,400	273,900	380,100
Mission	57,800	309,600	437,400	503,000	180,400	399,900	499,000	549,200
Mission Bay	45,800	285,300	417,200	487,800	154,800	367,600	475,300	531,400
Nob Hill	86,200	318,900	441,600	506,100	168,700	375,300	480,100	535,000
Noe Valley	10,800	231,200	384,200	463,100	49,700	309,600	438,900	504,100
North Beach	42,500	238,300	377,700	458,100	142,600	347,500	459,300	519,400
Oceanview / Merced / Ingleside	4,300	116,300	299,200	399,200	12,800	243,400	392,500	469,300
Outer Mission	5,100	159,600	331,700	423,600	22,300	277,400	416,500	487,300
Outer Richmond	6,300	57,400	237,000	351,400	14,800	135,500	310,800	407,700
Pacific Heights	22,200	221,200	370,000	452,300	61,400	305,300	431,900	498,800
Portola	5,500	171,900	336,900	427,400	21,900	265,000	404,800	478,500
Potrero Hill	13,900	206,500	359,400	444,300	52,000	296,200	426,600	494,900
Presidio	2,500	47,300	218,200	336,500	13,100	151,400	314,300	409,500
Presidio Heights	16,000	152,800	321,100	415,200	29,300	240,700	386,000	464,400

Neighborhood	Median transit accessibility at the block level				Maximum transit accessibility at the block level			
	Time thresholds				Time thresholds			
	15 min.	30 min.	45 min.	60 min.	15 min.	30 min.	45 min.	60 min.
Russian Hill	42,500	256,400	393,500	470,000	85,000	305,900	430,600	497,900
Seacliff	3,900	43,200	213,500	333,100	7,400	73,300	256,000	365,700
South of Market	132,400	355,100	467,300	525,400	257,300	439,300	525,200	568,800
Sunset / Parkside	4,600	46,800	228,200	346,000	16,700	153,500	331,100	423,300
Tenderloin	146,600	374,900	481,600	536,100	268,700	449,600	532,300	574,200
Treasure Island	300	81,800	241,600	352,800	2,000	151,200	305,500	403,100
Twin Peaks	5,900	179,300	349,300	436,900	20,800	258,800	404,100	478,000
Visitacion Valley	2,800	87,200	272,700	379,000	5,500	151,900	321,300	415,600
West of Twin Peaks	5,900	159,000	334,100	425,500	39,300	303,500	434,400	500,700
Western Addition	32,500	274,200	410,400	482,700	143,000	382,400	487,600	540,600

Table A2-2. Change in accessibility to jobs within San Francisco from the integration of public transit with Chariot – Chariot network with minimal headways.

Neighborhood	Median change in accessibility at the block level				Maximum change in accessibility at the block level			
	Time thresholds				Time thresholds			
	15 min.	30 min.	45 min.	60 min.	15 min.	30 min.	45 min.	60 min.
Bayview Hunters Point	-	69,000	63,000	48,300	122,000	220,300	161,900	122,100
Bernal Heights	144,500	202,700	142,300	107,000	348,600	294,900	203,800	153,100
Castro / Upper Market	70,000	73,600	49,700	37,500	221,900	187,300	127,100	95,500
Chinatown	120,900	105,200	76,700	57,800	292,700	230,700	163,900	123,200
Excelsior	6,300	126,300	91,900	69,200	202,200	193,300	133,500	100,400
Financial District / South Beach	84,100	79,700	57,000	42,900	265,700	456,700	537,400	578,000
Glen Park	103,400	111,200	76,200	57,400	273,800	222,900	152,300	114,400
Golden Gate Park	65,700	268,300	186,900	140,400	186,700	288,100	234,500	184,400
Haight Ashbury	221,600	216,400	147,800	111,100	351,900	305,000	209,000	157,000
Hayes Valley	150,700	111,100	75,200	56,600	290,800	221,700	150,300	112,900
Inner Richmond	234,900	315,900	225,700	170,100	364,600	382,200	268,300	201,800
Inner Sunset	31,300	146,100	101,500	76,300	264,300	272,400	187,700	141,100
Japantown	156,600	156,100	112,300	84,500	203,200	209,800	149,000	112,000
Lakeshore	-	40,000	48,600	37,200	-	59,500	51,700	39,800
Lincoln Park	109,300	339,800	309,900	236,300	177,600	373,200	318,600	243,600
Lone Mountain / USF	177,500	223,700	154,400	116,000	336,600	280,500	195,600	147,000
Marina	258,900	276,900	201,100	151,700	381,000	347,300	250,300	189,200
McLaren Park	-	66,300	88,700	69,600	1,400	152,500	119,300	89,900
Mission	94,500	81,900	56,100	42,300	339,300	269,400	184,300	138,400
Mission Bay	97,400	95,700	69,400	52,300	309,100	239,200	165,800	124,600
Nob Hill	122,100	103,600	74,300	55,900	305,600	211,600	146,500	110,100
Noe Valley	180,900	177,400	121,000	91,000	351,000	277,900	188,400	141,500
North Beach	128,200	159,700	121,500	91,500	211,500	199,400	148,100	111,400
Oceanview / Merced / Ingleside	-	64,500	53,200	40,200	30,600	78,600	59,600	45,000
Outer Mission	8,400	111,500	88,700	66,900	213,400	210,100	143,500	107,800
Outer Richmond	186,500	348,300	277,100	209,000	375,500	484,300	370,100	279,800
Pacific Heights	260,000	254,600	182,100	137,000	373,700	366,400	262,400	197,500
Portola	-	38,800	34,200	26,200	41,300	134,500	107,000	80,900
Potrero Hill	187,600	208,700	157,800	119,500	347,900	309,600	217,600	163,700
Presidio	51,200	242,600	189,700	144,600	220,100	325,700	284,500	216,300
Presidio Heights	241,400	294,400	209,900	158,100	370,400	374,800	264,800	199,500

