

TORONTO SUBWAY DELAY ANALYSIS REPORT

(2014-2021)

Prepared for:

Toronto Transit Commission (TTC)

Prepared by:

Gurkirat Jaitla



REPORT OVERVIEW

This report presents an in-depth analysis of the delays experienced in the Toronto subway system from January 2014 to June 2021. The analysis identifies the primary causes of delays, trends over time, and provides actionable recommendations to mitigate these delays. Key findings indicate significant impacts from passenger-related and equipment-related issues, with notable frequency during early mornings and at specific stations. Recommendations include targeted maintenance strategies, enhanced passenger management, and improved communication systems.

EXECUTIVE HIGHLIGHTS

- Peak Delay Times and Days:

The highest number of delays occur during morning and afternoon peak hours, especially on weekdays, with Wednesday and Tuesday experiencing the most delays.

- Top Delay Causes:

Passenger-related issues are the second most common cause of delays, following a diverse 'Other' category, which includes various non-specified issues.

- Stations with Most Delays:

Major hubs like Kennedy BD Station and Kipling Station face the highest frequency of delays, indicating potential areas for targeted improvements.

DATA SOURCES

- Toronto-Subway-Delay-Codes.csv: Contains delay codes and their descriptions.
- Toronto-Subway-Delay-Jan-2014-Jun-2021.csv: Contains records of delays, including date, time, station, and delay duration.

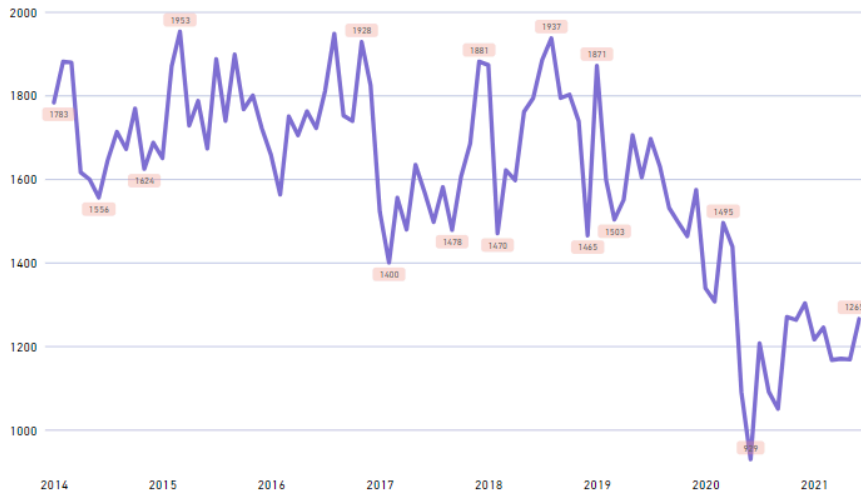
DATA CLEANING AND PREPARATION

- Standardized column names for consistency.
- Converted date and time columns to appropriate datetime formats.
- Merged the two datasets on the delay code fields to enrich the delay records with descriptions.
- Categorized delay descriptions into meaningful groups (e.g., Train Related, Signal Related).

ANALYSIS

- Calculated overall statistics such as total delays, total delay time, and average delay time.
- Conducted category-wise analysis to determine the frequency and impact of different delay causes.
- Analyzed trends over time to identify patterns in delay occurrences.
- Identified stations and lines with the highest delays.

