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Conference Paper

An Empirical Model of Expressway Drivers Behaviors on Stopover at sa/pa involving the Location Choice

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**AN EMPIRICAL MODEL OF EXPRESSWAY DRIVER'S BEHAVIORS ON
STOPOVER AT SA/PA INVOLVING THE LOCATION CHOICE**

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ABSTRACT

Drivers on expressway have not only need of high speed and safety but also other various kinds of services for their comfortable traveling. The Japan expressway company (called NEXCO) privatized in 2005 has increasingly attached great importance to improvement of those services. Service and parking areas (SA/PAs) are consequently required to offer not only traditional rest stop services but also additional services, such as refreshments, dining, and souvenir shopping. Previous researches of driver decision-making on stopover at SA/PA and on which SA/PA is chosen have been hardly advanced because of lack of survey data. These data are clearly useful to identify the factors determining SA/PA choice behaviors and also to develop marketing strategies for promoting SA/PA use.

This research aims to analyze driver's decision structures on SA/PA choice behaviors and the level of customer satisfaction with SA/PA services. The web-based questionnaire surveys were conducted twice to the drivers who stopped at the studied SA/PAs on the surveyed period. One was done at the section on Chugoku expressway in 2012 and the other was on Sanyo expressway in 2013. Based on the results from our previous study, in which a structural equation model (SEM) was applied to represent the decision structure underlying SA/PA choice behavior using Chugoku expressway data in 2012, a discrete choice behavior model is developed to identify whether a given driver would stop at any of the studied SA/PAs or not and to identify which SA/PA would be chosen. In this modeling, two different types of the nested logit models, in which the upper level is the decision on stopover at SA/PA or not and the lower level is the one on choice of the location, are mainly calibrated using both the data set of Chugoku in 2012 and those of Sanyo in 2013. The goodness of fit of estimated models including statistical significance of estimated parameters are discussed to clarify the differences in determining factors between Chugoku and Sanyo expressways. The results indicate that both two types of nested logit models are significant in common while the goodness of fit for Chugoku models are different from that for Sanyo models. They also indicate that those differences are caused by driver's characteristics such as travel distance and frequency of expressway use, and by SA/PA characteristics such as the contents of services and the CS (customer satisfaction rate) and the location distribution.

INTRODUCTION

Background and Objectives

Recently, it has been recognized that leisure drivers have a variety of needs when using expressways in Japan. This implies that the service areas (SAs) and the parking areas (PAs) are required to offer not only rest services, but also other services, such as refreshments, dining, and souvenir shopping. Some SA/PAs along expressways in Japan are markedly different from those in European countries and even those in US. They have innovated in their function as a service facility, providing amenities such as shops and restaurants in addition to restrooms. Notably, a SA with a luxurious, marble toilet has become an attraction, like a tourist spot.

In Japan, interurban expressways have either SAs or PAs every 20 km. Drivers thus have a choice of several SA/PAs when they utilize SA/PAs as part of leisure tours taken on vacation. Previous research on such drivers' SA/PA choice behavior has not been conducted. Iida (1998) has explored the basic characteristics of rest service areas on expressways in Japan focusing on their parking spaces and amenity services. Recently, Shino, Hibino and Morichi (2005) has analyzed performances of usage of rest areas such as dropping rate, staying time, and effect of the congestion level on driver's choice behavior of rest areas. When we consider the variety of need and want for SA/PAs, it is clearly important to identify which of many possible factors determine SA/PA choice behavior. It is also required to analyze the current status of leisure drivers SA/PA choice behavior and the level of customer satisfaction with SA/PA services in terms of marketing research.

When focusing on the demand side of the services market on expressways in Japan, we can note trends indicating a decrease in leisure trips on non-workdays. A comparison of non-workday PT data from 2000 and 2010 in Kyoto, Osaka, and Kobe shows the out-going rate on non-workdays has decreased from 67.0% in 2000 to 59% in 2010. Notably, it decreased by up to ten percentage points in case of younger segments of the population. Further, total discretionary trip generation on non-workdays decreased nearly three percentage points, from 18.5 million trips/day (51.5%) in 2000 to 16.2 million trips/day (48.8%) in 2010. While the total trip generation by car on non-workdays has declined (from 18.1 million trips/day in 2000, to 16.8 million trips/day in 2010) as a whole, it is noteworthy that the ratio of discretionary trips by car to the total has declined since last decade for the younger generations.

The supply side of services market in expressways has recently made efforts to react to the changes in the demand side. The main efforts made by the supply side of expressway services market are to progress to a better understanding of SA/PA users need and want and to identify effective measures to improve the level of services in SA/PAs to increase customer satisfaction.

This research aims to analyze driver's decision structures on SA/PA choice behaviors and the level of customer satisfaction with SA/PA services. The web-based questionnaire surveys were conducted twice to the drivers who stopped at the studied SA/PAs on the surveyed period. One was done at the section on Chugoku expressway in 2012 and the other was on Sanyo expressway in 2013. Based on the results from our previous study, in which a structural equation model (SEM) was applied to represent the decision structure underlying SA/PA choice behavior using Chugoku expressway data in 2012, a discrete choice behavior model is developed to identify whether a given driver would stop at any of the studied SA/PAs or not and to identify which SA/PA would be chosen.

