

Verification Study on Construction Planning of New Transit and Related Public Facilities Based on Psychological Analysis

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New transportation system (People Mover) has been regarded as one of the most attractive topics in recent urban and regional development. This article is the study on the plan of constructing High Speed Surface Transportation (HSST), as a new magnetic levitation type of transit, in Shiga Prefecture. To plan a new transit in local area needs comprehensive consideration, not only from technical and financial aspects, but also from its social influence. The study tries to explore the relationship among people, transportation and related facilities from social psychological aspect and communication with residents to make efficient and effective planning. It tests the fit of the theory of planned behavior (TPB) by applying the Structure Equation Model (SEM) with the information from the residents in Otsu and Kusatsu City. Perceived behavior control, as a component of TPB, is found to be closely related to the intention. Therefore, the desired facility can help increase the acceptance greatly. The plan of constructing public sports center nearby one station of the new line is discussed together by optimizing the utility function. Regarding these, the article also considers the possible application of the hybrid planning system. This study can be a meaningful experiment of introducing some psychological theory into transportation planning.

【Keywords】 transportation planning, public facilities, social psychology

1. Background

As the environmental problems become more and more serious, we have to face the shortage of public resource. The rise of the gasoline price has caused many families to consider the change of car use. Public transportation is quite focused by most of the governments to change the current heavy traffic situation. Kinds of New Transportation Systems, in the other words, People Movers have been evaluated and developed here and there in the world.

A People Mover is a fully-automated, grade-separated rail transit system. The term is generally used only to describe elevated single-rack loops serving small areas such as airports or theme parks, but is sometimes applied to considerably more complex automated systems. It is

positioned, by transportation ability, over bus, LRT, but below metro. The following lists all the People Movers built in Japan:

- Hiroshima: Astram Line, 18.4km, 1994
- Kobe: Port Liner, 10.8km, 1981; Rokko Liner, 4.5km, 1990
- Komaki: Peach Liner, 7.4, 1991
- Nagoya: Linimo, 8.9km, 2005; Nagoya Guideway Bus, 6.5km, 2001
- Osaka: New Tram (Osaka Municipal Nanko Port Town Line/OTS New Tram Technoport Line), 7.9km, 1981
- Saitama Prefecture: New Shuttle, 12.7km, 1983
- Sakura: Yamaman Yukarigaoka Line, 4.1km, 1982
- Tokyo: Yurikamome, 14.7km, 1995; Nippori-Toneri

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Line (opens 2007)

- Yokohama: Kanazawa Seaside Line, 10.6km, 1989

The study is centered on the High Speed Surface Transportation (HSST) construction plan in Shiga prefecture. HSST has been developed as a new transit type for either inter-city or intra-urban transportation. One line has been constructed and put into use in Aichi World Exhibition, named as Linimo. HSST provides fast and quiet transportation service, which is good to the environment. And the maintenance and operation cost is lower compared to other traditional transits.

Kusatsu City and Otsu City are located in Shiga Prefecture, with a total population of about 460 thousand, and yearly visitors over 1.5 million. The subject area lies in the middle part of the two cities, with three universities: Ryokoku University, Shiga Prefecture Medical University, and Ritsumeikan University. The proposed HSST line will connect these three universities and the residential area to be ended with JR Kusatsu and Ishiyama Station (shown in Fig.1), totally about 11 kilometers, and it is to be extended in the future. The target is to provide convenient,

comfortable transportation with high service level to citizens and to promote the new transportation style.

The blooming area has an increasing population and supplies labors for Kyoto-Osaka-Kobe metropolitan. Provided with nice nature around Lake Biwa, more immigration is expected to be settled in this area. New transit is considered to be able to activate those nature resort spots. It will also satisfy the strong demand of inner mobility for the universities, hospitals, and factories and so on. Recently, more and more shops have been opened in this area, which can be an evidence of commercial potentiality. All these facilities are located quite sparsely. Since bus network is not enough, and there is high volume of car use, causing congestions often. About 53.6% transportation are realized my car, only 27.1% taking railway or bus. Over 32.7% people do not think the bus network works well. There is a strong desire for the development of new public transit system.

Not only the new transit, but also the related public facilities are discussed in this study. Since the new transit is expected to connect those spots like universities, factories,

