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Encouraging Access to Technology-Enabled Transportation Data for Passenger Mobility in US Cities

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The explosion of big data offers new opportunities for planning and provisioning energy-efficient transportation services and infrastructure in cities. The prominence of technology-enabled mobility services has led to the creation of large datasets. Cities can use this valuable information on the daily transportation choices that people make to effectively change the transportation planning landscape.

For personal mobility options, technology-enabled services such as the ZipCar and car2go car-sharing programs have taken off in urban centers in recent years, in part because they remove the onus of personal vehicle ownership in areas where the costs of maintaining and insuring a car often outweigh the benefits of driving. Bike-sharing programs offer commuters and city residents another alternative to driving personal vehicles for certain trips. Both bike- and car-sharing programs provide urban residents with vehicles for short, spontaneous trips through cell phone apps that allow members to locate vehicles and identify return points. Similarly, cell phone applications have enabled the boom in ride-sharing services in urban areas. Cell phone apps also give urban residents access to real-time public transit data from transit agencies. These data include bus- and train-tracking information and dynamic transit maps and schedules to navigate growing and increasingly complex transit systems.

A number of cities have begun considering the benefits of making transportation data easily accessible to the public. Many of these municipalities were spurred by the US Department of Transportation's 2016 Smart City Challenge, in which cities competed to win $50 million in federal funding for planning and implementing a smart transportation system using data, applications, and technology. The primary goal of the Smart City Challenge was to encourage cities to move people and goods faster and more efficiently while reducing transportation-related greenhouse gases (GHGs), improving safety, and improving overall security. The seven finalist cities—including the eventual winner, Columbus, Ohio—have all made commitments to move forward with at least a few elements of their ambitious plans.

Cities can use various mechanisms to ensure universal access to transportation data. First, local agencies can gather and release transportation-related data to the public. For example, in many US cities, transit agencies have released real-time data for developers to create bus- and train-tracking applications and dynamic transit maps and schedules to help residents navigate the growing and increasingly complex transit systems.

Second, cities can require that mobility service providers make information relevant to transportation planning available in exchange for operating permissions. While this approach is still generally uncommon in US cities, many large urban municipalities are beginning to broker data-sharing agreements with transportation network companies (TNCs) such as Uber and Lyft

and other mobility providers to gain access to data that could help them identify key transportation trends and changes.

Finally, cities can create data-sharing platforms that serve as a clearinghouse for transportation and other city-level data and allow easy access to the information.

Program Goals and Benefits

Tech-enabled mobility approaches can generate large amounts of data from various sources including transit agencies, telecommunications providers, and individual companies. These data provide multiple energy and nonenergy benefits for city-level transportation systems. They can help individuals with their day-to-day travel decisions, help decision makers optimize infrastructure investments, and serve as the basis for sound policymaking. Companies such as Google have already made available transit agencies' real-time transit arrival and departure data on universal applications such as Google Maps. Likewise, many transit agencies across the country have made route and scheduling data available to third-party app developers. Accurate data are also critical to identifying service and infrastructure gaps, planning future transportation systems that meet urban residents' needs, and implementing policies that support the creation of smart, sustainable transportation systems.

Improving access to transportation data can help cities achieve many of their goals and targets. Cities often have a wide range of energy- and nonenergy-related transportation challenges to consider. The Smart City Challenge highlighted several consistent themes that cities were interested in addressing using data-driven approaches.

Reducing Congestion

Congestion can cost urban residents time and money, in addition to releasing smog-forming pollutants that can affect the health of communities. Cities can use transportation data to pinpoint the factors that push people toward alternative modes of transport and increase transportation services to take cars off the road and provide citizens with a range of reliable transportation options (DOT 2017). Additionally, with access to real-time travel information, residents can make informed travel decisions that will help them save time, money, and fuel (DOT 2017).

Achieving Energy-Reduction and Greenhouse Gas Targets

Transportation accounts for 25–38% of energy use and GHGs in most cities in industrialized countries (Ribeiro et al. 2017) and offers significant climate emission reduction opportunities. American cities have taken the lead on this front in light of the current administration's planned withdrawal from the Paris Agreement. As a result, cities have become an incubator for ambitious climate-related policies and programs. Smart, electrified transportation systems are key to achieving local GHG targets.

The emergence of big data will help policymakers and decision makers understand how emerging mobility options can be incorporated into existing transportation systems to save energy and meet climate targets. For instance, in some US cities, ride-sharing through companies such as Uber, Lyft, and Grab has been shown to become a substitute for transit and add to congestion (Clewlow and Mishra 2017). Ensuring that this does not become a permanent trend across the country will be critical to creating sustainable transportation systems.