Analytical Framework

The analytical framework consists of four stages, as shown in **Figure 1**. The first stage identifies goals for service performance at expressway SA/PAs. These four stages are sequentially linked. Our marketing process has an advantage that the proposed goal itself will be reframed through the P-D-C-A cycle. At present, our first goal is to develop an effective tool for evaluating how many number of expressway drivers are increased through improving their satisfaction with services at SA/PAs. In the second stage, a questionnaire on driver behaviors is conducted at selected SA/PAs. An internet-based survey is conducted about one month later to complement the initial questionnaire. Additionally, the number of stop-over vehicles per day and the total traffic per day around the surveyed SA/PAs is observed.

The third stage is the main part of our research. In our previous study, the structural equation model denoted as SEM has been developed to identify the decision structure of driver decisions about whether to revisit to the SA/PA. The SEM is a model capable of identifying factors that determine whether drivers choose the same SA/PA when driving to the same destination. This paper here introduces a brief result from the developed SEM. Next, as a latter half of the third stage, we focus on a better understanding of the driver decision structures that underlie SA/PA choice behavior. Our challenge is to develop a nested type of discrete choice model: The model consists of two layers. The upper is concerned with the decision whether drivers stop over at SA/PA or not. The lower is the decision which SA/PA they decide to stop over. While the fourth stage is not entirely included in this paper, a particular concern is about how marketing strategies can effectively improve expressway drivers' satisfaction with services at SA/PAs.

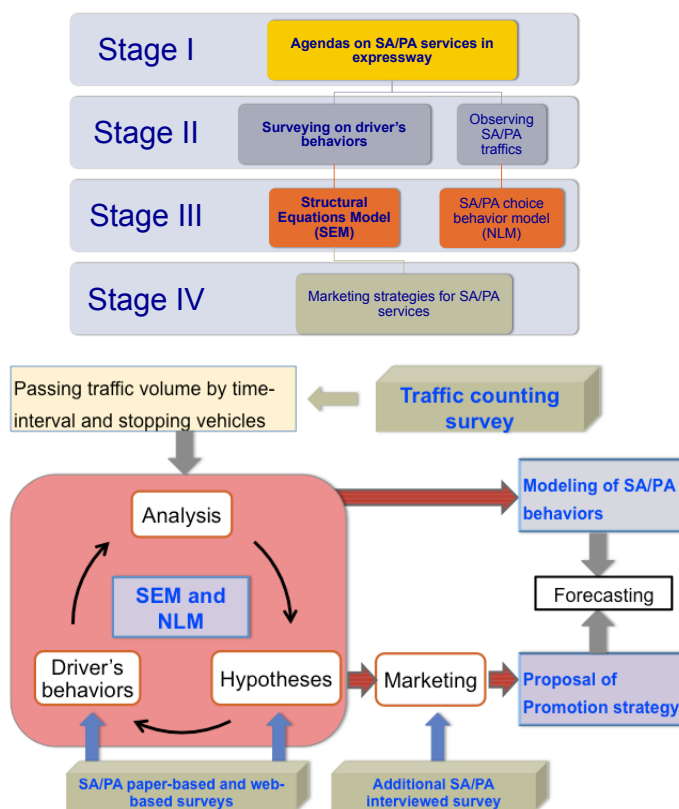


FIGURE 1 The Analytical Framework.

A SURVEY OF DRIVERS' SA/PA CHOICE BEHAVIORS AND THEIR BASIC PROPERTIES

The Surveyed SA/PA s and Their Profiles

Figure 2 shows a map of the surveyed SA/PA s on the Chugoku-Expressway bound for Hiroshima. This survey focuses on the following four SA/PAs: Nishinomiya-Nashio SA, Akamatsu PA, Yashiro PA, and Kasai SA. The figure shows the total number of vehicles that pass through each of the surveyed SA/PAs and the number of the vehicles that stop at each SA/PA. The ratio of stop-over to pass-through at these SA/PAs is as low as 9.4% in the Yashiro PA and as high as 26.8% in the Kasai SA.

