A Framework to Reveal Gaps in Transportation Asset Maintenance Through 311 Complaints

CTIPS-026

Approved 8/17/2024

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Research Needs

Over the last decade, several U.S. cities have mainstreamed a non-emergency system called 311, which invites citizens to document complaints about several features in the city (Nam and Pardo, 2014; Stowers, 2023). Complaints range from transportation issues such as broken sidewalk/crosswalks, parking, potholes, and non-functional pedestrian lights, to all other features of city life including noise, garbage, graffiti, and loitering (Minkoff, 2016). Though such a

citizen-led participatory model for improving the city is arguably admirable, several researchers show that grievances are documented with greater propensity around where the individual lives (O'Brien, 2015, 2016), and that some types of environmental justice locations have lower number of grievances (Clark et al., 2013; Minkoff, 2016; Clark et al., 2020). Moreover, there are differences between who uses phone calls versus apps, and the expectations of the complaint maker in terms of resolution (Wu, 2021). Overall, individuals from locations with lower-income and racial minority households tend to make fewer complaints, and when they do, they rely on apps (Clark et al., 2013; Xu and Tang, 2020). Some scholars are enthusiastic about the potential of 311 as big data to predict urban futures (Wang et al., 2017), while several analysts caution that these data need more ground truthing (White and Trump, 2018; Vydra and Klievink, 2019), especially around how agencies react to 311 service calls (Chatfield and Reddick, 2018).

From the extant literature on 311 service calls, there are no systematic analyses of how transportation-sector grievances are being generated across time and location types, what the nature of complaints is, and how long resolutions takes. Given the volume and variety of 311 data, despite limitations, there is a strong potential that 311 complaints may engender better maintenance of infrastructure assets, given the widespread use of this system across the U.S. The relationship between transportation-sector complaints and locations, especially equity locations such as neighborhoods with low-income and racial/ethnic households, needs to be understood. It is likely that environmental justice locations may have not just fewer complaints but also that reactionary city agencies might focus on clearing out 311 backlogs, thus improve infrastructure over time more so in well-off locations relative to poor neighborhoods. These outcomes from newly mainstreamed technologies such as 311 might revive historic missteps (e.g., urban renewal) on winners and losers of local and regional planning agendas. We ask: using 311 calls to improve infrastructure, are we incentivizing a systematic maintenance apartheid in the transportation sector? What are frameworks to identify gaps in maintenance regimes to incentivize equitable outcomes?

Research Objectives

The key steps for this project are the following:

1. Conduct literature review
2. Identify data sources and verify data quality in case cities
3. Assemble data into geo-spatial and database formats
4. Clean data to focus on transportation-sector grievances
5. Conduct cluster analysis to identify census block group typologies (across income, race, ethnicity, education, and age attributes)
6. Conduct autocorrelation and causal statistical analyses
7. Present results to public officials
8. Share finding broadly through publications and presentations

Research Methods

Literature Review

The intent of Phase 1 is to review the existing literature on 311 service calls, identify case cities, and learn from analytical approaches used by others. This stage will include a systematic review of academic papers, city/government reports, and transportation studies.

Data Collection, Cleaning, and Assembly

In Phase 2, we plan to collect and clean the 311 service call data needed to build out a comprehensive dataset across five year (2019-2023). Since the variables/attributes of the data may differ between cities, we will come up with common approach for standardizing the data. The data will be assembled in a GIS as well as a spreadsheet format. Finally, transportation-sector 311 complaints will be identified either through pre-existing categories available in the original data or through other methods such as key word searches. We will also create our own classification across various types of complaints such as potholes, sidewalks, crosswalks, traffic lights, street lighting, pedestrian signals, among others.

Data analysis

We will rely on cluster analysis and causal spatial models (Allen et al. , 2020) with random effects at the census block group level. Using U.S. census block group data in the identified case cities, we will create typologies of block groups across five vectors (income, race, ethnicity, education, and age). Next, we will generate Moran's I measures for autocorrelation to investigate the geospatial agglomeration of transportation-focused 311 calls. Finally, based on the type of outcome variables (either categorical or count), we will generate multi-level models accounting for spatial and temporal random effects.

Relevance to Strategic Goals

This research is closely linked to the equity focus of USDOT's strategic goals. By creating a replicable data-driven framework to help cities identify gaps in how 311 service calls may result in locations that are underserved by maintenance investments, this project connects to expanding access and wealth creation in disenfranchised geographies. This project will create a scalable and replicable framework that can be adopted both at various scales, local, regional, or broader. The work leverages data for informed decision-making about maintenance planning in the transportation sector.

Educational Benefits

This research will employ graduate students as research assistants who will be trained in literature review, data assembly, geo-spatial analysis, and documenting findings. The resulting data will be made available to students for course work or research projects.

Outputs through Technology Transfer

The project results will be shared with stakeholders in a hybrid seminar/webinar format. Local and regional agency practitioners, who have advised the research team on several grants, will be invited to the seminar. Further, peer-reviewed conference papers and journal articles will be written to help with sharing the lessons learned. Finally, a public-facing report will be written for a practitioner audience so that the work is readily available for transportation professionals wanting to identify gaps in 311 service calls and their potential for infrastructure maintenance.

Expected Outcomes and Impacts

The anticipated outcomes of this research include:

- Develop of a standardized approach for transportation-sector analysis of 311 service call data
- Reveal a standard method to investigate commonalities and differences in 311 service call data across case cities
- Create a framework for identifying equity impacts from the over/under use of 311 calls across locations
- Support the goal of preserving existing transportation infrastructure by preparing cities to leverage 311 service calls to identify gaps in maintenance regimes

Work Plan

The proposed scope of work is scheduled for one-year and will adhere to the following timeframe:

Task	Timeline
Literature review	Months 1 – 2
Identify data sources and verify data quality	Months 2 – 3
Assemble data into geo-spatial and database formats	Months 3 – 5
Data cleaning to focus on transportation-sector	Months 5 – 6
Cluster analysis to identify census block group typologies	Months 6 – 7
Autocorrelation and causal statistical analyses	Months 7 – 10
Results presented to public officials (tech transfer)	Months 10 – 11
Draft public-facing report	Months 11 – 12

Project Cost

Total Project Costs:	$120,000
CTIPS Funds Requested:	$ 60,000
Matching Funds:	$ 60,000
Source of Matching Funds:	University of Colorado Denver

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