Neighborhood	Median change in accessibility at the block level				Maximum change in accessibility at the block level			
	Time thresholds				Time thresholds			
	15 min.	30 min.	45 min.	60 min.	15 min.	30 min.	45 min.	60 min.
Russian Hill	208,100	203,100	149,600	112,500	334,400	276,500	199,100	149,800
Seacliff	126,100	332,100	284,300	216,300	250,100	389,100	308,200	234,100
South of Market	63,400	56,000	39,500	29,800	206,300	158,600	111,700	84,000
Sunset / Parkside	-	112,800	116,300	87,700	101,400	261,900	237,300	180,100
Tenderloin	44,300	37,200	26,100	19,800	164,800	107,100	72,200	54,400
Treasure Island	-	49,000	61,100	49,200	300	65,500	64,100	49,300
Twin Peaks	2,500	89,900	61,200	46,100	92,800	136,200	92,000	69,200
Visitacion Valley	-	31,500	33,500	25,900	-	84,000	70,100	52,900
West of Twin Peaks	-	58,900	50,200	37,900	119,000	134,300	94,600	71,200
Western Addition	117,200	124,400	85,900	64,600	273,300	195,400	137,600	103,500

Table A2-3. Change in accessibility to jobs within San Francisco from the integration of public transit with Chariot – Chariot network with maximal headways

Neighborhood	Median change in accessibility at the block level				Maximum change in accessibility at the block level			
	Time thresholds				Time thresholds			
	15 min.	30 min.	45 min.	60 min.	15 min.	30 min.	45 min.	60 min.
Bayview Hunters Point	-	69,800	65,000	49,700	122,800	223,200	163,900	123,600
Bernal Heights	145,500	205,600	144,300	108,500	351,200	297,900	205,800	154,600
Castro / Upper Market	70,400	73,800	49,800	37,600	222,600	188,000	127,600	95,900
Chinatown	122,700	108,200	78,700	59,300	296,200	233,800	165,900	124,700
Excelsior	6,300	127,600	92,800	69,900	203,700	195,100	134,700	101,300
Financial District / South Beach	85,700	82,700	59,000	44,500	267,700	459,700	539,400	579,500
Glen Park	104,100	112,300	77,000	58,000	275,800	225,900	154,300	115,900
Golden Gate Park	65,800	268,500	187,000	140,500	186,900	288,200	234,800	184,700
Haight Ashbury	221,800	217,000	148,300	111,400	352,500	305,100	209,100	157,000
Hayes Valley	152,000	112,000	75,800	57,100	291,800	222,800	151,000	113,500
Inner Richmond	236,400	316,100	226,200	170,500	366,900	383,100	268,900	202,200
Inner Sunset	31,500	146,300	101,600	76,400	264,500	272,600	187,800	141,100
Japantown	157,400	158,700	114,100	85,800	204,200	211,800	150,300	113,000
Lakeshore	-	40,300	48,900	37,500	-	60,200	52,200	39,800
Lincoln Park	110,000	340,600	310,400	236,800	178,800	374,100	319,100	244,000
Lone Mountain / USF	177,500	223,700	154,400	116,000	340,200	280,500	195,600	147,000
Marina	263,400	283,200	205,900	154,900	389,200	358,800	256,700	193,400
McLaren Park	-	67,200	89,600	70,400	1,400	154,100	120,500	90,800
Mission	96,200	84,000	59,500	44,900	342,000	272,400	186,300	139,900
Mission Bay	99,500	99,500	71,400	53,800	311,400	242,200	167,800	126,100
Nob Hill	123,600	106,600	76,300	57,400	309,000	214,600	148,600	111,700
Noe Valley	182,000	178,500	121,800	91,600	353,900	280,900	190,400	143,100
North Beach	129,300	162,700	123,600	93,000	213,700	202,400	150,100	112,900
Oceanview / Merced / Ingleside	-	65,400	53,800	40,700	30,800	79,600	60,300	45,500
Outer Mission	8,500	112,600	89,400	67,400	215,000	212,500	145,000	109,000
Outer Richmond	187,600	349,000	277,600	209,400	377,100	485,200	370,700	280,200
Pacific Heights	262,600	263,100	186,300	140,000	377,100	369,400	264,400	199,000
Portola	-	46,100	37,100	28,500	41,500	135,900	108,000	81,600
Potrero Hill	189,000	211,600	159,800	121,100	350,600	312,600	219,600	165,200
Presidio	51,600	247,700	193,100	146,900	228,100	326,500	285,000	216,700
Presidio Heights	242,900	297,100	211,700	159,500	373,600	377,700	266,800	200,900