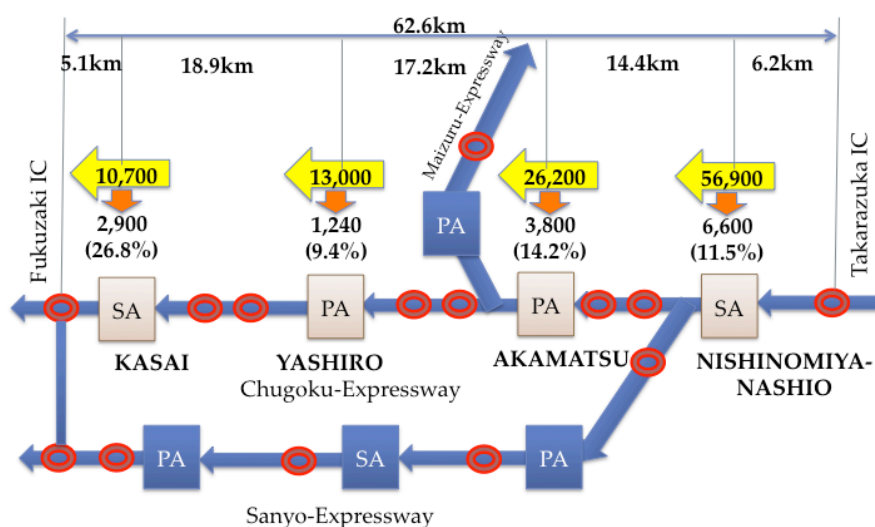


FIGURE 2 Map of the surveyed SA/PA s

TABLE 1 Profile of the surveyed SA/PA s

SAs / PAs	Nishunomiya-nashio SA	Akamatsu PA	Yashiro PA	Kasai SA
Parking spaces	Passenger cars: 202 lots Trucks / Buses: 22 lots	Passenger cars: 126 lots Trucks / Buses: 63 lots	Passenger cars: 32 lots Trucks / Buses: 21 lots	Passenger cars: 121 lots Trucks / Buses: 45 lots
Service Facilities	Souvenir-shop Food court (24hrs) Restaurant (7am-10pm) Gas stand (24hrs) Café (7am-9pm)	Convenience store (Daily Yamazaki) (24hrs) Food court (6am-10pm) Shopping corner (6am-10pm)	Souvenir-shop Food court (7am-8pm)	Souvenir-shop Food court (24hrs) Restaurant (7am-10pm) Gas stand (24hrs)
Other service Facilities	Baby care Facsimile Information desk Wheelchair Hot-spot/i-desk	ATM Facsimile Massage chair	Facsimile Doggy run	Baby care Facsimile Information desk Wheelchair Hot-spot/i-desk

Table 1 shows the variety of services at each surveyed SA/PAs on the Chugoku-Expressway as well as the number of parking spaces for each.

Our questionnaire was conducted on March 11, 2012 (Sunday) from 9:30am to 6:00pm. In this survey, 4,250 questionnaires were distributed at the four SA/PAs, and 1,154 sheets were returned by mail. The response rate was 27.2%, as shown in Table 2.

Table 2 Distributed questionnaire sheets and response rate by SA/PA

Surveyed SAs / PAs	No. of distributed sheets	No. of returned sheets	The ratio of return(%)
Nishunomia-Nashio SA	2,000	460	23.0
Akamatsu PA	700	200	28.6
Yashiro PA	250	89	35.6
Kasai SA	1,300	392	30.2
unknown	-	13	-
Total	4,250	1,154	27.2

The profiles of the respondents to our questionnaire are described below. The age-distribution is as follows: 1st, 60’s (31.0%) 2nd, 50’s (25.3%), 3rd, 70’s (13.5%), 4th, 40’s (13.4%). It is noteworthy that the drivers aged 20-39 account for only 13% of the total. This indicates that age demographic of expressway drivers is increasing.

The purposes of their trips on the surveyed day are as follows: 1st, sightseeing and leisure activities (46.9%), 2nd, other activities (17.2%), 3rd, returning home after leisure activities (13.3%), and 4th, homecoming (10.6%).

When focusing on the major OD patterns of respondents, it was found that the top ten OD patterns account for 80% of total behaviors; the driving distances of these patterns covered up to 150 km. The top five OD patterns are as follows: 1st, Osaka-Hyogo (23%), 2nd, Osaka-Okayama (10%), 3rd, Hyogo-Hyogo (9.5%), 4th, Kyoto-Hyogo (6.8%), and 5th, Osaka-Tottori (5.9%).

The Basic Properties of Driver Behaviors and Satisfaction with Use of SA/PAs

The results obtained from our questionnaire are as follows. First, the data only characterize the SA/PA where drivers stopped on the surveyed day. The percent of respondents who did not know the SA/PA at which they were stopped was 13.4%. It is noteworthy that the level of SA/PA recognition at the Nishinomiya-Nashio SA (20.2%) is much higher than at the other three SA/PAs: Kasai SA (9.9%), Yashiro PA (6.7%), and Akamatsu PA (5.5%).

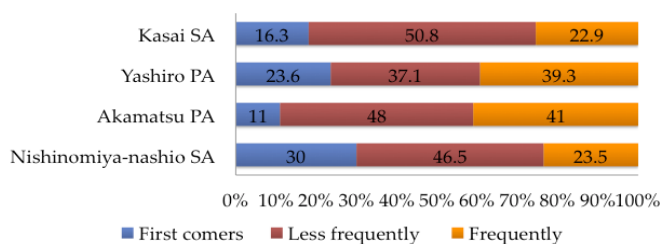


FIGURE 3 The frequency of visits to SA/PAs

This may be because at the Nishinomiya-Nashio SA, approximately 90% of the visitors who failed to recognize the SA were first-time visitors to the SA; these included the passengers who stopped there by bus. As shown in **Figure 3**, the percent of first-time visitors to the Nishinomiya-Nashio SA is higher than at the Akamatsu PA and the Kasai SA.

Figure 4 shows a distribution of the reasons drivers and passengers stopped over at the SA/PAs. The figure indicates that almost 90% stopped at the SA/PA for toilet-use and that approximately one third of the total stopped for restaurants (38%), purchases (35%), or rest to alleviate drivers’ fatigue (26%).

