Effects on Service Improvement of Transport in View of Urban Sustainability

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Abstract

In these years, the urban planning system has been reconsidered in terms of sustainable policies. The sustainability in urban areas involves attempts of urban development including environmental, social and economic improvements, policies and practices in the next generation stage. In most of Japanese cities and towns, transport planning was based on the efficiency of car vehicles use until these years. As a result, traffic congestion occurred and caused slower speeds, longer times of car vehicles in a downtown area, while car drivers used the car vehicles even for walking distance. Therefore, it is necessary for the cities to improve the transport service in their areas including walking, cycling, and public transit oriented system and so on, namely, mobility management. These traffic modes contribute to the urban sustainability positively and correspond to the appropriate mobility of the people.

In this study, first of all, the effect on the introduction of a new public transport system, namely, an extension of tram car system was examined. Here, the impacts on surrounding areas due to tram line extension are assessed in view of the sustainable urban planning. In the next objective, the effects on the improvement of an underground passage, which is more convenient for pedestrian to go around the downtown area, were evaluated. The practical research and study was examined in Sapporo City, Japan.

The results of analysis show in the following aspects: 1) the inhabitants expects the extension of tramcar in the supposed area, 2) people also expect activeness and attractiveness resulted from the extension of tram car line, 3) the pedestrians expect to be capable more choice of shop facilities, particularly, in rainy or snowy weather due to the use of underground passage, 4) the underground passage stimulates the behaviors of visitors between two commercial areas which exist separately to stay and enjoy for longer time.

Keywords: *Transport planning, urban sustainability, tram improvement, mobility management*

1. INTRODUCTION

In these years, it has been popular to discuss a sustainable city or eco-city which is the city designed with consideration of environmental impact, inhabited by people devoting to minimization of required inputs of resources and outputs of waste and polluted loads [10]. Specifically, it is to create the smallest possible ecological footprint, and to produce the lowest quantity of pollution loads, to use urban area efficiently, to reduce use of the fossil fuels [16]. So the urban planning system has been

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reconsidered in terms of sustainable policies. Here, the sustainability in urban areas involves attempts of urban development including environmental, social and economic improvements, policies and practices in the next generation stage [7]. In most of Japanese cities and towns, transport planning is based on the efficiency by use of car vehicles and the increase of automobile traffic has often occurred traffic congestion in downtown areas. As a result, traffic congestion causes slower speeds, longer times of car vehicles in a downtown area, while car drivers use their car vehicles even for walking distance [8]. Therefore, it is necessary for the cities to improve the transport service in their areas including walking, cycling, and public transit oriented system and so on, namely, mobility management. These traffic modes contribute to the urban sustainability positively and can offer an appropriate mobility measure of the people. At the same time, we should verify an appropriation of introducing such mobility management [6].

In this study, first of all, the effect on the introduction of a new public transport system, namely, an extension of tram car system is examined. It has 1.9 million populations. Here, the impacts on surrounding areas due to tram line extension are assessed in view of the sustainable urban planning. In the next objective, the effects on the improvement of an underground passage, which is more convenient for pedestrian to go around the downtown area, were evaluated. The former measure has been planned and the latter measure has just been used in Sapporo city which is located in Hokkaido Japan. Finally, we discuss through above-mentioned evaluations synthetically.

2. METHODS AND ANALYTICAL PROCEDURE

2.1 Procedure of analysis

In urban transportation planning, it is popular to evaluate the appropriation of a plan on transport facilities using a monetary analysis, for example, cost-benefit analysis. However, it can be limited to use such a analysis in case of downtown transport planning because of complexity of behaviors of travelers and multifarious needs of inhabitants [13]. So we should introduce some different methods to analyze the assessment based on human behavior and needs for mobility directly [4], [3].

Thus, analytical procedure of this study is proposed depending on the specific measures as shown in Figure 1.

First of all, we think of several attributes to evaluate alternatives and to investigate the relevant contents in case of extension of tramcar line using Analytical Hierarchy Process (AHP) [14]. Next we compare a new measure with the existing case in order to make sure an effect due to the extension of tramcar line. Moreover, we verify the awareness or cooperation of inhabitant by application of Contingent Valuable Method (CVM) [9]. That is, the residents' expectations for the effect of regional improvement due to extension of tramcar line are indicated by willingness to pay. On the other hand, we build a model of choice behavior on commercial facilities in terms of season, weather, scale of facility and respondent's attributes. And then, we evaluate visitors' choice behaviors in commercial districts in case of effect on use of underground pedestrian path. We finally discuss the synthetic effects on urban sustainability due to two new improvement of transport in downtown.