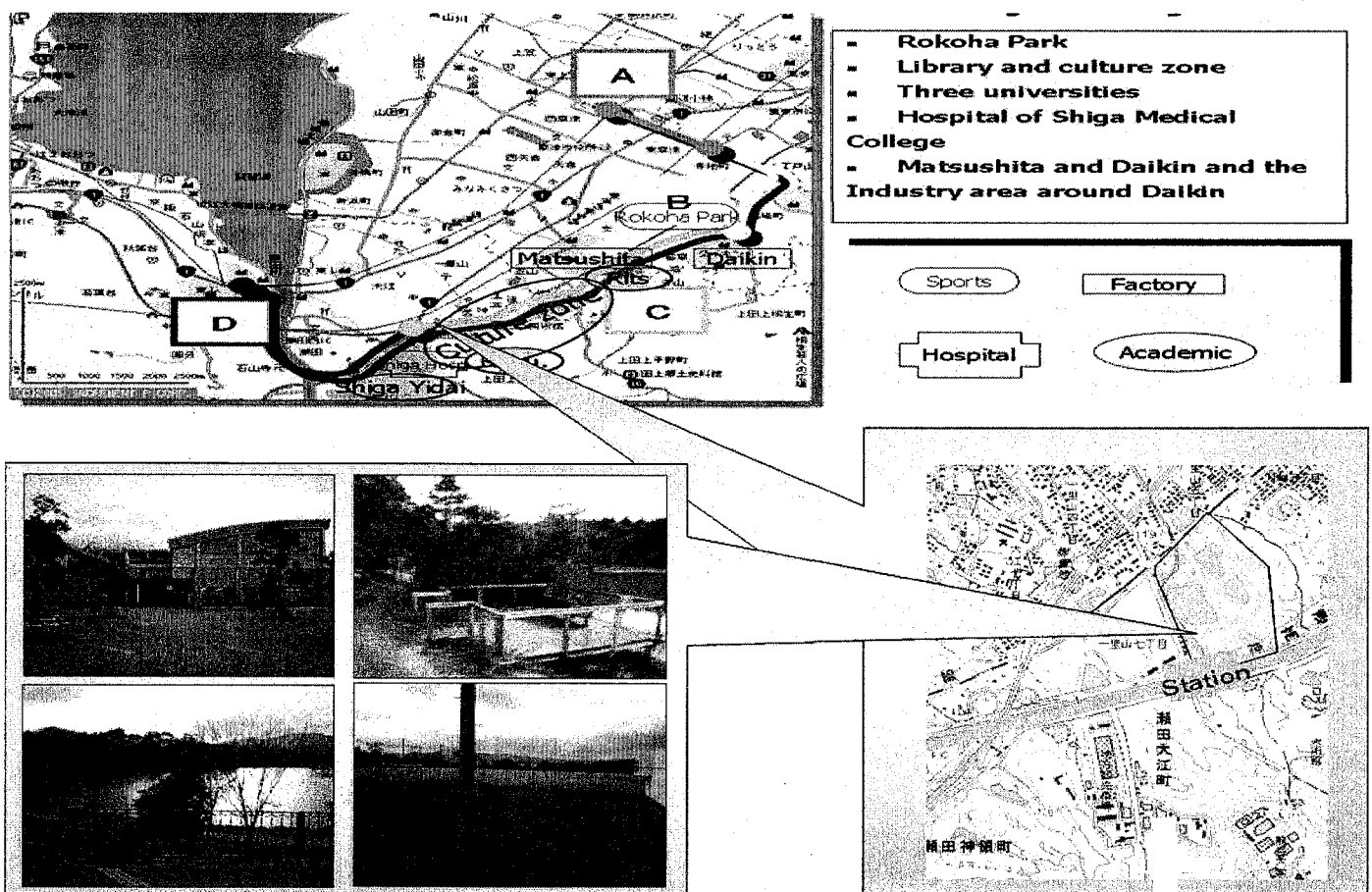


Fig.1 Study Area and Line under Consideration

hospitals and those residential zones. The urban activities will be encouraged most probably. In this study, Seta park area is chosen as the spot for public sports center, where one station is planned to be built. From the survey, information shows that about 47.1% of the population do not have sports in daily life. The lack of sports facilities is concluded as the important reason. Daily sports activities are regarded as one the important elements for high living quality. Especially for the area with increasing population, sports can help people to relax and get familiar to the living environment. New transit can provide the residents more convenient access to sports center. So as the planning of HSST being processed, the public sports center is taken into consideration as one of the most attractive related facilities to the new transit.

2. Literature Review

Recently social psychology has been widely applied in kinds of practical fields. Some researchers have tried to introduce social psychology to solve social dilemma by bring people to use public transportation (S. Fujii & R. Kitamura¹⁾ 2003). To know passengers' attitude helps induce the traffic flow. Psychology is the essential element included in each behavior. This article is trying to explain the relationship among behavior, transportation and related facilities by introducing social psychology.

Firstly, the important fundamental theory for this study is one of the most popular social psychological theories in behavioral prediction, named Theory of Planned Behavior (TPB). The basic paradigms of TPB are that people are likely to carry out a particular type of behavior if they believe that such behavior will lead to a particular outcome that they value; that their important referents will value and approve of the behavior; and that they have the necessary resources, abilities, and opportunities to perform such behavior (Ajzen²⁾, 1985; Conner et al.³⁾, 1999). TPB is especially applicable to behaviors that are not entirely under personal control (Corby, Schnedier-Jamner, & Wolitski⁴⁾, 1996), and the theory itself encompasses the relatively thoughtful process involved in considering personal costs and benefits of engaging in various kinds of behavior (Petty, Unnava, & Stratham⁵⁾, 1991).

TPB postulates a set of relations among attitude, subjective norm, perceived behavioral control, and behavioral intention. Fig.2 shows the framework of TPB. An attitude (AB in Fig.2) is a predisposition, created by learning and experience, to respond in a consistent way toward an object, such as a product. This predisposition can be favorable or unfavorable (Moutinho⁶⁾, 1987). In this paper, attitudes are predispositions or feelings toward HSST as new transit, based on multiple perceived product attributes. According to Fishbein and Ajzen⁷⁾ (1975), an