VISUALIZATIONS AND INSIGHTS



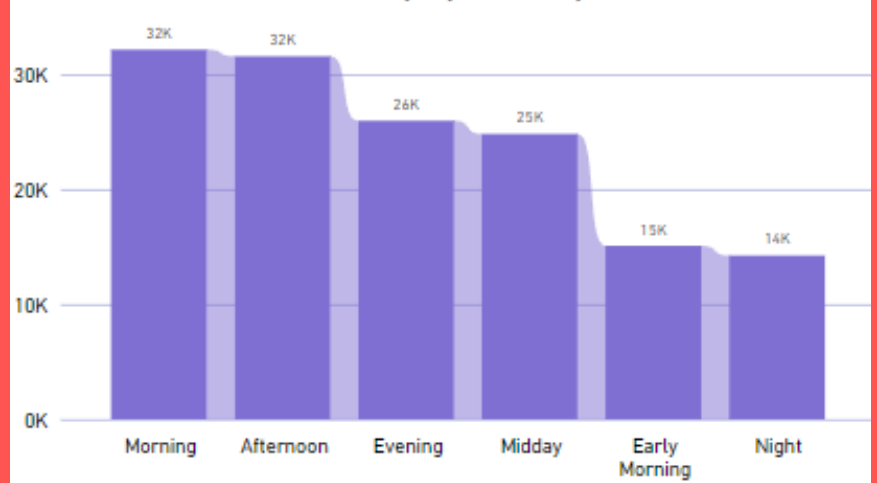
MONTHLY TREND OF DELAYS

The monthly trend analysis shows fluctuations in the number of delays over the months, with noticeable peaks and troughs. The data indicates a general decline in delays from mid-2019 onwards, with a significant drop in early 2020, likely influenced by the COVID-19 pandemic and reduced passenger volumes.

DELAYS BY TIME OF DAY

The highest number of delays occur during the "Morning" and "Afternoon" time slots, with 32,000 and 31,000 delays respectively. This can be attributed to the peak commuting hours when passenger volumes are at their highest. The "Evening" time slot also sees a significant number of delays (25,000), likely due to the evening rush hour. In contrast, fewer delays occur in the "Night" and "Early Morning" periods, with 14,000 and 15,000 delays respectively.

Total Delays by Time Of Day

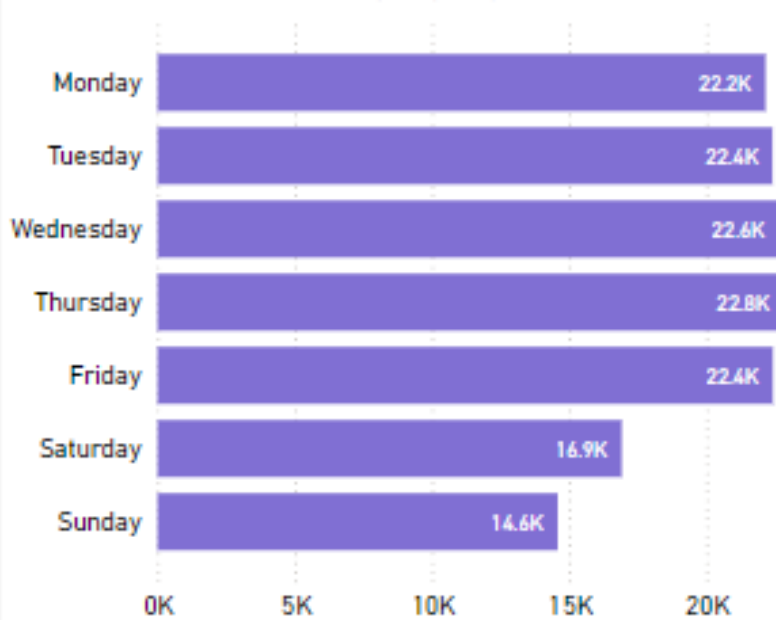


DAY	Afternoon	Early Morning	Evening	Midday	Morning	Night
Monday	4753	2240	3749	3777	5664	1971
Tuesday	4902	2201	3979	3776	5494	2054
Wednesday	5095	2211	4083	3767	5378	2100
Thursday	5292	2392	3963	3829	5254	2080
Friday	5008	2370	4074	3780	4979	2210
Saturday	3357	2247	3354	3219	2720	2016
Sunday	3180	1441	2778	2682	2679	1819

DELAYS BY DAY AND TIME OF DAY

A combined analysis of delays by day and time of day shows that delays are most frequent during weekdays, especially on Wednesdays and Thursdays. The morning and afternoon time slots have the highest number of delays, emphasizing the impact of peak commuting times on service reliability.