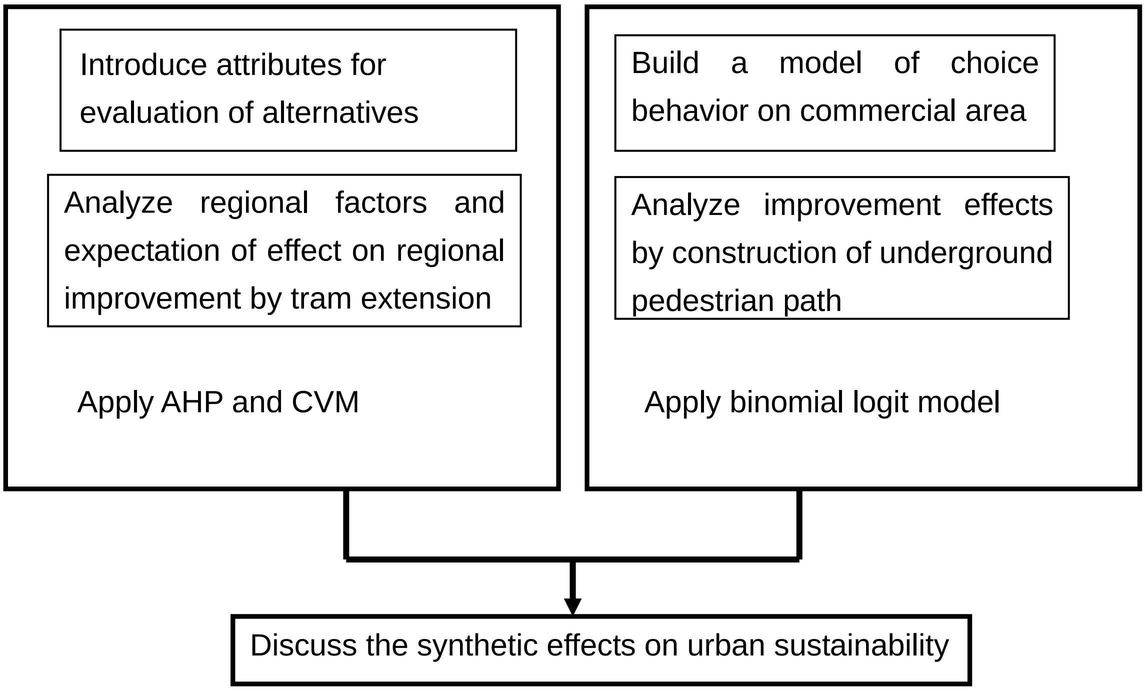

Figure 1 Analytical procedure of this study

2.2 Application of AHP and CVM

(1) Application of AHP

We introduce AHP to indicate the attractiveness of the downtown area quantitatively. The general procedure is implied as the following contents [17]:

1) Compose the hierarchical figure by analyzing a problem.
2) Assess the importance of factors in each level and make a matrix. The interrelation is examined from an upper level to a lower level orderly with a pair comparison [14].
3) Compute the weight of factors and consistency index (CI) in each pair of matrix.

(Two kinds of pair comparisons) i)A pair comparison in each level and ii) a pair comparison of alternatives in every evaluated factor shown .

(Calculation of weights) i) geometry mean of each factor and ii) weight based on geometry mean formulated as Equation 1 and Equation 2.

$$A_i = \sqrt[n]{a_1 a_2 ......a_n} \qquad (1)$$

$$W_i = \frac{A_i}{\sum_{i=1}^{m} A_i} \qquad (2)$$

,where a_n : surveyed importance of sample n, A_i : average importance of factor *i* in all respondents, W_i : weight of factor *i*.

(Consistency index CI) consistency index is formulated as Equation 3.

$$CI = \frac{\lambda_{\max} - m}{m-1} \qquad (3)$$

where $\lambda_{\max}$: maximum eigen value, *m*: number of factors.

4) Compound weights from the result of a pair comparison analysis and obtain the comprehensive weight of an alternative.

(2) Evaluation in terms of CVM

When there is originally no market on the evaluation, CVM makes a market imaginarily and intends to consider it[5].

In this method, first of all, the contents of environment and administrative service are introduced to the respondents. And then, willingness to pay is asked toward heightening the level of environment. On the other hand, we can consider willingness to accept compensation if environment or administrative service is declined. WTA is indicated as the necessary money to obtain the original utility again. CVM can also evaluate both the use values and holdover value. Direct and indirect use value and option value are measurable even in terms of usual consumer's surplus analysis and Hedonic approach which is a kind of the analyses on the non-market material. But it is only possible to evaluate the existing value in terms of CVM. The CVM is possible to estimate not only the values of substantial environment or administrative service but also their virtual values. On the basis of the questionnaire supposed to the imaginary situation, it is possible to ask monetary values of environment and the administration service directly. The questionnaire of WTP in CVM is divided roughly into the following four methods.

1) Method due to free answer: to ask sum of payment freely.

