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New Measure of the Level of Service for Basic Expressway Segments Incorporating Customer Satisfaction

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Abstract

Using an empirical approach, we produced a level of service (LOS) measure that is consistent with a driver's subjective evaluation from the viewpoint of customer satisfaction (CS). The study consists of (1) analysis of the causal relation between the level of CS and drivers' perceptions related to traffic flow conditions using individual response data obtained through in-laboratory experiments with video images, (2) construction of practical driver satisfaction models segmented by the number of lanes of which independent variables are selected among ordinary indices of traffic flow considering results of the analysis presented above, and (3) a proposal of a real-time application of practical satisfaction models.

Keywords: Customer satisfaction; subjective evaluation survey; structural equation modeling; real time application; number of lanes

1. Introduction

The Highway Capacity Manual 2000 (HCM 2000) specifies quality of service (QOS) on a road as a level of service (LOS) that is determined according to observable traffic indices. However, as generally discussed in the marketing research field, QOS should be evaluated from perspectives of both the service provider and the customer, in this case, with the road administrator and the driver. This study analyzes the relation between the LOS and the driver's evaluation of the expressway (hereby customer satisfaction, CS), and proposes a method to use the model during everyday operations.

The study includes the three parts described below.

1. Perception structure models of driver satisfaction – Based on experimental surveys of evaluation using traveling video images, it is revealed that the perception structure of driver satisfaction is explained with traffic indices that are dependent on the number of lanes.
2. CS estimation models – Perception structure models suggest the structure of a nonlinear CS estimation model in which traffic indices serve as the explanatory variable.

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3. Application of a CS estimation model and case examples – A method of using the CS estimation models with data obtainable through real-time operations is proposed.

A Japanese expressway is defined as a motor highway with more than four lanes (or more than two lanes for each direction; hereby 'multilane'), explicitly limited on and off, and medians that separate directions are placed. However, this definition tentatively includes highways of only two lanes (one lane in each direction) because of the stepwise construction and operation. When compared with the definition in HCM 2000, a Japanese multilane expressway section corresponds to a freeway; an expressway with two lanes corresponds to a class-1 arterial roadway between cities of two-lane highways with no-passing zones. As of 2008, 57.9 million passenger cars exist in Japan, where 10,100 km of expressways stretch across the nation. The total extent of toll expressways was 8,054 km as of 2005. Of those, 22.0% are operated with two lanes, 69.4% with four lanes, 8.5% with six lanes, and 0.04% with eight lanes.

2. Background and Aim of the Study

2.1. Customer satisfaction

The definition of customer satisfaction (CS), as specified by ISO 10002 (Customer Satisfaction, Complaints), is the "customer's perception of the degree to which the customer's requirements have been fulfilled" (ISO, 2004). The marketing departments of firms have sought improvement of services using CS as a benchmark for performance evaluation. The public sector also uses CS as a service index. New Public Management (NPM) reforms employ CS as part of the evaluation of administrative services, and the Government Performance Results Act (GPRA) states that the government of the USA shall disclose CS data as a benchmark of its performance. Therefore, CS can be regarded as a common evaluation scale for measuring customer satisfaction or dissatisfaction for quality of service (QOS). It can be considered that measurement of CS associated with road traffic by drivers who travel on expressways is useful to evaluate the QOS of road traffic.

2.2. Driver satisfaction

Choocharukul *et al*. (2004) and Washburn *et al*. (2004) discussed the performance evaluation scale and other issues that are regarded as important for drivers. Washburn *et al*. (2006) modeled relations between a driver's perception of level of service (LOS) and service evaluation scales. In addition, Ishibashi *et al*. (2006) examined relations among the satisfaction rate, satisfaction level, and traffic indices in a nonlinear model.

Choocharukul *et al*. (2004) performed a quantitative survey targeting university students and truck drivers. Video images showing diverse traffic situations taken from a crossover of an expressway were presented to respondents, who were asked to relate each image with traffic situations of six LOSs of the HCM. The conclusions inferred from the analyses include the perception of LOS as dependent on the traffic volume and the attributes of road users. In addition to traffic density, visibility and traveling speed should be regarded as factors of LOS. The higher rate of full-sized vehicles acts as a QOS-positive factor for truck drivers and as a QOS-negative factor for other drivers. Furthermore, they found that the six-step scale of LOS does not actually coincide with the QOS that drivers perceive.

Washburn *et al*. (2004) surveyed drivers and passengers at rest stations and service areas of a rural expressway and concluded that three or more determinants of QOS exist for a rural expressway. Among them, traffic density is a major factor influencing the perception of QOS, although the speed fluctuation range and the rate of traveling at a free flowing speed also influence perception. Moreover, factors such as quality of pavement and driving manners are important. Washburn *et al*. (2006) used video images of traveling on four-lane and six-lane sections (or two/three lanes in each direction) of an expressway to conduct a probit analysis to describe a six-step LOS with explanatory variables such as traffic indices and respondents' attributes. Results showed a strong relation between drivers' perceptions associated with QOS and traffic density, and also showed that respondents' attributes such as frequency of driving expressway, frequency of long-distance travel, age, and income strengthen the explanatory power. They further argue that the driver's perception evaluation rates for QOS is lower than that of the LOS stated in HCM 2000.