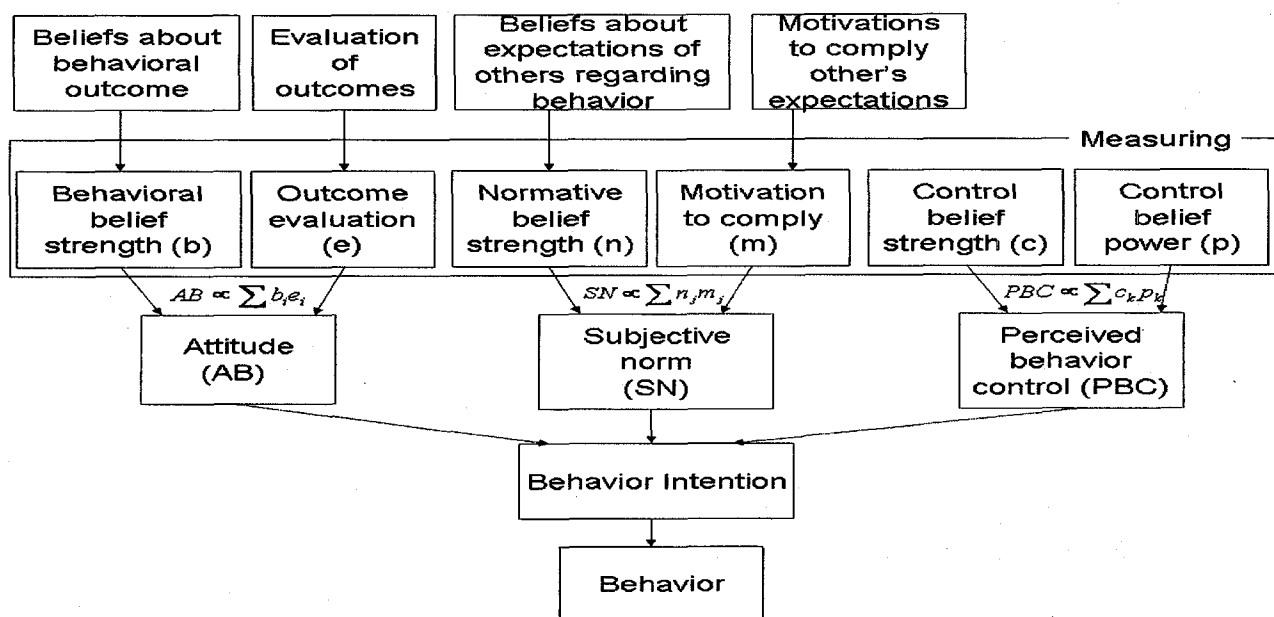


Fig.2 Framework of TPB

attitude is the function of behavioral beliefs and evaluation of outcomes. Behavioral belief is one's belief in performing a specific behavior that will lead to a specific consequence. It is behavioral belief strength (b) for practical measurement in Fig.2. And evaluation of outcome is one's assessment of that specific consequence. It is outcome evaluation (e) in Fig.2. Attitude can be estimated by multiplying an individual's behavioral belief of each salient attribute associated with the behavior by his/her evaluation of the corresponding outcome of each salient attribute, and then summing the products for the total set of beliefs.

People turn to particular groups for their standards of judgment. Any person or group served as a reference group could exert a key influence on an individual's beliefs, attitudes, and choices (Moutinho⁸, 1987) because an individual may conform to his/her referent group(s). Such conformation is subjective norm (SN in Fig.2), and it consists of concepts or generalizations which guide behaviors. Schiffman and Kanuk⁹ (1983) suggested that different types of referent groups can be identified as a function of an individual's contact with the various groups. Subjective norm is determined both by an individual's normative belief strengths (n in Fig.2) about what others who are most important to him/her think he/she should do and the extent of motivation (m in Fig.2) to which the individual wants to comply with what his/her referents think (Ajzen & Fishbein, 1980). That is, subjective norm is social in nature in which the consideration of whether he/she should perform an act is based on the opinions of the people important to him/her and on perceived social pressure to behave in a particular way (Hee⁰, 2000). Numerically, subjective norm can be predicted by using an index produced by multiplying normative belief strength by the corresponding motivation to comply.

Perceived behavioral control (PBC in Fig.2) is about how easy or difficult an individual thinks it is to perform a behavior. It comprises the control belief strength (c in Fig.2) and perceived behavioral control components multiplicatively combined. The proposed relationship between perceived behavioral control and behavioral intention/actual behavior is based on two assumptions. First, an increase in perceived behavioral control will result in an

increase in behavioral intention and the likelihood of performing the act. Second, perceived behavioral control will influence behavior directly to the extent that perceived control reflects actual control (Armitage & Conner¹⁰, 2001). Perceived behavior control is positive related to control belief strength multiplied by control belief power (p in Fig.2) for numerical measurement.

Behavioral intention could be defined as an individual's anticipated or planned future behavior (Swan¹¹, 1981). It represents an individual's expectancies about a particular behavior in a given setting and can be operationalized as the likelihood to act (Fishbein & Ajzen, 1975). According to the TPB, behavioral intention to act in a certain way is the immediate determinant of a behavior (Ajzen, 1985). When there is an opportunity to act, the intention results in behavior; thus, if the intention is measured accurately, it will provide the best predictor of behavior (Fishbein & Ajzen, 1975). In this study, behavioral intention was defined as the acceptance or usage of local residents to the new transit.