2) Method due to bid price using game mode: to ask agree or disagree with the proposed price to repeat until obtaining the answer of “No”.

3) Method due to payment card system : to answer the appropriate value within some

alternative choices.

4) Method due to a pairing choice system: to ask agree or disagree with proposed price This study adopted the payment card system.

Supposed the probability of agreement with a given WTP price to $\Pr[yes]$, it is formulated as Equation 4.

$$\Pr[yes] = \frac{1}{1+e^{-\Delta V}} \qquad (4)$$

where ΔV ; a difference of utility between proposed prices.

Here, it can be estimated parameters of estimate equation by maximum likelihood method as equation 5 [4].

$$\Delta V = \alpha + \beta T + \sum_{i=1}^{n} \gamma_i y_i + \sum_{k=1}^{m} \delta_k z_k \qquad (5)$$

where $\alpha, \beta, \gamma, \delta$; parameters, T is a proposed price, y_i ; variables of a respondent's attributes ($i = 1, n$), and z ; variables of a respondent's awareness ($k = 1, m$) .

(3) Choice behavior model for visiting facility

Choice behavior model to visit facility (district) is constructed as following procedure [1], [15]. First of all, choice model to visit facility with season and weather condition is constructed using binomial logit model. In terms of questionnaire results, choice behavior is modeled for selecting a district between two districts corresponding to three objectives, namely, shopping, eating and drinking, and playing [2].

In this study it is supposed that a main effect due to pedestrian travel through underground path is regarded as the reduction of travel time. The explanatory variables are introduced such as each season, each weather, pedestrian time to facility, the scale of facility, and dummy variables of generations [11].

Specifically, symbols of introduced equation is represented as

$g \in G$: set of generations

$w \in W$: set of weathers {f : fine, r : rain, c : snow}

$p \in P$: set of aims {b : shopping, e : eating and drinking, j : amusement}

$d \in D$: set of downtown districts {o: Ohdori district, s: Sapporo station district}

$a \in A$: set of activities {y : staying in downtown, n : going back to home}

The utility function in the model is defined as Equation 6 using above variables. Here, $v^k{}_{ypd}$ ($(\forall p \in P, \forall d \in D)$ is the utility of person k having objective p and selecting facility d , and δ_g^k is the dummy variable (generation g of person k is 1 and otherwise is 0.).

$$\Delta v_{ypd}^{k} = v_{ypo}^{k} - v_{yps}^{k} = \sum_{w \in \{f,r,c\}} \theta_w (t_w^o - t_w^s) + \theta_m (x^o - x^s) + \theta_o + \sum_{g \in G} \theta_g^p \bullet \delta_g^k \qquad (6)$$

t_w^d : walking time to facility *d* in weather *w*,

θ_k : parameter of walking time in weather *w*,

x^d : facility scale *d*,

θ_m : parameter of facility scale,

θ_g^p : parameter of generation *g* having objective *p*,

θ_g : constant (district B)

Walking time is real time in a rain. U_{ypd}^{k} is probability variable.

$U_{ypd}^{k} = v_{ypd}^{k} + \varepsilon$, ε ~*iid* (depending on Gumbel distribution)

The choice probability of facility is given Equation 7 [12].

$$P_{yps} = \Pr(U_{yps} > U_{ypo}) = \frac{1}{1 + \exp(\Delta v_{ypd})} ,$$

$$P_{ypo} = 1 - P_{yps} \qquad (7)$$

(4) Choice behavior model for staying/ returning

If model structure as shown in Figure 2 is regarded as NL model, log- sum variables of facility utility can be represented as the utility of each objective. This variable is represented as Equation 8.

$$v_{yp}^{k} = \ln(\sum_{d \in D} \exp(v_{ypd}^{k})) \qquad (8)$$

Choice probability is formulated as Equation 9.

$$P_{yp}^{k} = \frac{\exp(v_{yp}^{k})}{\sum_{p' \in P} \exp(v_{yp'}^{k})} \qquad (9)$$

As same way, the log-sum variable obtained by utility of each objective is regarded as Equation 10.

$$v_{y}^{k} = \ln(\sum_{p \in P} \exp(v_{yp}^{k})) \qquad (10)$$

The utility of choice for returning home using staying time *t* is formulated in Equation

11. Moreover, the choice probability between staying in downtown and returning home is calculated by binomial logit model as Equation 12. The parameters are also estimated by binomial logit model.

$$v_n^k = \theta_t \cdot t \qquad (11)$$

$$P_n^k = \frac{1}{1+\exp(\Delta v_a^k)}, \quad P_y^k = 1 - P_n^k$$
$$where\ \Delta v_a^k = v_n^k - v_y^k = \theta_t \cdot t - \theta_y \cdot v_y^k \qquad (12)$$