Neighborhood	Median change in accessibility at the block level				Maximum change in accessibility at the block level			
	Time thresholds				Time thresholds			
	15 min.	30 min.	45 min.	60 min.	15 min.	30 min.	45 min.	60 min.
Russian Hill	215,000	206,200	152,700	114,700	337,800	279,500	201,200	151,300
Seacliff	127,000	332,900	284,900	216,700	251,500	390,000	308,700	234,500
South of Market	74,300	65,400	46,500	35,100	219,100	165,400	115,800	87,100
Sunset / Parkside	-	112,900	116,400	87,800	101,600	262,000	237,700	180,400
Tenderloin	45,500	40,100	28,100	21,300	195,200	125,400	84,400	63,500
Treasure Island	-	50,000	63,100	50,700	300	68,100	66,100	50,800
Twin Peaks	2,500	90,000	61,300	46,200	93,200	136,700	92,400	69,600
Visitacion Valley	-	36,400	36,900	28,400	-	85,000	70,900	53,500
West of Twin Peaks	-	59,200	50,500	38,200	120,000	134,400	94,700	71,200
Western Addition	117,300	124,900	86,300	64,900	305,700	215,800	150,800	113,400

Figure A2-6. San Francisco analysis neighborhoods and communities of concern.

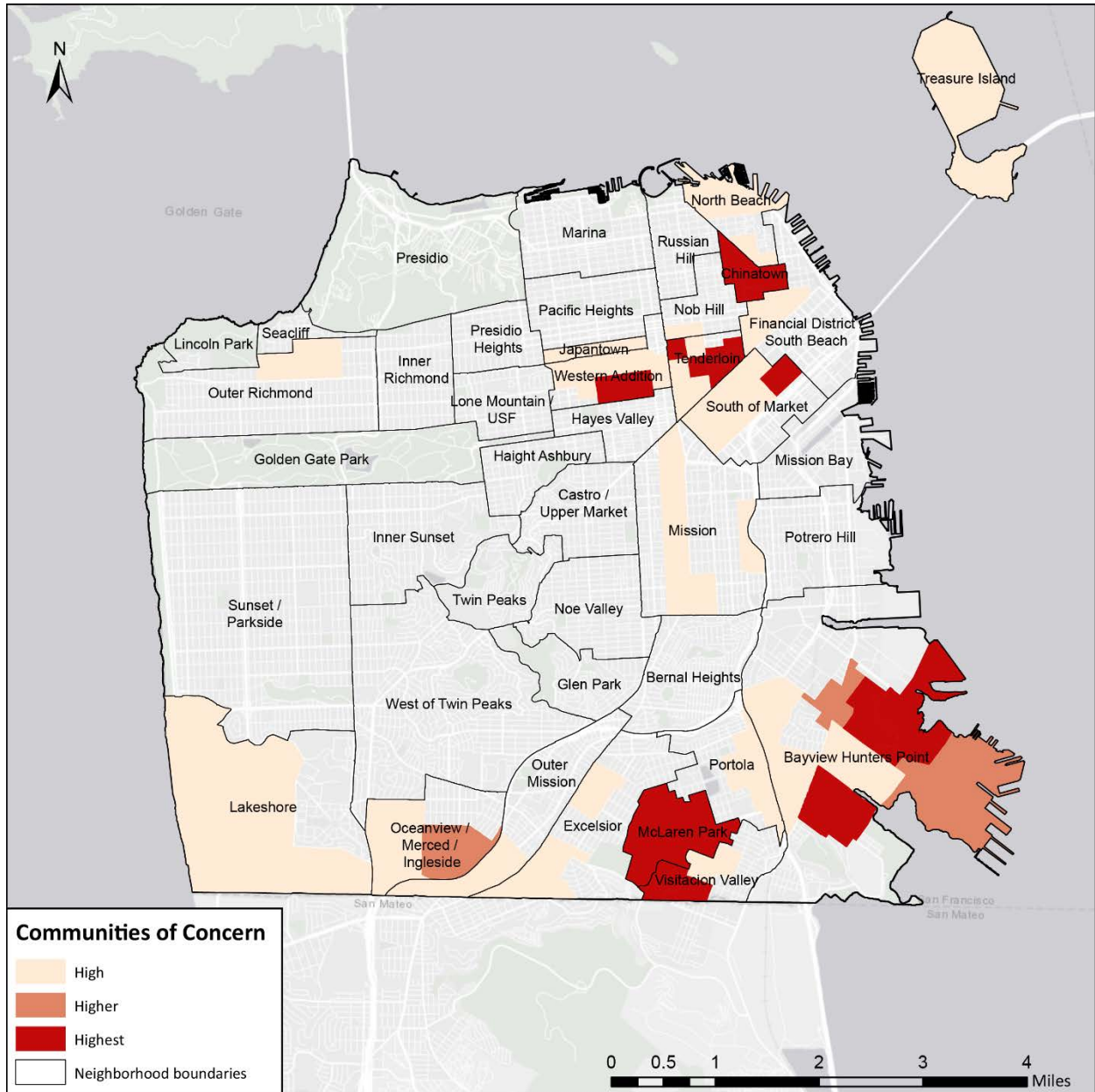




Figure A2-7. Distribution of increases in accessibility to jobs within 15, 30, 45 and 60 minutes for San Francisco’s communities of concern when integrating high-frequency or low-frequency microtransit and public transit.

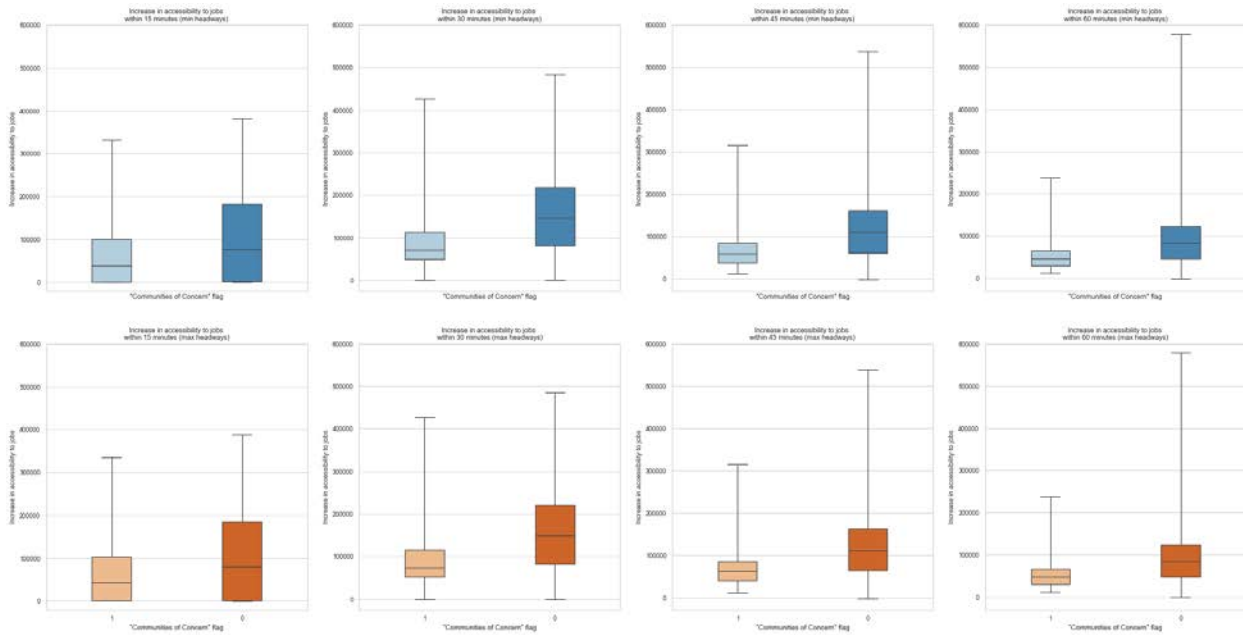


Figure A2-8. Distribution of increases in accessibility to jobs within 15, 30, 45 and 60 minutes by class of communities of concern in San Francisco when integrating high-frequency or low-frequency microtransit and public transit.