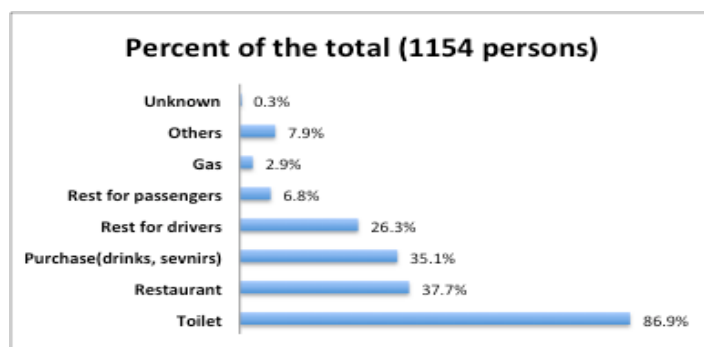
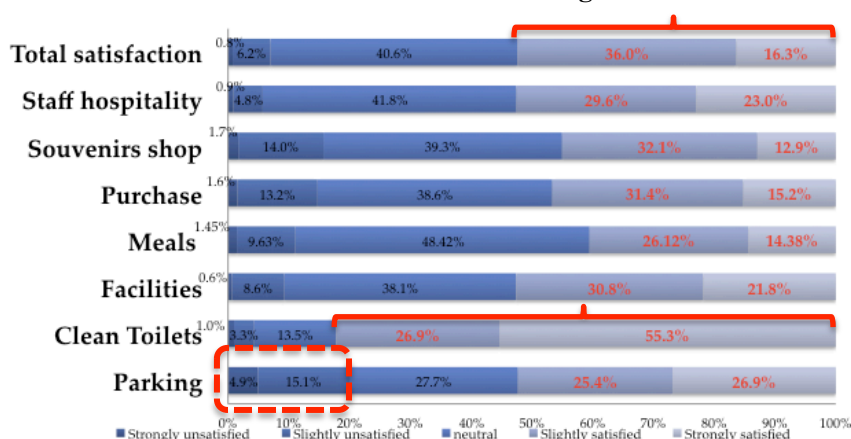


FIGURE 4 The distribution of reasons why people stopped at the SA/PA

The data also indicate that visitors undertake multiple activities at the SA/PA. For example, 26% of drivers performed two activities in addition to using the toilet; other significant combination patterns are toilet and purchase (14.6%) and toilet and dining (13.2%).

The questionnaire also collected results on driver satisfaction for the SA/PA. Figure 5 shows the distributions of satisfaction ratings for activities at the SA/PA. A five-category rating scale was used: “strongly unsatisfied”, “slightly unsatisfied”, “neutral”, “slightly satisfied”, and “strongly satisfied”. Total satisfaction is here defined as the sum of satisfaction scores for all evaluated items. The data indicate relatively high overall satisfaction: the sum of “strongly satisfied” (36.0%) and “slightly satisfied” (16.3%) responses accounts for 52.3% of the total. “Cleanness of toilets” is a high-satisfaction category, with over 80% of drivers either “strongly satisfied” or “slightly satisfied” with this attribute.

FIGURE 5 The distribution of satisfaction ratings for activities at SA/PA s



In contrast, satisfaction with the availability of parking, denoted as “parking”, was evaluated as relatively low; the percent of “strongly unsatisfied” together with the percent of “slightly unsatisfied” accounts for 20.0% of respondents. The reasons why parking satisfaction was low are mainly parking congestion (63.4%), insufficient parking lots (45.5%), and small parking lots (30.8%). Visitors were generally not satisfied with parking, especially, in case of the

Nishinomiya-nashio SA, where approximately 40% of the drivers provided an “unsatisfied” rating due to congestion and lack of space.

Figure 6 shows that approximately 15% of drivers are either “strongly unsatisfied” or “slightly unsatisfied” with local souvenirs. When comparing the local souvenir satisfaction by SA/PA, the Yashiro PA shows the lowest satisfaction, with approximately 21% of respondents providing an “unsatisfied” evaluation. However, the Akamatsu PA and the Kasai SA represent higher satisfaction ratings. It was also found that when visitors are unsatisfied with the souvenir offerings at an SA/PA, they tend also to report that they “did not purchase”. In other words, at the SA/PAs with low satisfaction with local souvenirs, drivers tend not to purchase anything even if they stop there.

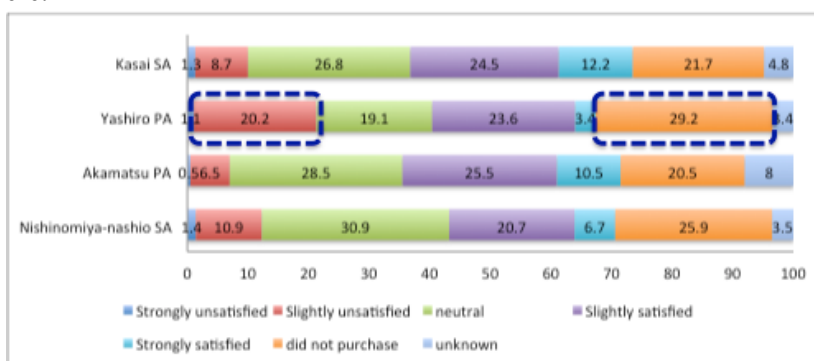


FIGURE 6 The distribution of satisfaction ratings for local souvenirs by SA/PA

In our survey, one stated preference question was included: “Will you revisit the SA/PA if you make a trip to the same destination?” **Figure 7** results indicate that the percent of total responses for “will probably revisit” is 36.1% and for “will revisit” is 34.2% . When these two responses are summed for each SA/PA, the Kasai SA shows the highest percent (78.3%), followed by the Akamatsu PA (73.5%), the Nishinomiya-Nashio SA (65.9%), and the Yashiro PA (60.7%).