Additionally, theories of human behavior hold that the best predictor of behavioral intention and future actual behavior is the frequency of past relevant behavior (Quellette & Wood¹², 1998; Sonmez & Graefe¹³, 1998). One of the possible reasons is that people tend to maintain behavioral persistency and value consistency (Cialdini¹⁴, 1988; Staw¹⁵, 1981). Although TPB has been considered as a valid model for predicting behavioral intention, Quellette and Wood (1998) found that the variance in explaining behavioral intention increased when past behavior was added into the TPB model. In the case study, since HSST is new to most of the residents as a conclusion of the survey. Most people know about HSST or Linimo of Nagoya, but only less than 5% people have tried it. Other researches on the relationship of habits and changing to public transportation (Fujii, Garling, & Kitamura¹⁶, 2001) concluded that most people with habits of using my car were more difficult to change to use public transportation than others. So at the starting of this study, more attention is paid to the relationship among the other three aspects and the acceptance of the new transit.

3. Planning System for Transportation and Related facilities

People realize different social activities based on transportation and land use. Generally speaking, transportation system can be divided to two groups: hardware including transportation facilities, and software like kinds of transportation policies. Land use includes zone creation or redevelopment projects. Private and public sectors cooperate in most projects. Improvement of transportation facilities and development of urban facilities has close relationship with the activation of social and economical activities. The systematic frame is shown in Fig.3. Understanding the systematic frame including transportation system and land use will help us to establish an effective project planning system to improve residents' life quality as the final target.

Many researches have been done by behavior simulation to analyze the human activities, like travel behavior and consumption behavior. Behaviors can be defined by OD data, time and so on. In the past study, the traffic behaviors and shopping behaviors were simulated by Yamada, K. & Haruna, M.¹⁷⁾ (2000). The effective and practical hybrid model analysis method for planning and designing traffic facility was developed to release the traffic congestion caused by visitors to large scale shopping center in the district around the shopping center.

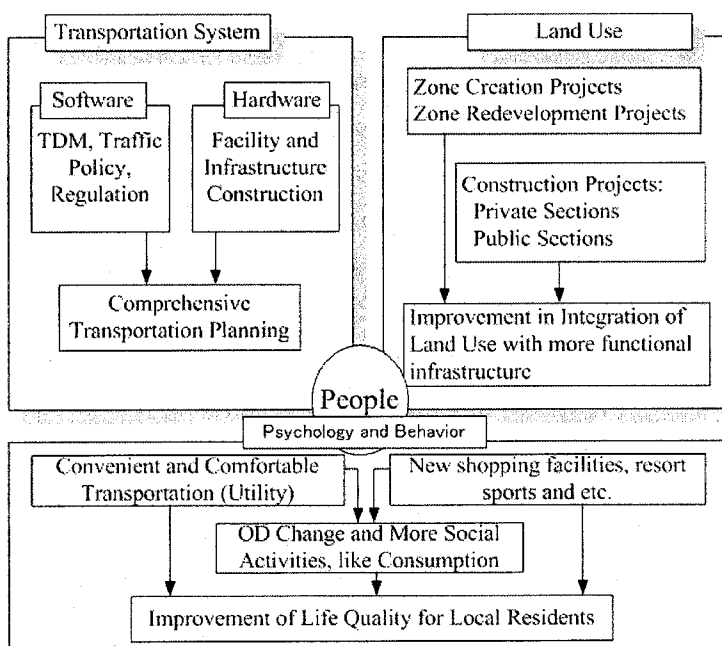


Fig. 3 System Structure

Furthermore, from social psychological viewpoints, we can know what factors have influence on behavior deeply. In this study, we are trying to analyze the phenomena from social psychology prospect. The Structure Equation Model (SEM) result of chosen factors related to transportation was concluded in the following part. The utility function for residents and other visitors will be defined based on the frameworks of social psychology. We assume that when people get satisfied, they will take consumption behavior, support behavior (investment), and immigration behavior. And these behaviors will contribute a lot to the urban development and construction of such facilities. So, we define maximizing the utility of people as the objective function in optimization model. Furthermore, there will be many constraints to ensure the feasibility of the construction from physical conditions including area, financial conditions including total budget and so on.

To judge how much people get satisfaction, it follows the expectance theory, which regards the satisfaction as the distance from expected level to real level. In the simulation model, planning alternatives are assumed to be constructed thoroughly, that's to say, planning alternatives represent the real level. Then we can predict roughly the proportion of satisfaction, which will help to the prediction of the volume in consumption, investment and immigration. The effect of each planning alternatives will be simulated and they will be feedback to the optimization model to tell us the

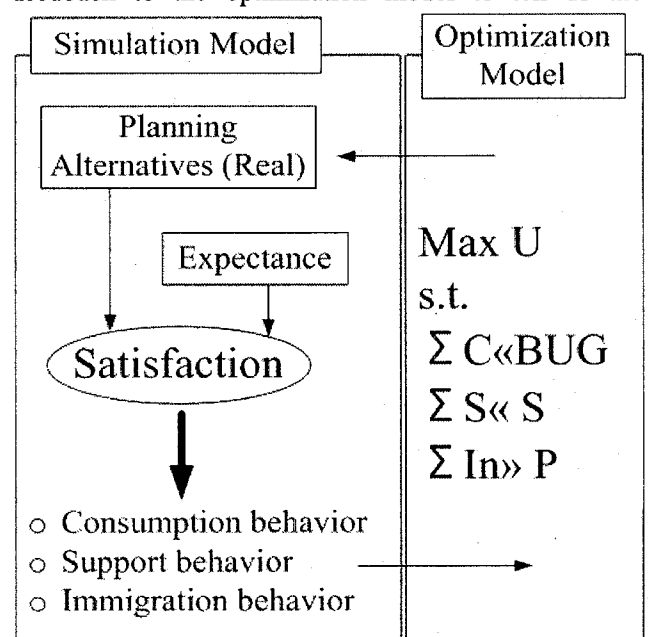


Fig.4 Hybrid Planning Model

direction to modify the plan. The simulation model and optimization model can be incorporated into such a cycle mechanism. We defined it the hybrid modeling system or hybrid planning system, as shown in Fig.4. However, the expectance can hardly be satisfied at the first time. There will usually be a process of improving satisfaction level step by step. We design several stages to plan the implementation of the construction from new transit, and step to wide urban plan including related facilities.

