# Empirical analysis of ramp preference in the case of accidents on the Metropolitan Expressway

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**Abstract:** Electronic toll collection data, which capture the history of an individual's use of the Metropolitan Expressway, are used to analyze the ramp preference in the case of a traffic accident. The comprehensive result reveals behavioral changes such as the change in ramp preference and the cessation of the use of the Expressway.

**Keywords:** ETC, ramp preference, traffic accident, metropolitan expressway

## 1. Introduction

Knowledge of the ramp preference in the case of a traffic accident on an urban expressway plays an important role in effective traffic management. However, empirical analysis that considers the change in ramp preference for each user has not been conducted, although data from traffic detectors have been analyzed by several researchers [1][2]. On the other hand, accumulated data of fare transactions, in which an individual user can be distinguished by identification numbers, are increasingly being used in traffic behavior analysis. One such example is the use of data from smart cards that are used in public transportation [3]. As for urban expressways, electronic toll collection (ETC) data can be used [4][5][6][7][8]. These data can be analyzed by classifying them according to usage characteristics such as frequency, time, and spatial properties, and the results of such analysis can used to distinguish the differences between ramp preference under unusual conditions such as accidents and under normal conditions.

In the study, ETC data, which contain the history of an individual's use of the Metropolitan Expressway (MEX), are utilized, and the results of the analysis of ramp preference in the case of traffic accidents are reported.

## 2. Method of analysis

In this study, ETC data, including on-ramp data, off-ramp data, on-ramp entry times and off-ramp exit times, are used, even though the personal data for each individual is impossible to obtain. The targeted users for the analysis are frequent and stable users, who use the MEX frequently and have regular ramp usage and entry times. Using the data pertaining to such users, any changes in the behavioral characteristics of the users in the case of an accident are determined by comparing the users preferred ramp for regular use with the ramp selected at the time of the accident.

The user group that has a particular ramp preference and particular on- and off-ramp

entry/exit times are considered (the terms used here are preferred ramp and preferred ramp entry time) as factors for categorization in the analysis. For each preferred ramp, a change in the population ratio for the ramp and in the preferred entry time period is considered as a possible change in ramp preference.

The target route selected is the No. 3 Shibuya inbound line shown in Fig. 1. The target time period covers the morning peak hours, from 5:00 am to 10:00 am, and the target vehicle type is the standard passenger car. ETC data from July to December for the year 2006 are used for the analysis.
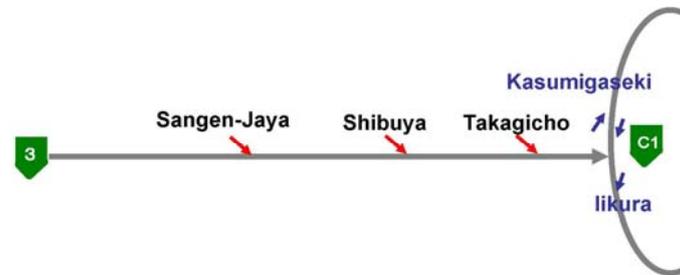


Fig. 1 Target Ramps for Analysis

## 3. Results

The states for each user for each weekday are defined as follows: (1) Before accident, (2) During accident clearance, (3) Within 30 min of clearance, and (4) Over 30 min after clearance. These states are defined considering the relationship between the time of occurrence of the accident and the typical average entry time. Next, the rate of change in ramp preference for normal days is calculated and shown in Figs. 2, 3, and 4 for the users that have Sangen-Jaya, Shibuya, and Takagicho as their preferred ramps, respectively.

The rate of users using their preferred ramp reduces in the case of an accident. In particular, this tendency is markedly observed during accident clearance. At the same time, the rate of users that use other ramps and do not use the MEX increases. This indicates that users tend to either avoid entry into the ramp for avoiding the inconvenience caused by the accident or abandon the use of the MEX altogether.