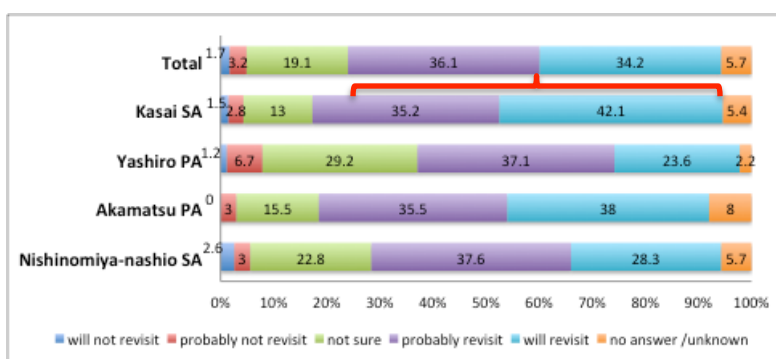


FIGURE 7 The distribution of stated preference on revisit to the SA/PA

A DEVELOPMENT OF SEM IN SA/PA CHOICE BEHAVIORS

The Result of SEM in Our Previous Study (2012)

Here, we introduce the results of our structural equation model (denoted as SEM) using the data set obtained from our questionnaire. Through our several experiences of SEM applications, this method is expected to be useful for us to identify causal relationship among factors determining driver’s decision structure on SA/PA choice behaviors (See Nishii et. al (1996), Nishii et. al (1998), Kim, Nishii et. al (2007)).

The data used for the proposed SEM were extracted as follows. From the total of returned sheets with no missing information, 650 samples were used to calibrate our model. We excluded the respondents who used either buses or expressway buses and those whose modes were unknown.

Our SEM here focuses on the driver’s decision regarding whether he/she would choose the same SA/PA if he/she made a trip to the same destination again. The model has seven latent variables with causal relationships with each other, following the hypotheses:

H₁: The stated preference for the “revisit SA/PA” observed variable is a function of the “intention to revisit SA/PA” latent variable.

H₂: The “intention to revisit SA/PA” is causally influenced by three latent variables: “SA/PA area brand consciousness”, “SA/PA recognition”, and “external environment”. These latent variables are assumed to have a positive effect on the intention of revisiting the same SA/PA.

H₃: “SA/PA area brand consciousness” is causally influenced by three latent variables: “basic services”, “hospitality of workers” and “additional/complementary services”. “Area brand consciousness” is here assumed to be a function of these three variables.

Figure 8 shows the causal relationships between the “intention to revisit SA/PA” latent variable and the other six other latent variables. **Table 3** shows a list of the observed variables used in our SEM.

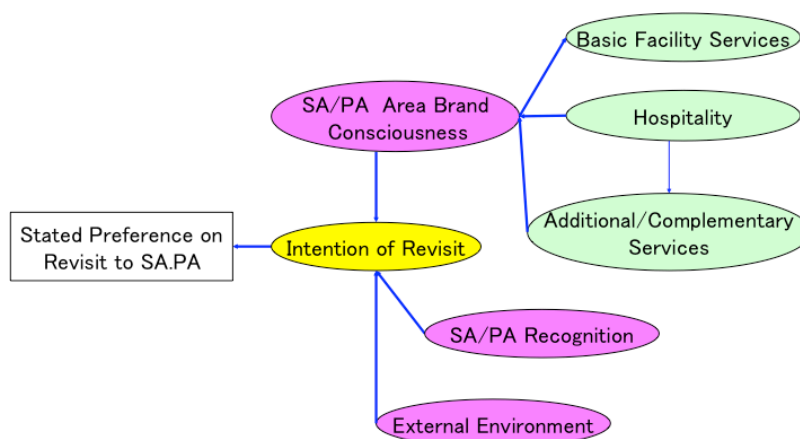


FIGURE 8 Hypothesized causalities among latent variables in SEM

Table 3 A list of observed variables in SEM

Observed variables	Definition
Stated Preference on Revisit to PA/SA	1:will NO, 2: probably NO, 3: neutral, 4: probably YES, 5: will YES
Revealed Recognition of SA/PA	1: never know, 2: only know the name, 3: roughly know, 4: well know
Frequency of visits to SA/PA	1:first comer, 2:less than once a year, 3: twice a year, 4: once every a few months, 5: once a month, 6: more than twice a month
Readily Available Parking	Five ratings: From unsatisfied (1) to satisfied (5)
Amenity Inside Facilities	Five ratings: From unsatisfied (1) to satisfied (5)
Toilet Amenity	Five ratings: From unsatisfied (1) to satisfied (5)
Substantial Meals	Five ratings: From unsatisfied (1) to satisfied (5)
Pleasant Souvenirs	Five ratings: From unsatisfied (1) to satisfied (5)
Local Specialities	Five ratings: From unsatisfied (1) to satisfied (5)
Driver's Fatigue	1: YES, 2:NO
Distance from IC to SA/PA	The distance (km) of the shortest route in NEXCO-West expressway
Distance from SA/PA to IC	The distance (km) of the shortest route in NEXCO-West expressway
Worker's Service Attitude	Five ratings: From unsatisfied (1) to satisfied (5)

While the parameters estimated for our primitive SEM showed significant goodness of fit judging from the indices (AGFI=0.922, CFI=0.940, and RMSEA=0.066) and most of the estimated coefficients of paths were statistically significant, only two of them were insignificant; the one was the path from “complementary services” (latent variable) to “SA/PA-area brand consciousness” (latent variable) and the other was the path from “external environment” to “intention to revisit SA/PA”. It was also found that the estimated coefficient of path from the “hospitality” latent variable to the “SA/PA-area brand consciousness” latent variable is a minus sign. This means that “hospitality” exerts a negative influence on “brand consciousness” even if it is improved. It is also noted that this “hospitality” may have a positive effect through the “complementary services” latent variable.

Next, we introduce a brief result of the advanced type of our SEM. The model was improved for the primitive type of SEM. Especially, two latent variables were mainly focused on: One was “Basic Facility Services” representing the need or preference for use of both PA and SA and the other was “Complementary Services” closely relating to use of SA. It was an quite interesting subject for us to identify whether leisure drivers can recognize the differences in services between SA and PA when their driving car in expressway. Such a point of view was the reason why we tried a sensitivity testing for the advanced SEM.