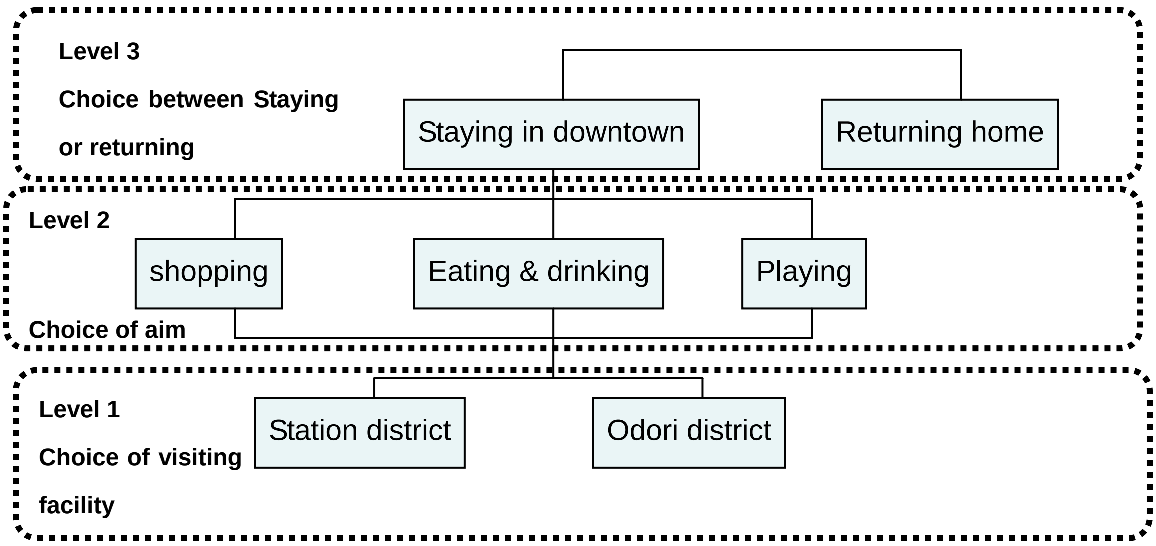

Figure 2 Structure of choice behavior model

3. ANALITICAL RESULTS

3.1 Case study 1: Effect due to extension of tramcar

(1) Objectives

The objectives of this study are mentioned in detail. It is to investigate the indirect effect (impact on surrounding areas) of the extension of Sapporo tramcar. The district with tram extension is called as Naebo. Up to the present, when a local government examines the introduction of a new public transport system, profitability (supply and demand) of the system is main concern. However, assessment of the impacts on surrounding areas by system is also important from the aspect of deliberate urban planning.

(2) Questionnaire survey

The questionnaire survey was executed on the following objectives, namely, what inhabitants desired in terms of extension of tramcar line, what they expected some effects in the surrounding district, and how much they should paid to the plan on extension of tramcar willingly.

First of all, the questions on pair-wise comparison and alternative comparison survey were prepared for analyzing AHP. The alternatives were considered as the case of extension of tramcar or existing case.

As the second viewpoint, the questions were made with regard to willingness to pay using CVM. Specifically, a method of payment was introduced in order to support management after completing the extension of tramcar.

The questionnaire survey was performed in the area of tramcar extension and another area without the influence on its extension. Table 1 shows the outline of questionnaire contents.

Table 1 Outline of questionnaire contents

Surveying Date	**December 18,19,2009**
respondents	**Residents in Naebo district and outside districts**
Method of distribution	**Direct distribution & collecting by mail**
Number of distribution	**1000 sheets (Naebo) and 1000 sheets (outside)**
Number of recovery	**504 sheets (recovery rate: 25.2%)**
Questionnaire contents	**Pairwise comparison between evaluation criteria, willingness to pay, personal attributes, etc.**

(3) Results by AHP

For the purpose of analyzing what kind of factors relate to urban planning, Analytical Hierarchy Process (AHP) is applied. First of all, the results obtained by applying AHP are presented. Figure 3 shows the Hierarchy chart assumed in the present study. The valuation factors are attractiveness, affluence, activeness, and environment.