Furthermore, the rate of users that select the preferred ramp decreases drastically after accident clearance. The decrease in the use of the preferred ramp eventually corresponds to the cessation of the use of the MEX. One reason for this phenomenon is assumed to be that users wish to avoid the heavy congestion caused by the traffic accident and hence refrain from using the MEX. Another reason for this phenomenon is considered to be that users stop using a car and switch to public transport upon receiving traffic information pertaining to the accident.
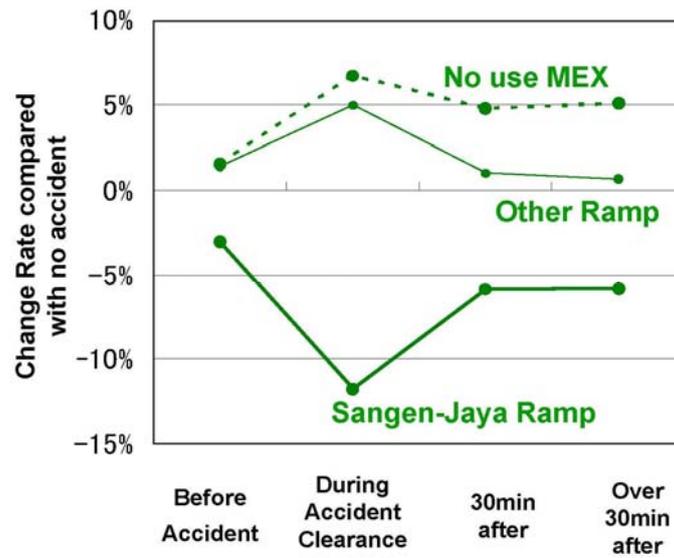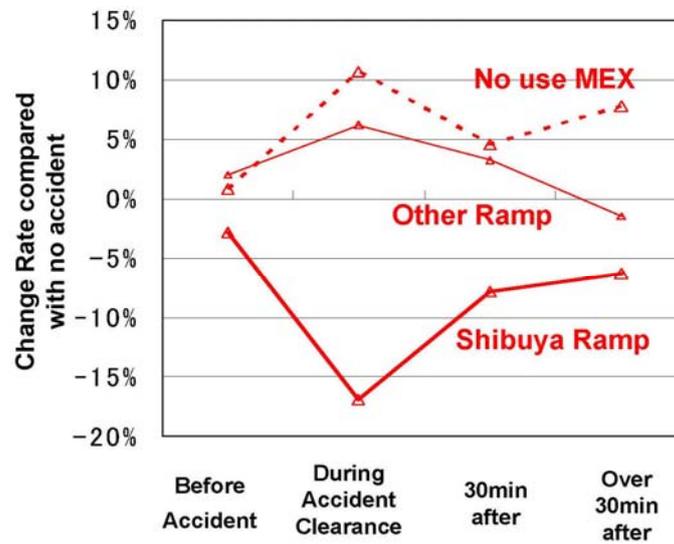
Fig. 2 Result for Sangen-Jaya Ramp Users
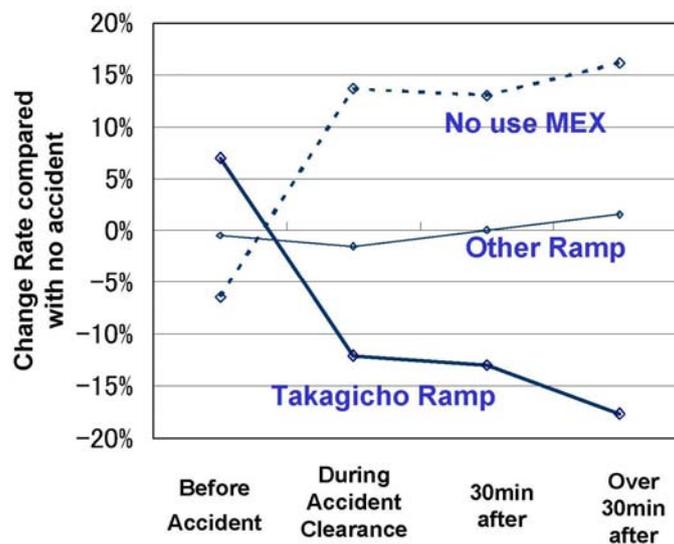


Fig. 3 Result for Shibuya Ramp Users



Fig. 4 Result for Takagicho Ramp Users

## 4. Conclusions

In this study, the change in ramp preference is analyzed using ETC data, which indicates each user's daily ramp usage behavior. According to the result, frequent users of a ramp tend to change their preferred ramp in more than ten percent of the cases. Several users that change their ramp preference are found to stop using the MEX altogether.

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