Table 4 and **Figure 9** show the result of parameters estimated for our advanced type of SEM. The table indicates significant goodness of fit judging from the following indices: AGFI=0.856, CFI=0.876, and RMSEA=0.086, although the values of these indices decrease slightly comparing with those in our primitive SEM. The table also shows that most of the estimated coefficients of paths are statistically significant, except the path from “External Environment” to “Intention of Revisit”.

Table 4 Parameters estimated for advanced type of SEM

Causal Relation	Adj. estimates	S.E	t-statistic	p-value
Intention of Revist ← Basic Facility Services	0.419	0.07	5.979	***
Intention of Revist ← Complementary Services	0.352	0.175	2.016	0.044
Intention of Revist ← SA/PA Recognition	0.688	0.071	9.667	***
Intention of Revist ← External Environment	0	0	1.491	0.136
Stated Preference on Revisit to PA/SA ← Intention of Revist	1			
Revealed Recognition of SA/PA ← SA/PA Recognition	1			
Frequency of visits to SA/PA ← SA/PA Recognition	2.07	0.2	10.331	***
Readily Available Parking ← Basic Facility Services	1			
Amenity Inside Facilities ← Basic Facility Services	1.201	0.113	10.693	***
Toilet Amenity ← Basic Facility Services	0.779	0.086	9.086	***
Substantial Meals ← Basic Facility Services	0.77	0.08	9.65	***
Worker's Service Attitude ← Basic Facility Services	0.632	0.076	8.292	***
Worker's Service Attitude ← Complementary Services	1			
Substantial Meals ← Complementary Services	1.37	0.245	5.597	***
Pleasant Souvenirs ← Complementary Services	3.315	0.542	6.112	***
Local Specialities ← Complementary Services	3.551	0.59	6.015	***
Driver's Fatigue ← External Environment	0	0	2.459	0.014
Distance from IC to SA/PA ← External Environment	1			
Distance from SA/PA to IC ← External Environment	0.315	0.051	6.161	***
Frequency of visits to SA/PA ← External Environment	0.002	0.001	2.997	0.003

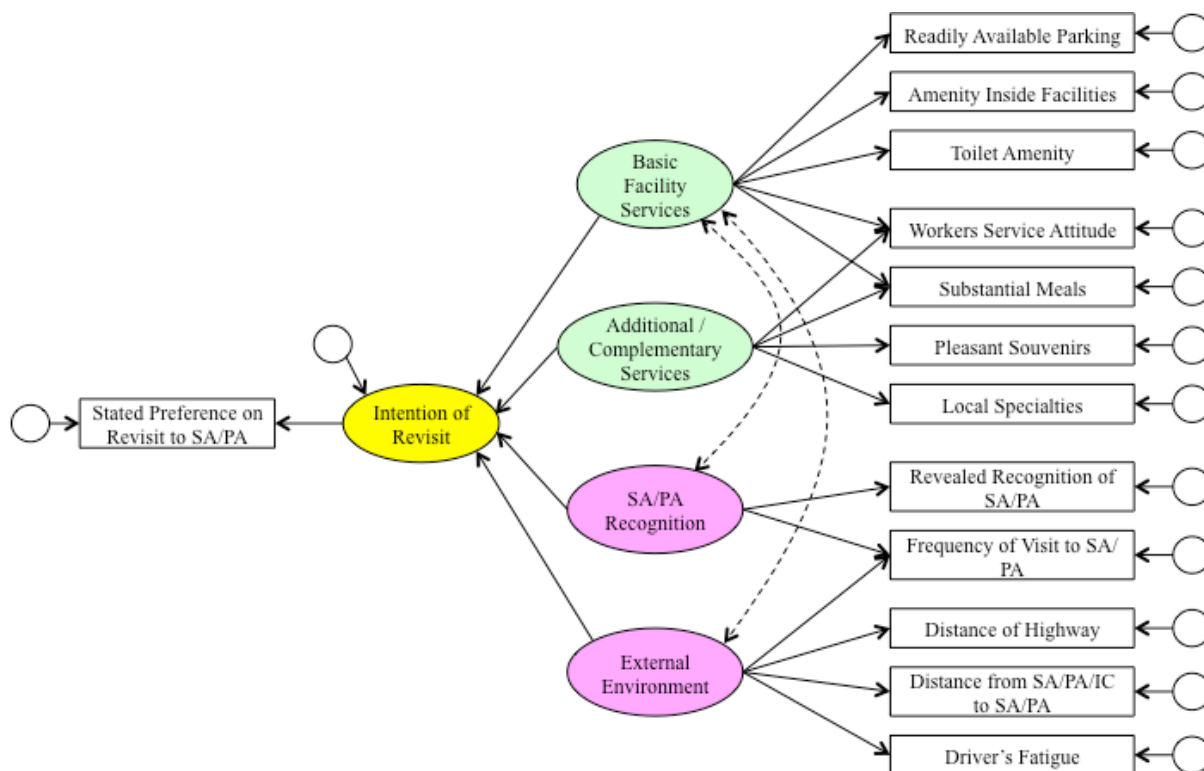


FIGURE 9 Hypothesized causalities among latent variables in our advanced type of SEM

