

Transit Impacts Research Program

A research program developed through collaboration between Twin Cities public agencies and the University of Minnesota



Examining off-peak transit behaviors to improve transportation equity

Transit service planning has traditionally focused on peak travel and on the needs of peak-time commuters. Off-peak transit travelers—an essential yet frequently underrepresented group—offer an opportunity for improving social equity. Often, off-peak transit trips are linked to the commutes of shift-based essential workers and transit-dependent populations, and the COVID-19 pandemic has underscored the need for a closer examination of these trips.

To better understand transit users who ride during non-peak times, TIRP researchers contrasted peak with non-peak travel behaviors in Minnesota's Twin Cities metropolitan area. The study provides **new insights into evolving transit behaviors** and highlights the **importance of the transitway system** in facilitating efficient travel.

Research Phase 1

Scrutinizing off-peak transit commutes and transfers

In the project's first phase, researchers examined an on-board transit survey (conducted in 2016 by the Met Council) and automatic fare collection data (2018–2023) to scrutinize off-peak transit commutes and transfers, particularly within the transitway system (defined as the METRO network of light rail and bus rapid transit lines). Detailed trip data showing where people travel to and from was used to illustrate travel patterns.

Key findings

- Peak-time transit riders had a longer average distance (8.5 miles) than off-peak transit riders (5.7 miles).
- Home-based and commute trips dominated the morning peak, while trips for shopping and social visits were more inclined toward off-peak times.
- Transitway trips and non-home or non-work trip purposes were more concentrated during off-peak hours.

Key terms

- **Peak travel:** Rush-hour travel, defined as trips departing between 6 and 9 a.m. and 3 and 6:30 p.m.
- **Off-peak travel:** All trips departing outside of peak hours, including early morning, midday, and overnight.
- **Transitway:** Twin Cities Metro Transit METRO lines, which include both light rail and bus rapid transit. (metrotransit.org/metro)

Research Phase 2

Examining transitway preferences

In the second research phase, investigators examined passengers' preferences for transitways compared to bus-only options by creating a set of route choices for transit trips, analyzing choice results, and modeling travel time differences to route choice probabilities. In addition to confirming transit users' preferences for transitways, the analysis highlighted variations in this preference across different groups.

Key findings

- Transitways appeared to facilitate transfers; 23 percent of people took a transfer (including routing via a transitway) even when a direct bus path was available.
- 60 percent of passengers chose trip options with METRO routes over other routes when travel times were equal.
- Commuters (especially peak-time users) were less sensitive to mode choice, tending to prioritize shorter travel times over the inclusion of a transitway route.

Research Phase 3

Analyzing long-term commute behaviors

Finally, the research team enhanced and integrated the automatic fare collection data with the survey data using machine-learning techniques to analyze long-term commute behaviors from 2018 to 2023. Importantly, this captured periods before and during the COVID-19 pandemic.

Key findings

- About one-third of transfers were associated with transitways.
- Off-peak commutes increased notably after the pandemic: The proportion of off-peak trips heading to the downtowns of Minneapolis and St. Paul increased from 28 to 40 percent and to other areas from 15 to 23 percent.
- After the pandemic, the total number of transfers decreased but the proportion of transit trips with transfers increased.

Recommendations

By identifying the characteristics of and shifts in off-peak commute patterns, the results of the study could help transportation planners adapt their transit planning strategies to evolving behaviors. These valuable insights into transfer dynamics could guide the improvement of routes, schedules, and infrastructure. Ultimately, this will enhance users' overall transit travel experiences.

Additionally, this study demonstrates the importance of continuously monitoring the short-term responses and long-term behavior changes of transit users to ensure that transit services align with the evolving needs of the community. As illustrated in the following figure, the machine-learning models developed in this study can greatly aid this process.

Further reading

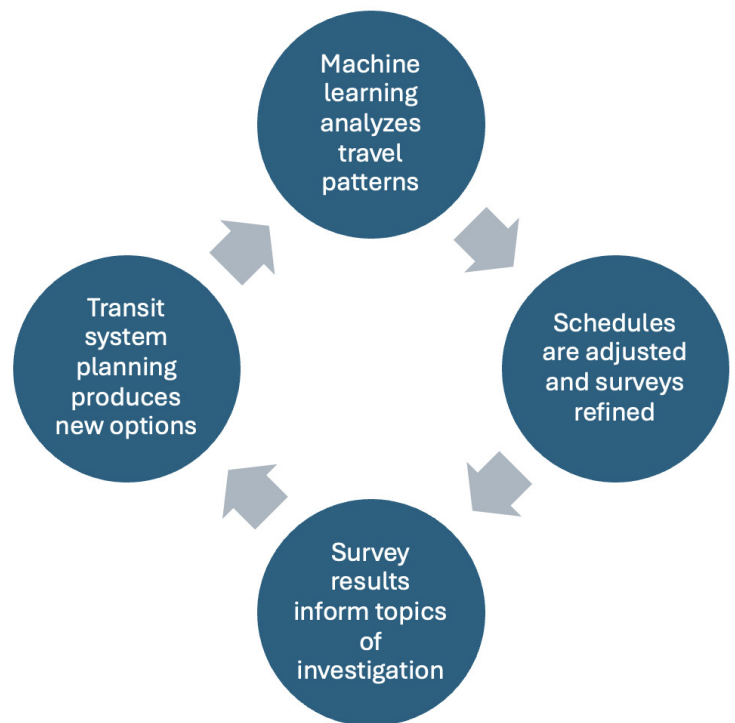
Final report: Transit Behavior and Off-Peak Commutes (CTS 24-06, Oct. 2024)

Available at cts.umn.edu/tirp

Research team

- Principal investigator: Alireza Khani, associate professor, Civil, Environmental, and Geo- Engineering
- Kwangho Baek, PhD student, Civil, Environmental, and Geo-Engineering

Aligning transit services with users' evolving needs



“Transit investments have traditionally prioritized the needs of peak-time commuters. By examining the behavior of riders during off-peak hours and how transitways support these journeys, we can develop a more comprehensive understanding of underrepresented travel patterns to help adapt the transit system to increase transportation equity.”

—Alireza Khani, Principal Investigator

The Transit Impacts Research Program (TIRP) studies the contributions of transit to mobility, economic development and job access, equity and opportunity, public well-being and safety, and sustainability. The program aims to provide information to optimize transportation investments, regional connectivity, and system effectiveness.

cts.umn.edu/tirp

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