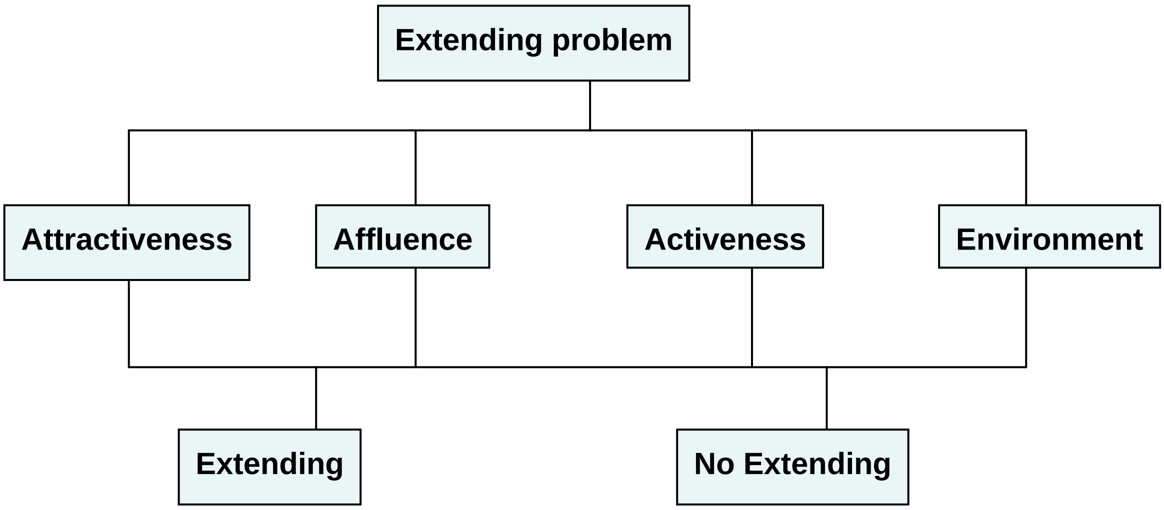

Figure 3 Hierarchy chart for AHP

The valuation factors are explained in detail as Table 2.

Table 2 Definition of evaluation criteria

Evaluation criteria	Detailed definition
Attractiveness	This plan will increase attractiveness in the surrounding district in terms of image and symbolization.
Affluence	This plan will enhance functions in the district due to fulfillment of commercial facilities and medical facilities.
Activeness	This plan will bring activeness in the district by increase of residents opportunity for going out.
Environment	This plan will decrease environmental loads such as reduction of green house gas.

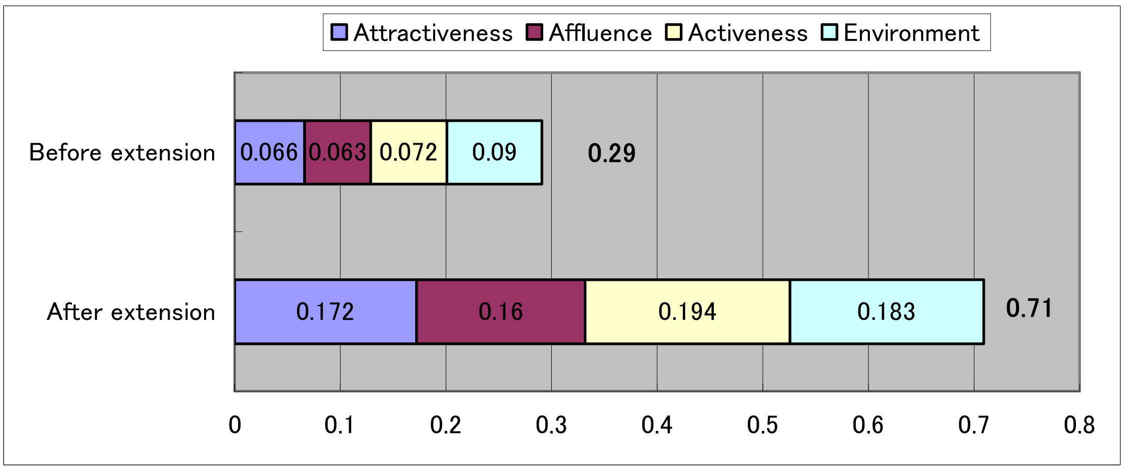

Figure 4 Result of AHP (Survey on Naebo district)

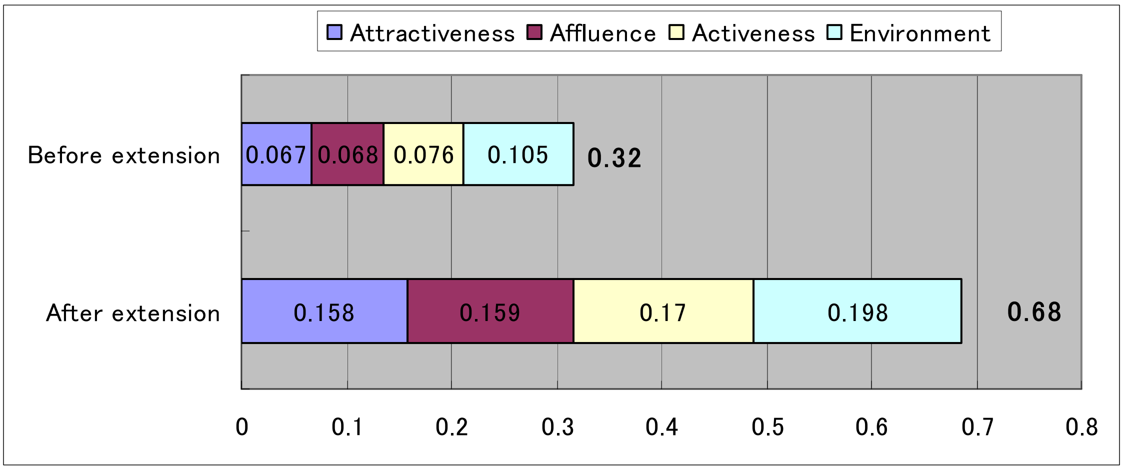

Figure 5 Result of AHP (Survey on outside district)

From the results, Sapporo citizen expects the extension of Sapporo tramcar to Naebo district from the aspect of impact on surrounding areas.