However, this article is just the starting of the whole systematic research. Chapter 4, 5 give the model based on TPB, which proves the land use stills the most influential fact for people in local area to decide the travel pattern. Following this information, Chapter 6 makes the case study of a sports center nearby the station, using opinion poll to conclude utility function. The article wants to to propose the planning process or methodology involving social psychology analysis and caring residents' preference.

4. Modeling based on TPB

Based on TPB, the questionnaire was designed. At first, 41 copies were collected as pilot survey. Later, 1000 questionnaire were distributed in research area. 165 were collected and 152 were verified as usable, including 70 female (46.1%) and 82 male, with the average age of 51.74. Due to the difficulty of the questionnaire on psychology, the number of reply is not bad. Those who attended the survey were greatly appreciated for their contribution. In brief PT questions, four kinds of trip were asked: for commuting to school and work, for dairy goods, for non-dairy goods and for leisure. In commuting to school and work, about 45% answer by using my car, the average travel time is 31.1 minutes. In travel for dairy goods, about 60.5% use my car, and the average travel time is 15.1 minutes. In travel for non-dairy goods, about 54.6% use my car, and the average travel time is 29.9 minutes. In travel for leisure, about 45.4% utilize my car, the travel time is too various to count.

The detail of the questionnaire is shown in appendix Table 4. Some measures were done to ensure the effect of the questionnaire. Firstly, since the first HSST line was named Linimo in Nagoya, we used Linimo instead of

HSST in questionnaire to make residents understand easily. Secondly, to avoid consequential effort, we changed the order of each group and asked from negative aspect about some question. Thirdly, each item was designed with a 7 Likert scale, e.g. from strongly disagree to strongly agree. Finally, the questionnaire was well translated into Japanese and revised to Japanese style.

SPSS was applied for descriptive, factor reduction and inferential analysis. Factor analysis (Table1) was performed to reduce the measurements of Behavior Belief. Initially, 12 items were surveyed, which were picked out after pilot survey. To moderate the complexity of final model, these items are divided into three groups according to the result of factor analysis in SPSS. The three groups are named according to their contents by Characteristics of Linimo (marked by BBF1), Facilities related to stations (marked by BBF2) and Characteristics of planed line and stations (marked by BBF3). The cumulative percentage of variance extracted by the two factors is 59.667%, with Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.861, which is higher than the recommended index of 0.60 (Garson, 2001). The Bartlett's Test of Sphericity is 557.595 ($p=.000$). The Cronbach's alpha of the total Scale is 0.845. These indexes can prove that the factor analysis has been well made. However, the item "cheap" (BB3OE3 in Table1) is not quite clear discriminated, since its other loading of F1 is 0.433, which is near to its loading in F2. It is probably because that the assumed price of tickets should be sensitive to different people, which is going to be studied in future survey.

The simulation Structural Equation Model (SEM) is made in Amos 5 (Fig.5). SEM implies a structure of the covariance matrix of the measures. Once the parameters have been estimated, the resulting model-implied covariance matrix can then be compared to an empirical or data-based covariance matrix. If the two matrices are consistent with each other, then the structural equation model can be considered a plausible explanation for relations between the measures. Four common model fit measures are used to assess the model's overall goodness of fit.

- 1) The first one is the relative chi-square χ^2/df . Wheaton et al (1977) suggested a ration of approximately 5 or less as beginning to be reasonable. In most research, however, the chi-square to degrees of freedom rations in the range of 2 to 1 or 3 to 1 are the indicative of an acceptable fit between the hypothetical model and the sample data. For the model in this study, the relative chi-square is 2.321, which is considered to be reasonable.
- 2) The second fit measure is the comparative fit index, briefed as CFI (Bentler, 1990). CFI values close to 1 indicate a very good fit. The CFI of this model is 0.855, which tells that the model concluded can be considered to be good.
- 3) The third one is root mean square error of approximation, called RMS by Steiger and Lind, and RMSEA by Browne and Cudeck (1993). The RMSEA of this model is 0.094. The opinion recognized mostly is that a value of about 0.08 or less for the RMSEA would indicate a reasonable error of approximation and the model with RMSEA less than 0.1 is just acceptable.
- 4) The last one is The Bentler-Bonett (Bentler & Bonett, 1980) normed fit index, briefed as NFI. Since the scale of the fit indices is not necessarily easy to interpret (e.g., the indices are not squared multiple correlations), experience will be required to establish values of the indices that are associated with various degrees of meaningfulness of results. In our experience, models with overall fit indices of less than 0.9 can usually be improved substantially. In this case, the NFI is 0.777. It shows that this model still needs modified to be more practical.

5. Results from TPB Model

From the TPB model shown in Fig.5, attitude, subjective norm and perceived behavior control are found to be related to the intention of acceptance. Congruent with this, analysis of the standardized path coefficients indicated that the influence of attitude to HSST is weaker than those of the other ones.