Table 5 Parameter-sensitivity testing by segmented sample case

Model 1: Advanced Type		SA/PA	SA	PA	Nishinomiya-nashio SA	Kasai SA	
Goodness of fit	CFI	0.876	0.890	0.821	0.871	0.906	
	RMSEA	0.086	0.081	0.115	0.088	0.071	
Sensitivity	Intention of Revisit	← Readily Available Parking	0.12	0.12	0.19	0.08	0.17
		← Amenity Inside Facilities	0.19	0.19	0.13	0.18	0.21
		← Toilet Amenity	0.12	0.13	0.18	0.12	0.12
		← Workers Service Attitude	0.12	0.12	0.12	0.11	0.12
		← Substantial Meals	0.16	0.17	0.12	0.16	0.18
		← Pleasant Souvenirs	0.06	0.07	0.04	0.08	0.03
		← Local Specialties	0.06	0.07	0.06	0.08	0.03
		← Revealed Recognition of SA/PA	0.27	0.27	0.27	0.30	0.27
		← Frequency of Visit to SA/PA	0.35	0.35	0.34	0.41	0.33
		← Distance of Expressway use	0.05	0.02	0.10	0.04	0.02
		← Distance from SA/PA/IC to SA/PA	0.04	0.08	0.06	0.04	0.02
		← Driver's Fatigue	0.01	0.01	0.00	0.01	0.00

Table 5 shows the result of parameter sensitivity testing by segmented sample case. The table indicates that this type of SEM can represent the differences in path-connectivity among the segmented drivers who visited either SA or PA and who did either Nishinomia-Nashio SA or Kasai SA. It is therefore found that the advanced type of SEM is improved to identify the basic characteristics of causality of latent and observed variables determining the decision of revisiting SA/PA in expressway.

A MODEL OF SA/PA STOPOVER AND CHOICE BEHAVIORS

In this section, we discuss a model of driver’s behavior on stopover at SA/PA involving the location choice. It was found that our advanced SEM could represent the decision structure underlying SA/PA choice behavior in which latent variables were hypothesized to determine whether expressway drivers will intend to revisit the stopped SA/PA or not. We here try to develop a model of driver’s decision making on stopover at SA/PA as a whole, that is to say, both SA/PA stopover and the location choice behaviors.

A web-based questionnaire screening and surveying was conducted to select the drivers who passed through the section between studied SA/PAs in Chugoku Expressway including the drivers who stopped at the studied SA/PAs. About 600 samples were selected out from about 30,000web users who participated in the survey and the obtained data were used to empirically analyze basic properties of driver’s behaviors. Next, a nested typed model was applied to represent the hierarchical decision structure underlying SA/PA stopover and choice behaviors.

Table 6 shows a distribution of the sample obtained from 2012 web-based survey in Chugoku Expressway. As shown in **Figure 10**, two types of the nested logit model denoted as NLM are here assumed. While both of them have two layers, the upper one is concerned with the decision and the lower one is concerned with, either the location choice in four SA/PAs in Type 1 or SA/PA group & location choice in Type 2.

Table 6 Sample from 2012 Web-based Survey in Chugoku Expressway

Sample from 2012 Web-based Survey in Chugoku Expressway		Nishinomiya-Nashio SA	Akamatsu PA	Yashiro PA	Kasai SA	Other SA/PA	Non-stop at SA/PA	Total
No. of stopping drivers at SA/PA		92	38	9	43	157	270	609
Model Type 1	No. of drivers incorporating all of targeted SA/PAs into their choice set	137				124	217	478
		48	38	9	42			
Model Type 2	No. of drivers having either G1 or G2 as their choice set	Group 1(G1) :85		Group 2(G2) :48		124	217	474
		48	37	6	42			

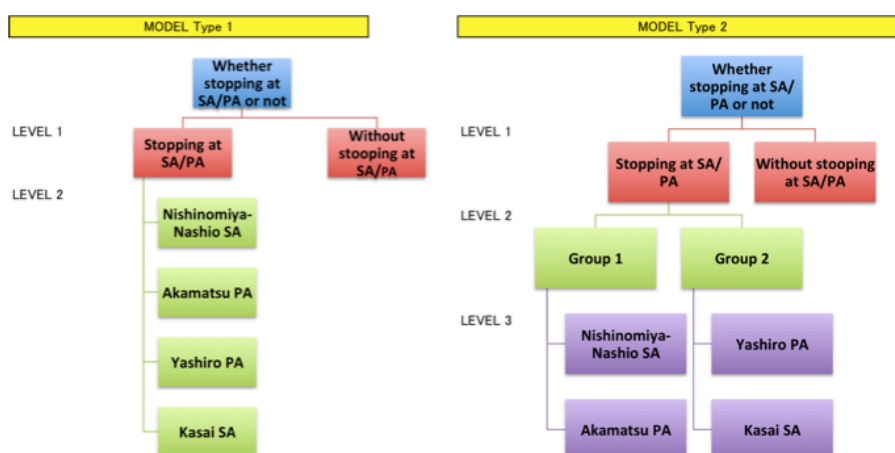


FIGURE 10 Two types of hypothesized decision structures of NLM

Table 7 shows results of parameter estimates for both types of NLM. The main findings are as follows:

As common properties, in the upper level, that is to say, in the decision whether drivers stopover at SA/PA or not, both “The extent of recognition for SA/PA” and “Log-sum variable” are statistically significant and these variables have positive effect on stopover at SA/PA. On the other hand, “Average distance between entrance IC and the studied SA/PAs” has significantly negative effect. This implies that the longer travel distance is getting, the higher possibility of stopover at other SA/PAs.