(4)Results obtained by CVM

Contingent Valuing Method is applied to estimate the indirect effect by the extension of Sapporo tramcar to Naebo district.

And, people living in Naebo district expect Activeness by the extension, while people living in the other districts expect attractiveness.

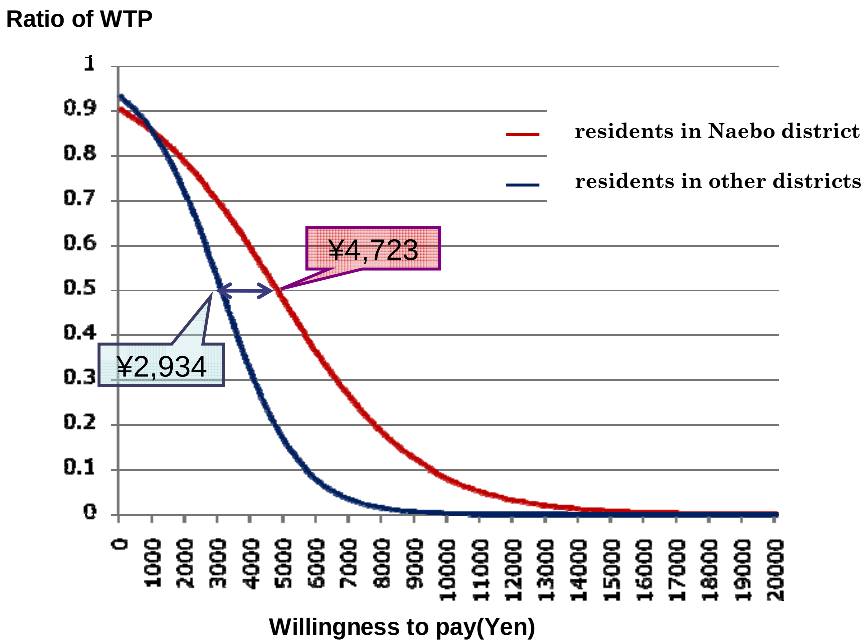

Figure 6 Calculation of willingness to pay in two different districts

Next, the results of CVM are presented. We developed a model which estimates willingness to pay (WTP). This model can analyze the effects of individual attributes on WTP. The amount of WTP and the benefit of indirect effect by the extension are estimated by the model. Figure 6 compares real odds of willingness to pay of Naebo district to estimated odds calculated by a model. Continuous line means estimated Using these results, the total value of benefit is accumulated as 13.8 million yen/year. The benefit can be divided into each criteria so that affluence, activeness and environment are 3.6 million yen/year, 3.5 million yen/year, 3.8 million yen/year, and 2.8 million yen/year respectively.

As above-mentioned, it was analyzed that the impact of the extending Sapporo tramcar to Naebo district on surrounding areas quantitatively. This result shows Sapporo city government must address consensus-building. That is, it is shown that Sapporo citizen expects activeness and attractiveness.

3.2 Case study 2: Effect on construction of underground pedestrian path

(1)Objectives

The road network improvement in a downtown prompts travelers to visit a new developed shopping area. For instance, the shopping area in the downtown of Sapporo is separated into two districts. One is the existing district and another is a new developed one. Many shops have been constructed and opened in the new developed district, while the existing shopping district has declined relatively. However, the underground path was completed this year, so that two shopping districts connect with each other continuously. Thus, it is more convenient for visitors to enjoy shopping. The behaviors of visitors will change more actively.

Here, a disaggregate model is constructed to analyze visitors' behavior on shopping in the downtown district. The factors of model include personal attributes, season and weather conditions, and scale of shopping facilities based on an questionnaire survey.

At the same time the effects on building the underground path connected two shopping districts in terms of focusing the visitors' behavior choice for shopping facilities.

(2)Questionnaire survey

The questionnaire survey in this case study was executed on visiting aim, choice of large-scaled or small-scaled shopping facility, staying time and choice of districts in the conditions of season and weather with or without the underground pedestrian path.