Based on the findings of the study, a number of salient implications can be derived. Firstly, the PBC contributes the most in explaining the intention of acceptance, although the correlative coefficients between these three components express close relationship. It means that most residents' decision of choosing what kind of travel pattern depends mostly on service time or the station near to the house or the stations on the way to destination. Moreover, the coefficient of the station near to house (CB2P2 in Fig.5) and the stations on the way to destination (CB3P3) is 0.61 and 0.49, fairly significant in the analysis. House and destination are close related to land use. Land use, e.g. construction of new shopping center, will influence passengers' daily shopping destination and the decision in using new transit or not. So in the next section, we provide a case study of planning sports center around one of the HSST stations. It aims to maximize the utility of residents, which is good for attracting residents to use the facility. Then, the connected station may have more passengers according to the first conclusion from TPB model.

Before the study, we assumed that people were provided more alternatives, e.g. bus, railway, my-car, when the transportation facilities or technologies were developed quickly, especially in developed countries or regions. Therefore, transit or bus should pay more attention to the service quality like more comfortable seats and so on. However, it doesn't fit in the situation of local city from analysis, since the basic network or facilities are still not quite enough, not like those of other large urban area such as Tokyo or Osaka, where all kinds of public transportation network are well constructed. The TPB model of Tokyo or Osaka setting is really needed for the comparison.

Secondly, in subjective norm, we investigate the influence from the majority groups to individual travel behavior. The coefficient is 0.85, which is larger than the other two factors in SN group: norm to contribute the environment protection and the media. It means that passengers would like to follow groups in social behavior.

From the direct measurement of attitude, we find Att has higher coefficients between At3, At5 and At2. "Being fast, convenient and economic" are the most important aspects for transit, over "being new and comfortable".

Table1 Factor Analysis Result of Behavior Belief Items

Behavior Beliefs	Fact Loadings	Eigen value	% of Variance	Reliability a
F1: Characteristics of Linimo (BBF1)		4.530	37.747	.753
BB1OE1) Silent and stable	.545			
BB4OE4) IC card which can be used in other facilities	.724			
BB5OE5) Speedy	.669			
BB8OE8) Keep to time table	.764			
BB9OE9) High frequency in rush time	.683			
F2: Facilities related to stations (BBF2)		1.475	12.290	.777
BB2OE2) Equipped with shuttle bus	.683			
BB3OE3) Cheap	.533			
BB10OE10) Desire facilities set up with or within stations	.584			
BB11OE11) Escalate and elevator in stations	.824			
BB12OE12) Parking built near to stations	.720			
F3: Characteristics of planed line and stations (BBF3)		1.156	9.630	.643
BB6OE6) Smooth transfer to JR	.571			
BB7OE7) Station near to your destination	.850			
Total:		7.161	59.667	.845