Total Delays by Day Of Week

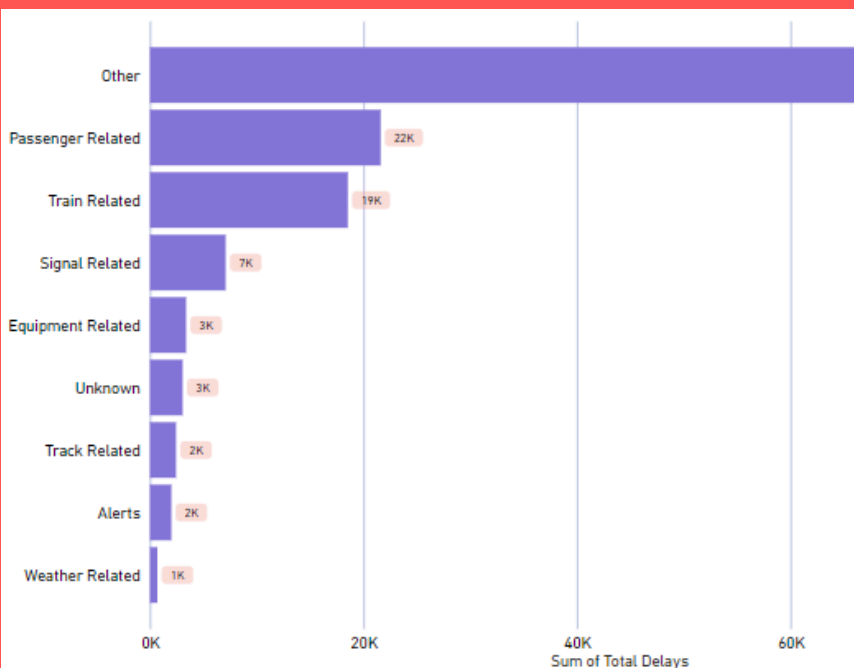
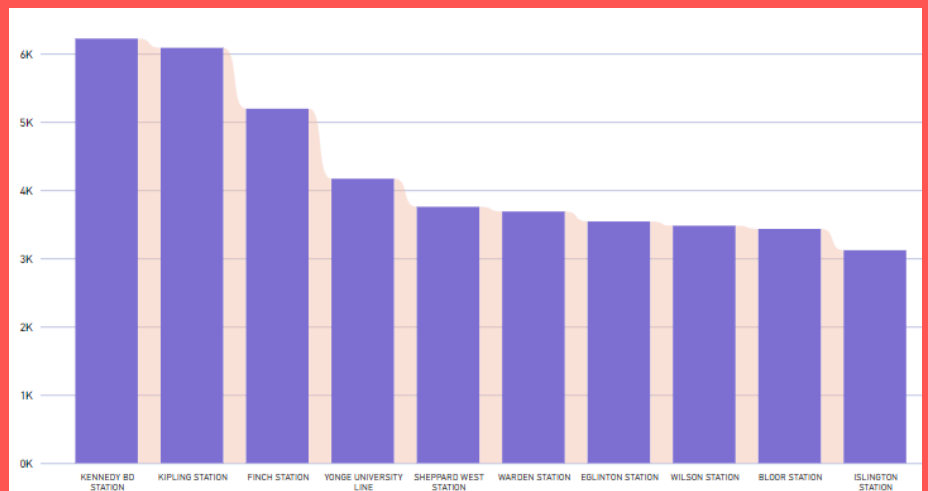


DELAYS BY DAY OF THE WEEK

Delays are more frequent on weekdays, with Wednesday (22,800 delays) and Tuesday (22,400 delays) showing the highest numbers. This pattern is consistent across other weekdays such as Monday (22,400), Thursday (22,800), and Friday (22,400). Weekends have relatively fewer delays, with Saturday and Sunday experiencing 16,900 and 14,600 delays respectively.