Table 3 Outline of questionnaire contents

Surveying Date	November 28,2010
respondents	Visitors to downtown area
Method of distribution	On-the-spot distribution & collecting by mail
Number of distribution	1000 sheets
Number of recovery	339 sheets
Number of valid answer	321 sheets
Questionnaire contents	Choice of shops, activity on surveyed day, choice of facility, personal attributes, etc.

The obtained data were applied to make a choice behavior model used for evaluation of effects on the measure of underground pedestrian path.
The outline of this questionnaire survey is displayed in Table 3.

(3) Results of Choice behavior model for visitors

In general, traveling measures of a visitor in a downtown are considered multifariously. Here, only walking is introduced for giving influences on use of an underground path and then a model is constructed in terms of pedestrians on it.
Pedestrian behavior choice in downtown districts is separated into three levels such as a choice of continuing travel activity in downtown or going back to home, a choice of travel aims and a choice of visiting facilities. Disaggregate model is prepared for determining the behavior choice of pedestrian in downtown before and after new development of shopping facilities.
It is supposed that visitors choose their aims and shopping facilities step by step after arriving in the downtown district.

Table 4 Analysis corresponding to choice levels

Choice level	Explanatory variable
Level 3 Choice of Staying or returning	Log-sum variable Staying time in downtown
Level 2 Choice of visiting aim	Log-sum variable
Level 1 Choice of visiting facility	Walking time in summer, in raining, in snowing, scale of facilities and generation

At level 1, a binomial logit model is constructed to choose the shopping point among two different districts depending upon whether the underground path is or not and weather condition. At the same time, the three objective utilities are calculated as log-sum variables of the facility utility at level 2. Finally, the binomial logit model for choosing either staying in downtown or going back to home is built based on the utility of staying and the staying time for each visitor at level 3. This model provides the information on time distances due to the seasonal and weather conditions and the disturbance of aim achievement and as a result, the new improvement of underground path brings effects to visitors.

The overall framework is already mentioned above in Figure 2. Furthermore, the list of explanatory variables is described in Table 4.

(4) Parameter estimation and examination

The analyses were used by free software R. Parameters estimation and examination were resulted in Table 5~7.

Table 5 Results of parameter estimation and examination in case of shopping

Aim	Explanatory variables		Parameter	T-value	
Eating & drinking	Necessary time	summer	-0.2021	-9.0422	***
		rain & snow	-0.2212	-9.6316	***
	Constant	Odori	0.7665	5.2916	***
	Facility scale		0.7394	7.6336	***
	Dummy of teenagers		0.5246	1.5710	
	Dummy of fifties		-0.3776	-2.1806	**
	Log likelihood at zero		-711.54		
	Log likelihood		-616.20		
	Likelihood ratio		0.1340		
	Hitting ratio		0.6537		

*** 1% of significance, ** 5% of significance * 10% of significance

Table 6 Results of parameter estimation and examination in case of eating & drinking

Aim	Explanatory variables		Parameter	T-value	
Eating & drinking	Necessary time	summer	-0.2021	-9.0422	***
		rain & snow	-0.2212	-9.6316	***
	Constant	Odori	0.7665	5.2916	***
	Facility scale		0.7394	7.6336	***
	Dummy of teenagers		0.5246	1.5710	
	Dummy of fifties		-0.3776	-2.1806	**
	Log likelihood at zero		-711.54		
	Log likelihood		-616.20		
	Likelihood ratio		0.1340		
	Hitting ratio		0.6537		

*** 1% of significance, ** 5% of significance * 10% of significance

Table 7 Results of parameter estimation and examination in case of playing

Aim	Explanatory variables		Parameter	T-value	
Playing	Necessary time	summer	-0.1375	-6.6466	***
		rain	-0.1864	-6.3203	***
		snow	-0.2379	-9.4655	***
	Constant	Odori	1.1215	7.2043	***
	Facility scale		0.9206	9.5577	***
	Dummy of teenagers		0.4299	1.3645	
	Dummy of forties		0.2881	1.5446	
	Log likelihood at zero		-744.56		
	Log likelihood		-632.63		
	Likelihood ratio		0.1503		
	Hitting ratio		0.7103		

***** 1% of significance, ** 5% of significance * 10% of significance**

The parameters of walking time were depended upon weather condition. Namely, time resistance for waking is larger in rainy or snowy time than summer (fine) time. In view of the aim, the eating and drinking had the largest resistance. The shopping and the playing followed it. Furthermore, the larger the facility is, the larger the utility is. In particular, in case of shopping, such the awareness was remarkable. The young generations were generally fond of Station district, while the old generations tend to visit in Odori district. This is because there are older shops in Odori compared with new developed area, Station district.

Next, the utilities of each aim and staying in downtown were calculated using the log-sum variables shown in Table 8.