Connecting Underserved Communities

As cities have sprawled and jobs have moved away from urban cores, many communities have become geographically more isolated and inadequately served by affordable and connected transportation services. In such communities, transportation options are often limited to automobiles and transportation costs can be high because residents must drive long distances to reach job centers and other services. Data collection efforts can identify these underserved urban areas for alternative transportation services (DOT 2017; Ribeiro et al. 2017).

Identifying Infrastructure Needs

City and public agencies can use comprehensive transportation data to assist in planning future transit expansion and in developing appropriate infrastructure. Big data can direct agencies to focus on programs and policies for increasingly popular modes and find ways to incorporate them into existing transportation systems in a sustainable and effective way.

Program Design and Adoption

While programs that focus on making transportation data available to the public are relatively new, many have identified the following elements as critical to their success.

Multi-Stakeholder Data

To provide residents, researchers, and planners with the clearest picture of travel and freight trends on the ground, transportation data access efforts must target a variety of data types. This involves negotiating the acquisition of both static and dynamic data from transit agencies, TNCs, telecommunication providers, and other stakeholders.

Dynamic and Location-Based Data

While static information will be critical to understanding how to incorporate emerging mobility and freight options to create sustainable transportation systems, up-to-the-minute real-time data will be needed to truly improve efficiency. For instance, commuters can benefit greatly from bus- and train-tracking systems, dynamic traffic maps, and schedules. Similarly, real-time data on traffic conditions will be useful to freight carriers who can use the information to improve delivery times and save on fuel.

Data-Sharing Platform

To make transportation data readily available to stakeholders, cities will likely need to create a centralized online repository. To create this platform, municipalities must address privacy and proprietary issues by establishing a vetted sharing protocol with the assistance of stakeholder groups that will use and provide the data.

All seven of the finalist cities for the Smart City Challenge recognized the importance of making transportation data available online. Pittsburgh, Pennsylvania, proposed the creation of the Data Utility to make transportation datasets available and provide a data collection and data-sharing framework (Pittsburgh 2016). Similarly, Columbus (the winner of the Smart City Challenge) will be centering its smart city approach on the creation of an integrated data exchange called Smart Columbus (Columbus 2016).

DATA COLLECTION FRAMEWORK

Cities will need a well-articulated data collection process to remove some of the barriers associated with hosting various types of data in a centralized platform. These frameworks will maintain consistency in how the data are displayed. Additionally, as privacy is often a concern when collecting data from multiple stakeholders, cities should create a process to anonymize publicly available information. This will be critical to getting buy-in from different data providers.

Implementation Resources

Given the newness of many of these data-sharing efforts, cities will need to look to their counterparts to determine best practice action and programs. Municipalities can evaluate programs in other cities with similar needs and conditions to identify practices that are achievable and successful. This will provide decision makers with a group of approaches to draw from (Vaidyanathan 2018). Our case studies here outline a few approaches that cities have used to provide various forms of universally accessible data.

Cities will also need to consult with their most critical resources—key stakeholders. Providing comprehensive access to transportation data obviously requires collecting various types of data from various stakeholders; cities will need to understand some of the concerns and barriers that these user groups and data providers may have above making these data public. Without buy-in from those using and providing data, universal data access is unlikely to succeed.

Energy Savings

Improved access to data can support new approaches to getting people out of single-occupancy vehicles, using more efficient transportation modes, and creating more efficient systems to fill specific transportation needs.

However the exact energy-related impacts of improved access to data from these emerging mobility options are still largely unclear. While giving residents and policymakers access to transportation-related data could streamline transportation system efficiency, cities must clearly understand the reasons behind an individual's travel behaviors and provide residents with the appropriate data to make travel decisions to ensure that car-based services do not supplant more efficient transportation modes. Whether an individual is using a ride-sharing service like Uber or Lyft to replace public transit or a single-occupancy-vehicle trip has a significant bearing on a transportation system's overall energy efficiency and sustainability.

On a larger scale, having freely available data is critical to spurring more innovation and improving public agency effectiveness and accountability. This could indirectly promote energy savings in the transportation sector as agencies find new ways to take advantage of existing efficiency potential and improve the success rate of programs (Vaidyanathan 2014).

Case Studies

In the following sections, we highlight transportation-focused data-sharing efforts in the cities of San Francisco and Boston.[1] We examine how these two cities have approached program design, adoption, and implementation, as well as their progress on evaluating these programs. Both cities have implemented unique programs targeted at addressing key transportation challenges. As mentioned above, creating open-access transportation datasets for use by multiple stakeholders is still a relatively new concept for cities, so it can be difficult to identify successful approaches and impacts in a concrete way.