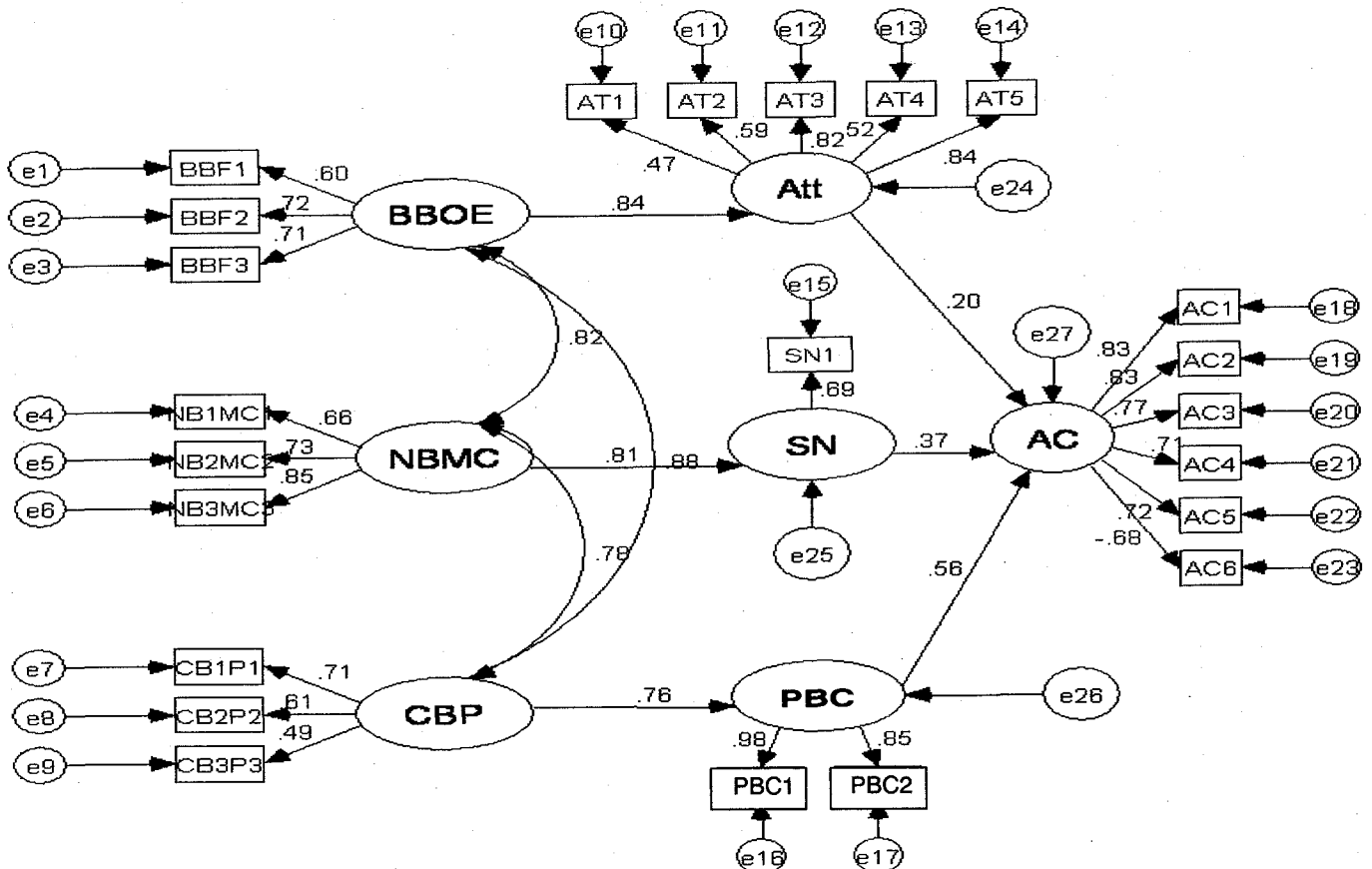


Fig.5 Modeling Result based on TPB

Note: Please refer to Table 4 in the appendix for the meaning that each simplified term stands for. Here, e is the error.

6. Planning Problem of Public Sports Center

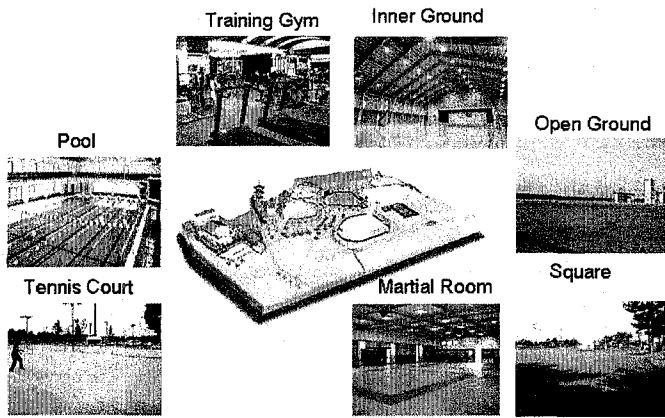


Fig.6 Image of Public Sports Center with 7 Facilities

In the background of the new transit plan, the construction of a public sports center close to one station is discussed in the following parts. The research area is the Seta Park located in Otsu City, as mentioned in the first part, covering 128000 square meters. The area around has been under development for residential zones. So more population are expected to settle there and with the accessibility improved by new transit, the area has a high potentiality to gathering more visitors for activation the nature and land resource.

According to the information collected by pilot survey before, sports facilities are quite needed for residents and students' daily life. The planning problem is set up on sports center for efficient and effective development in research area. On January 22, 2006, 310 sets of questionnaire were distributed and 162 sets (52.2%) were useful. The scale of the sports facilities is chosen as the first item which people care most, followed by surrounding environment as the second and parking as the third and public transportation as the fourth. From the survey, we find the relationship of scale and the satisfaction of each facility by linear regression(β, ε). Also, we conclude the relationship between each facility and the whole satisfaction (α).

Regarding these results, we forward the planning problem to the scales of each functional facility inside the sports center. Mathematical programming with constraints is applied for the optimization, taking the form of Cobb-Douglas¹⁸⁾ function:

$$Y = F(X_1, X_2, X_3, \dots, X_n) = X_1^{a_1} \cdot X_2^{a_2} \cdot X_3^{a_3} \cdot \dots \cdot X_n^{a_n} \\ (0 < a_1, a_2, a_3, \dots, a_n < 1)$$

$$\text{Max: } U = \alpha_0 (u_1)^{\alpha_1} (u_2)^{\alpha_2} \cdot \dots \cdot (u_7)^{\alpha_7}$$

$$u_i = \beta_i \ln X_i + \varepsilon_i$$

U : Total utility

u_1 : Evaluation for ground

u_2 : Evaluation for tennis court

u_3 : Evaluation for multi-functional gym

u_4 : Evaluation for training-gym

u_5 : Evaluation for martial room

u_6 : Evaluation for pool

u_7 : Evaluation for multi-functional ground

$\alpha, \beta, \varepsilon$: parameters

$X_i (1 \leq i \leq 7)$: area for each facility

S.t.

$$\sum_{i=1}^7 X_i \leq A$$

A : Total available area

Table2. Parameters & Coefficients in Formula and Results

Coefficient	a	R Square	
Ground	0.210603	0.725419	
Tennis Court	0.057393		
Multi-functional Gym	0.12274		
Training-Gym	0.138344		
Martial Room	0.06219		
Pool	0.575053		
Open Ground	0.012093		
Constant α_0	0.75504		

Regression	B	e	R square
Ground	3.064757	-23.5759	0.694672
Tennis Court	3.008517	-18.7519	0.719944
Multi-functional Gym	3.857202	-23.1828	0.659983
Training-Gym	4.674358	-20.9026	0.760874
Martial Room	4.199967	-22.5777	0.716216
Pool	3.494538	-15.8555	0.748779
Open Ground	3.114125	-17.5591	0.766838