Table 8 Utilities using log-sum variable

utility	shopping	Eating & drinking	playing
Each aim	8.5735	7.2238	8.2753
Staying in downtown	9.2740		

Moreover, the parameters on choice probability between staying in downtown and returning home were estimated in table 9. The hitting ratio was over 80%, so that the model was high-grade reliability.

Table 9 parameter estimation of the model for staying or returning

Explanatory variable	parameter	T-value	
Staying time in downtown	0.0146	23.5723	***
Constant (utility of staying in downtown)	0.3712	20.6514	***
Log likelihood at zero	-1271.80		
Log likelihood	-731.45		
Likelihood ratio	0.4249		
Hitting ratio	0.8255		

***** 1% of significance, ** 5% of significance * 10% of significance**

(5) Results of analysis using the model

Table 10 shows the change of the obtained choice probability in case of facilities called on by citizens. If the underground pedestrian path is utilized, the pedestrian traffic from Odori district to Station district was the increase of about 8%. On the other hand, the pedestrian traffic from Station to Odori was the increase of about 15%. Odori district can obtain an advantageous condition due to constructing the underground path. In view of weather condition, raining or snowing makes the increase of choice probability compared with summer (clear).

Table 10 Choice probability change of facilities without considering the facility scale

Direction of travel	Underground path	Season & weather	Choice probability of visited facility(%)		
			shopping	Eating	Playing
Station → Odori	Without path	summer	19.80	17.67	40.4
	With path	Summer	35.90	36.96	57.42
		Rain	39.08	39.20	63.24
		Snow	41.59	39.20	68.98
Odori → Station	Without path	Summer	7.36	3.58	5.19
	With path	Summer	15.29	9.25	9.81
		Rain	17.13	10.09	12.91
		Snow	18.64	10.09	15.22

In the downtown area, Station district has large-scaled compound shopping facilities, while Odori district has small or middle-scaled shopping facilities mainly. In next analysis, considering such a facility scale, the areas of facilities were introduced. The analytical results are illustrated in Table 11. Compared with the former analysis, the facilities in Station district obtained higher choice probability. The attractiveness of each facility in Station district can be high now because of existing large facility.

Table 11 Choice probability change of facilities without considering the facility scale

Direction of travel	Underground path	Season & weather	Choice probability of visited facility(%)		
			shopping	Eating	Playing
Station → Odori	Without path	summer	11.73	11.53	24.74
	With path	Summer	23.18	26.32	39.48
		Rain	25.68	28.21	45.42
		Snow	27.70	28.21	51.83
Odori → Station	Without path	Summer	12.87	5.76	10.18
	With path	Summer	25.09	14.36	18.38
		Rain	27.73	15.57	22.31
		Snow	29.84	15.57	27.08

In this case study, the pedestrian choice behavior model was constructed depending on weather condition, the attractiveness of facility and the attribute of visitors. The model was applied to the improvement of underground pedestrian path. Comprehensively, the underground pedestrian path brings multi-visits to the citizens. Particularly, in raining or snowing, it is available for using such the path. It will also be expected to give a large effect due to activation of downtown.

(6) Synthetic effects on urban sustainability

We discuss synthetic effects on urban sustainability though two case studies. Here, the extension of tramcar and the introduction of underground pedestrian path are management of transport in downtown. Basically, it is necessary for us to reduce a disparity of mobility in the downtown. The extension of tramcar contributes to reduce the disparity of mobility in an area with a poor public transport. This is one of sustainable improvements on urban planning.

On the other hand, the underground pedestrian path is useful to enjoy walking in rainy or snowy weather. In particular, people living in cold and much snowfall area want to walk around downtown in winter as same as summer season. Therefore, it is important for us to promote uses of underground facility.

Both ideas on mobility management are available for urban sustainability extremely.

4. CONCLUDING REMARKS

We conclude several important points on transport in urban sustainability through this discussion.

1) Transport planning should be a new method for sustaining people and their society in

an urban area.

2) The road is not used by only car, but by pedestrian and public transport modes. Therefore, it is necessary for us to use it wisely.

3) Future transport planning should be made a point of mobility management, while it does not make specific facilities and establishments.

4) Management is to answer the needs of society, community and to devote to users as well. Transport planning should be applied to a management system with unifying with urban or community planning.

5) The management of tramcar should be corresponded to the needs of the district appropriately.

6) It is important for the opening of underground path to evaluate as one of available measure for urban sustainable in cold and snowy area. In near future, it should be discussed innovations.

As future subjects of the study, the simulation of visitors' behavior will be examined and the possibility of comprehensive travel demand management using transit mall and so on will be confirmed quantitatively. Furthermore, the alternatives should be prepared with the agreement of inhabitants.

It is indispensable to assess the needs and concerns of the citizens to the alternatives in order to compose an appropriately sustainable plan in the future. It is also to establish the effective technique for building the transport system in downtown area corresponding to sustainability for future generations.

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