Table 7 Results of parameter estimates for Type 1 and Type 2 of NLM

MODEL TYPE 1					
(Ratio of Likelihood)	Variable	Stopping at SA/PA		Without stopping	
LEVEL 1 (0.132)	Average distance between entrance IC and 4SA/PAs(× 100m)	-2.10E-03		—	
	The extent of recognition for SA/PA	1.60E+00		—	
	Logsum variable for Level 2	4.00E-02		—	
	Constant	-6.50E+00		—	
(Ratio of Likelihood)	Variable	Nishinomia-Nashio SA	Akamatsu PA	Yashiro PA	Kasai SA
LEVEL 2 (0.268)	Store Area (m ²)	6.80E-04			
	Driver' satisfaction for SA/PA	5.30E-01			
	No.of passengers including a driver	-3.20E-02	7.30E-02	6.50E-02	—
	Dummy Variable : Activity is only toilet	1.10E+00	2.20E+00	-1.90E+01	—
	Distance between entrance IC and exit IC (× 100m)	-1.40E-04	-5.50E-04	-1.00E-03	—
	Dummy Variable : Less frequent uses for SA/PA	-5.10E-01	9.10E-02	1.40E+00	—

MODEL TYPE 2					
(Ratio of Likelihood)	Variable	Stopping at SA/PA		Without stopping	
LEVEL 1 (0.146)	Average distance between entrance IC and 4SA/PAs(× 100m)	-1.00E-03		—	
	The extent of recognition for SA/PA	1.40E+00		—	
	Logsum variable for Level 2	4.80E-01		—	
	Constant	-6.80E+00		—	
(Ratio of Likelihood)	Variable	SA/PA Group 1		SA/PA Group 2	
LEVEL 2 (0.227)	Passing traffic volume (vehicles/hour)	1.20E-03			
	Logsum variable for Level 3	4.80E-01			
	Constant	-3.40E+00			
(Ratio of Likelihood)	Variable	Nishinomia-Nashio SA	Akamatsu PA	Yashiro PA	Kasai SA
LEVEL3 (0.135) (0.352)	Store Area (m ²)	6.80E-04		-9.30E-04	
	Driver' satisfaction for SA/PA	5.30E-01		1.30E+00	
	No.of passengers including a driver	-6.20E-01	—	—	—
	Dummy Variable : Activity is only toilet	-1.70E+00	—	—	—
	Distance between entrance IC and exit IC (× 100m)	—	—	-2.70E-03	—
	Dummy Variable : Less frequent uses for SA/PA	—	—	2.40E+00	—

Next, when focusing on the result in the lower level of NLM (Type1), that is to say, in the decision which SA/PA drivers stop over among four SA/PAs, only “Drivers satisfaction for SA/PA” are statistically significant as a generic variable. On the other hand, almost specific variables are insignificant. “The dummy variable; Activity is only toilet” for Akamatsu PA is only significant.

Finally, we focus on the result in the lower level of NLM (Type2), that is to say, in the two stages decision, which SA/PA drivers stop over among two groups (Level 2) and two SA/PAs in each of groups (level 3). In the level 2, all of variables; “Passing traffic volume” and “Log-sum variables” and “Constant” are statistically significant. On the other hand, only “Store Area” for Group 1 is significant as a generic variable and “Driver’s satisfaction for SA/PA” is not significant.

CONCLUSIONS

Recently, it has been recognized that leisure drivers have a variety of needs when using expressways and that service and parking areas (SA/PAs) are required to offer not only traditional rest stop services but also additional services, such as refreshments, dining, and souvenir shopping. It is clear that lots of SA/PAs have been improved as higher profit service-facilities since privatization of Japan Highway Bureau in 2005. As previous researches on driver decisions related to SA/PA choice behaviors have been hardly found, it is necessary to identify the factors determining SA/PA choice behaviors to develop marketing strategies for promoting SA/PA use. The research aims to analyze activity and preference patterns at visited SA/PA. Both paper-based and web-based questionnaire were administered to the drivers who stopped at the studied SA/PAs and the obtained data were used to empirically analyze basic properties of driver’s behaviors. Next, a structural equation model was applied to represent the decision structure underlying SA/PA choice behavior. The result showed that the advanced SEM model represented goodness of fit as a whole and obtained consistency with basic properties of SA/PAs. We also tried to develop a model of driver’s decision making on stopover at SA/PA as a whole, that is to say, both SA/PA stopover and the location choice behaviors.

The current phase of this study is at the Stage III and the gate of Stage IV in our analytical framework. At the first stage, the objectives were identified based on the agendas underlying the improvement of services at SA/PA on expressways. Moving to Stage II, a questionnaire on drivers’ behaviors at the SA/PA and his/her stated preferences as far as revisiting the SA/PA was administered. It is noted that the traffic stopping over at SA/PAs are counted together with the total traffic passing through on the survey day. Therefore, it remains for us to analyze characteristics of the ratio of stopover vehicles and to calibrate a SA/PA choice model as a tool for marketing policy evaluation.

It is also necessary for us to analyze much more detailed characteristics of driver behavior, needs, and wants regarding SA/PAs. At that time, we will make use of the data set obtained from the web-based survey. These data are expected to be effective for comparison with SA/PA choice behaviors. It is furthermore necessary to identify which market segment should be taken into consideration in developing our SEM. It is clear that there remain a few problems to be resolved in our primitive model. In Stage IV, we expect to identify effective marketing strategies for increasing the attractiveness of services and recognition of SA/PAs on expressways by applying a market segmentation method to our developed SEM and NLM.

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