TOP STATIONS WITH MOST DELAYS

The top 10 stations suffering the most delays are major hubs and busy stations, with "Kennedy BD Station" and "Kipling Station" each experiencing over 6,000 delays. Other notable stations include "Finch Station", "Yonge University Line", and "Sheppard West Station", each with significant delay counts.



MAJOR REASONS FOR DELAYS

The categorization of delays reveals that the majority fall under the 'Other' category, which includes various non-specified issues, accounting for 85,000 delays. 'Passenger Related' delays are the second most common, with 22,000 delays, followed by 'Train Related' (19,000 delays), 'Signal Related' (7,000 delays), and 'Equipment Related' (3,000 delays).

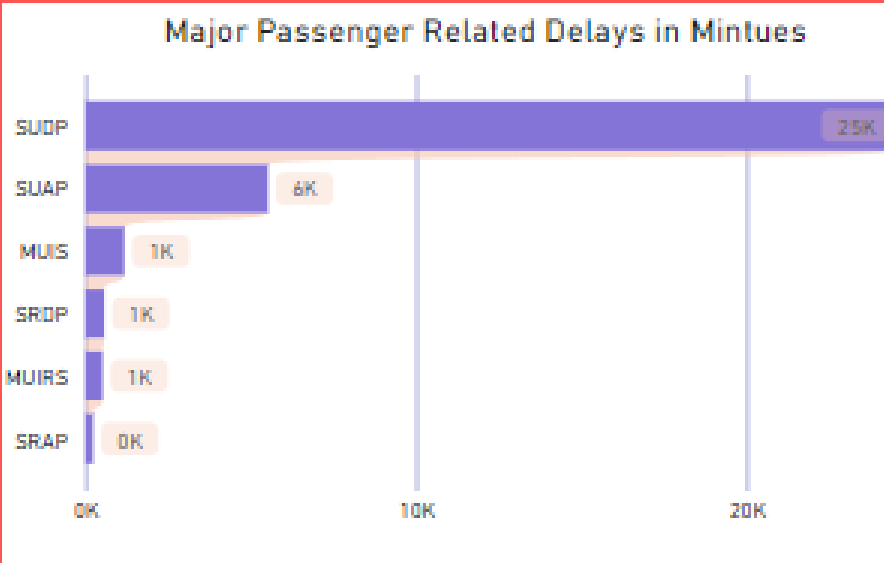
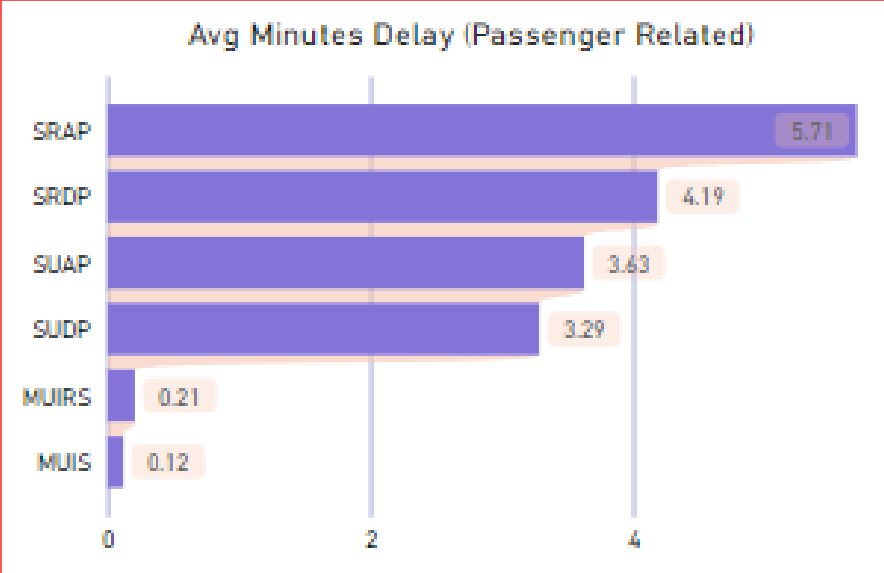
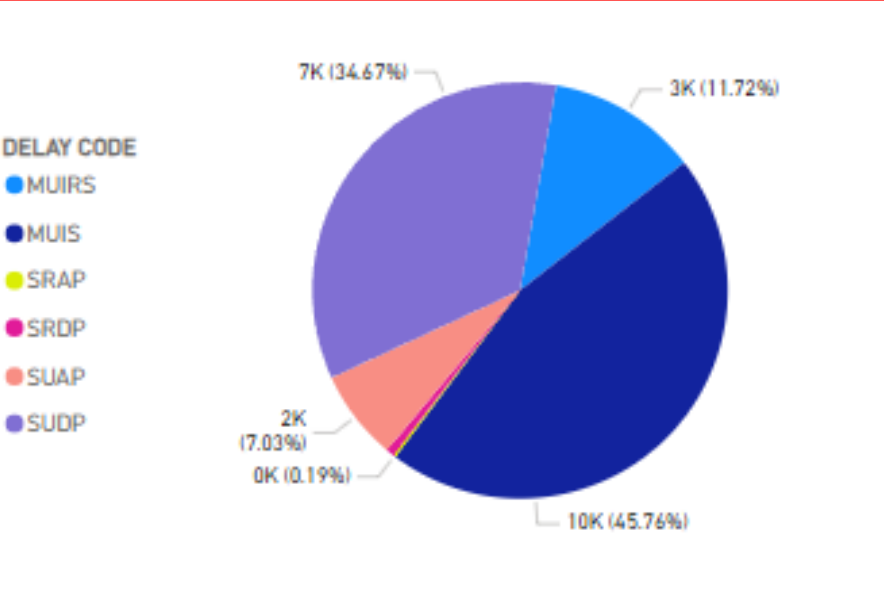
CODE	CODE_DESCRIPTION
MUIS	Injured or ill Customer (In S
MUIRS	Injured or ill Customer (In S
SRDP	Disorderly Patron
SUDP	Disorderly Patron
SRAP	Assault / Patron Involved
SUAP	Assault / Patron Involved