BOSTON, MASSACHUSETTS: DATA AGREEMENT WITH UBER

TNCs such as Uber, Lyft, and Grab have historically been very reticent to make their geographic and trip-specific data (such as pick-up and drop-off location, length of trip, and time of trip) public. This is largely because TNCs are private companies with very real proprietary concerns that could affect their market shares and their competitive prowess. Nevertheless, data from TNCs are extremely valuable given recent advances in mobility options at the city level. TNC data can help cities understand how ride-hailing is used, as well as whether shared-ride vehicles are substituting more efficient forms of transportation.

The city of Boston in the state of Massachusetts was the first US city to enter into a sharing agreement with Uber in an effort to better understand travel trends and incorporate them into long-range transportation planning. In 2015, Boston signed a voluntary agreement with Uber that specified that the company would provide the city with the following types of data:

- Anonymous pick-up and drop-off location of each ride by zip code and neighborhood within the city's boundaries
- Date and time of each trip
- Duration of trip
- Wait time for ride-share vehicle (Uber 2015)

The city's specific reasons for wanting these data included helping city policymakers and researchers gain a more thorough understanding of traffic implications of Uber trips and commute patterns. Additionally, Boston wanted to use these data to improve traffic planning, congestion reduction, and passenger movement while also evaluating whether existing zoning and transportation project planning adequately supported current travel trends (Uber 2015).

Although the agreement was initially hailed as a step in the right direction for TNC data sharing, the zip-code level information that Uber provided was ultimately too broad to draw any meaningful conclusions. In 2016, the City of Boston worked through the Massachusetts legislature to require that Uber and other ride-hail companies provide the city with data for much smaller geographic breakdowns (Vaccaro 2016).

[1] Both Boston and San Francisco have roughly similar populations. One-year estimates from the American Community Survey administered by the US Census Bureau (2018) show the 2017 population for Boston as 683,015 and for San Francisco as 884,363.

These efforts, as well as similar demand from other cities, pushed Uber to create its Movement tool for Boston and a select group of global cities in an effort to provide more granular data. The Movement tool provides anonymized data from approximately 2 billion trips to help cities with planning efforts. Movement compares current and past travel conditions in cities where Uber operates, and can help those cities identify relevant trends for transportation planning purposes. In the United States, in addition to Boston, the program currently covers Cincinnati, Ohio; San Francisco; and Washington, DC (Uber 2018).

Other TNCs have also been investing in relationships with cities. For example, Lyft has entered into a data agreement with San Francisco Municipal Transportation Agency (SFMTA), although under much more stringent conditions than the Uber effort and with a focus on bike-share data. Data-sharing agreements will be critical for cities for the foreseeable future to help them grasp the highly variable energy and emissions impacts that TNCs can create at the urban level.

San Francisco, California: Bike Ridership Tracking

SFMTA tracks bicycle ridership at key intersections and makes the data freely available to the public through a centralized website. The site provides daily and weekly ridership volumes, as well as ridership broken down by census tract. The bike-counter program originated with the creation of SFMTA's 2013–2018 Strategic Plan. The city noted a lack of robust bicycle infrastructure before 2010 and realized it needed to rectify the situation to make bicycling and other more efficient modes of transportation attractive to residents and to create a sustainable transportation system (T. Winters, transportation planner, SFMTA, pers. comm., July 12, 2018). Transportation accounted for 45% of the city's GHG emissions in 2016, with passenger vehicles accounting for 91% of transportation emissions (San Francisco 2018). The plan outlined three goals to improve the San Francisco area's overall transportation system (SFMTA 2018a):

- Create a safer transportation experience for everyone
- Make transit and other sustainable modes of transportation the most attractive and preferred means of travel
- Improve the quality of life and environment in San Francisco and the region (SFMTA 2018b)

SFMTA aimed to meet these goals in part by improving the safety and connectivity of the city's bike network, as well as by making bicycling a more convenient option so that city residents would view bicycling as a reasonable alternative to driving. Research for the bike-counter program began in 2011; by 2016, the program was officially kicked off and the necessary technology installed following a brief 2013–2014 pilot.

Under the program, data are collected directly from inductive loop bike counters that are installed in the pavement midblock. Inductive loop technology detects vehicles passing or arriving at a certain point, such as approaching a traffic light. The SFMTA Data Management team then cleans and verifies the data for inclusion and display on their public website through interactive dashboards. Additionally, these dashboards create handy data visualization graphics that show trends over time or at particular intersections (see figure 1 below).

At its inception, the bike-counter program was primarily aimed at providing information to the general public, as well as to research and academic stakeholders. SFMTA wanted to provide stakeholders with an accurate picture of bicycling trends and impacts in relation to

infrastructure, as well as how increased bike ridership could change travel trends over time. This information could also serve to induce travel behavior change, as people considered the best way to get from point to point within the city. Further, San Francisco agencies could use these data in their long-range transportation planning efforts and as a justification for strengthening the network of key bicycling infrastructure and facilities, as well as motivating investment in them, so that bicycling becomes a more viable mobility option.