DETAILED ANALYSIS OF PASSENGER RELATED DELAYS

Passenger-related delays are significant and require detailed analysis. Major delay codes in this category include SUCP (disorderly patron) and SUAP (assault/patron involved), with SUCP contributing the most total delay minutes. Average delay minutes per incident are highest for SRAP (5.71 minutes) and SRDP (4.19 minutes).

TREND ANALYSIS

- Monthly and yearly trends reveal fluctuations in delay occurrences. Notably, peaks during winter months, likely due to weather-related issues.
- A consistent increase in delays during early morning hours suggests potential operational challenges at the start of service.
- Certain stations, such as Kennedy BD Station, Kipling Station, and Finch Station, exhibit higher delay frequencies.
- Major delay caused by disorderly patron.



RECOMMENDATIONS

ENHANCED MAINTENANCE FOR EQUIPMENT

- Implement regular and targeted maintenance schedules for critical equipment to reduce equipment-related delays.
- Upgrade aging infrastructure to prevent frequent breakdowns.

PASSENGER MANAGEMENT

- Increase awareness and communication about peak times and expected delays to manage passenger flow.
- Implement strategies to handle disorderly patrons efficiently, such as increased security presence during peak hours.

IMPROVED COMMUNICATION SYSTEMS

- Enhance real-time communication with passengers regarding delays and alternative routes.
- Deploy advanced signal and switch systems to minimize signal-related delays.

OPERATIONAL ADJUSTMENTS

- Adjust early morning operational protocols to ensure smoother transitions into daily service.
- Conduct detailed audits of stations with high delay frequencies to identify and address specific issues.

By implementing these recommendations, the Toronto subway system can significantly reduce delays, improve service reliability, and enhance passenger satisfaction.