As the program has picked up speed, SFMTA notes that a variety of stakeholders have used the data for numerous purposes. For example, nonprofits and special interest organizations have used these data in their advocacy efforts, and San Francisco's regional metropolitan planning organization, the Metropolitan Transportation Commission, has fed the information into its transportation planning and research. Finally, SFMTA itself is hoping to use multiple years of bike counts for future modeling efforts that could help to capture full trip characteristics and trends (figure 1).

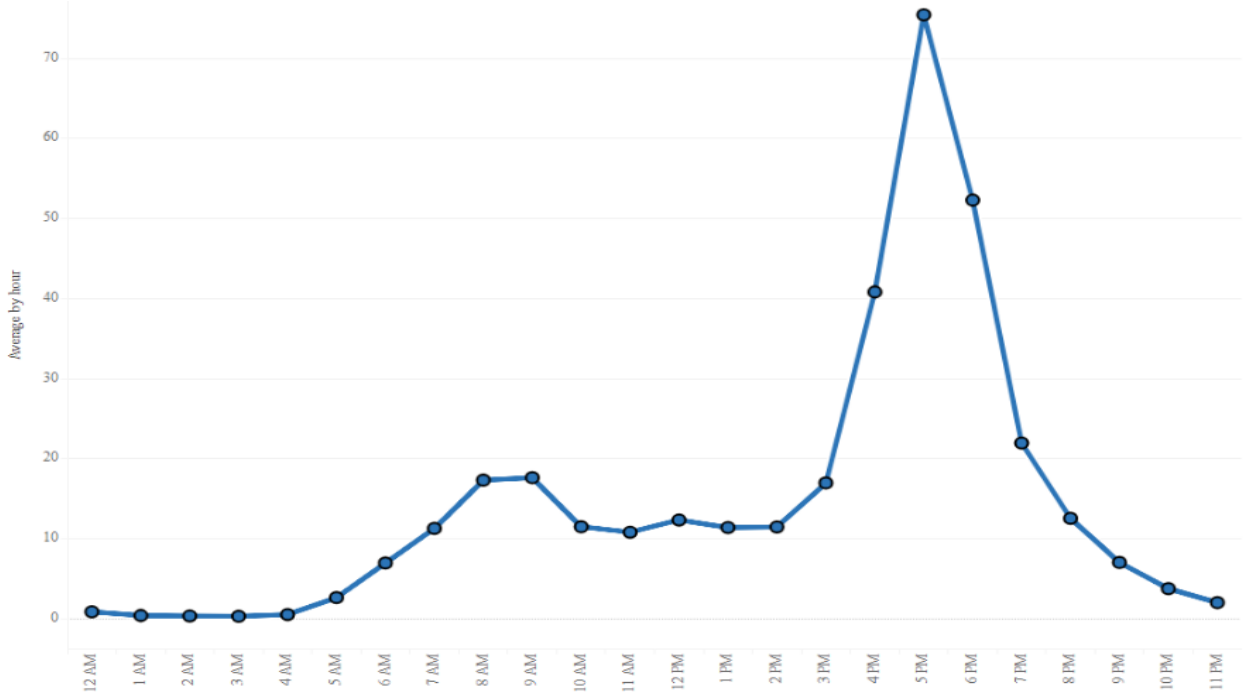

Figure 1. SFMTA weekday bike volumes dashboard for the Duboce Bike Path East of Church location

Although the bike-count program has not been evaluated for the energy savings yet, it already provides San Francisco residents with information about the popularity of biking as a mode of transport. The hope is that, as the dataset grows in size and detail, and the city continues to invest in bike infrastructure, residents will increasingly view bicycling as a reasonable substitute for private automobiles and as complementary to public transit.

Conclusion

These case studies provide examples of how cities are making transportation data free and accessible to residents and agencies alike. As data are increasingly generated from technology-enabled passenger mobility options, it will be important for cities to harness this information to

create sustainable transportation systems. Cities can play a central role in this effort by making their own agency data public, using policy mechanisms to require data disclosure from mobility service providers, and providing easily accessible centralized data-sharing platforms. Access to big data from relevant stakeholders can help cities identify service gaps, infrastructure needs, and underserved communities, in addition to providing residents with information on more efficient forms of transportation. All of these elements will help cities address energy consumption in the transportation sector. Because many of the data-sharing programs occurring around the United States are still relatively new, best practices and impacts are currently hard to identify. It will be important to track both progress and impact on efficient transportation choices as these programs proliferate in cities across the country.

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