Total Satisfaction	6.453774
Constraints	20000 m ²

Table3. Optimal Area Distribution Pattern

Facilities	Area (m ²)	Satisfaction
Ground	11986.98	5.207024
Tennis Court	3082.413	5.416881
Multi-functional Gym	2100	6.32359
Training-Gym	350	6.479501
Martial Room	900	5.99217
Pool	625	6.641484
Multi-functional Ground	955.6075	4.811059

In the planning model, seven facilities, which are Ground, Tennis Court, Multi-functional Gym, Training Gym, Martial Room, Pool and Open Ground (shown in Fig.6), are taken as planning variables. Objective is the maximization of the total utility, regarded as the total satisfaction. The multi-regression method is used to get the parameters (shown in Table2) between the utility and the area of each kind of facility, based on the information collected from questionnaires. Table3 shows the optimal pattern concluded from the optimization model. With this area distribution pattern, the public sports center can reach the satisfaction of 6.454.

7. Conclusion

This article is centered on the construction planning of the new transit and related facilities. It starts to analyze the relationship among people's urban activities, transportation and land use from social psychological viewpoint. From it, we can estimate more accurately what is needed by local residents or what can make them satisfied. In the project of construction the new transit, or the People Mover, almost 40% of the total cost will be provided by the prefecture and local governments. So the advice and the attitude to the project from local residents should be taken into account as one of the most important factors. Besides, the satisfaction can induce great influence to the change of life style, which helps to activate the urban activities such as consumption increase, immigration and so on.

The study investigates the applicability of the TPB in a Japanese setting and identified the relationships among various components. TPB, as a social psychological model theory, has been widely used in the analysis of different

human activities, e.g. health care, using of short message. Here, we should not go through without comparing it with the theory named Stated Preference (SP). Since SP is the most popular survey method for predicting the impact of new transportation facilities. SP is based on the microeconomic theory and quantifies the core preference as a utility function, which is invariant over a period and situation. However, it is argued that SP can not predict actual behavioral accurately since it neglects the existence of other behavioral determinants than core preference. While in the application of TPB, we have incorporated the effects of subject norms like media and perceived behavioral control as the chosen factors to explore people's intention of using new transit.

Overall, the TPB model explains well the intention of the residents in Otsu and Kusatsu of accepting the new transit HSST, with the conclusion that most residents' decision of taking what kind of transportation facilities or choosing what kind of travel pattern depends mostly on the accessibility, service time and the position of facilities related to their trip. Furthermore, land use, e.g. constructing public sports center, will influence passengers' decision in using new transit greatly.

The case study also explains the basic method by opinion poll to make facility design and consider based on the residents' preference. We will continue to study the relationship of new transit and other facilities in absorbing visitors to find how much the convenient transportation can support the development of the facility.

Finally, as identified by the four goodness-of-fit parameters, there remains large space for us to improve the performance of the model. In this survey, retired or aged people took up a great proportion as the typical aged society, but could not collect all the necessary information from people of different ages or occupations. In the future study, questionnaire will be performed with students and employees. More contents will be added in, and some new structure will be expanded from the original framework. And finally the systematic hybrid model including simulation model and optimization process is expected to be realized to complete the methodology.

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Appendix

Table 4: Outline of Questionnaire including Terms used in TPB Model

AC) Behavior intention (Acceptance):

AC1) Do you want to use Linimo?

AC2) How often will you use Linimo?

AC3) How do you expect Linimo?

AC4) Do you think it is necessary to build Linimo in Kusatsu and Otsu City?

AC5) Do you think taking Linimo is a good transportation style?

AC6) Do you think that you will not use Linimo?

Att) Attitude:

AT1) Comfortable: Do you think Linimo is comfortable?

AT2) Economic: Do you think using Linimo is economic?

AT3) Fast: Do you think Linimo makes the travel fast?

AT4) New: Do you think Linimo is very new?

AT5) Convenient: Do you think Linimo makes the travel convenient?

BBOE) Behavior beliefs: (BB×OE)

BB1OE1) Silent and stable:

Do you think Linimo is silent and stable? / Is "silent and stable" very important for you to choose travel tool?

BB2OE2) Equipped with shuttle bus:

Do you think Linimo is well equipped with shuttle bus? / Is "being equipped with shuttle bus" very useful for you?

BB3OE3) Cheap: Do you think Linimo is cheap? / Is "cheap" very important for you to choose travel tool?

BB4OE4) IC card which can be used in other facilities:

Do you think Linimo is well set with IC card used also in other facilities? / Is "IC card system" very useful for you?

BB5OE5) Speedy: Do you think Linimo is speedy? / Is "speed" very useful for you?

BB6OE6) Smooth transfer to JR:

Do you think Linimo has smooth transfer to JR? / Is "smooth transfer to JR" very necessary for you?

BB7OE7) Station near to your destination

Do you think station is near to you destination? / Is "station near to the destination" very important for you?

BB8OE8) Keep to time table: Do you think Linimo keeps to timetable? / Is "keep to timetable" very important for you?

BB9OE9) High frequency in rush time:

Do you think Linimo gives high frequency in rush time? / Is "high frequency in rush time" very important for you?

BB10OE10) Desired facilities set up in stations:

Do you think Linimo is well set up the desired facilities in stations? / Is "desired facilities in stations" good for you?

BB11OE11) Escalate and elevator in stations:

Do you think escalate and elevator in station is well equipped? / Is "escalate and elevator in stations" very good for you?

BB12OE12) Parking built near to stations

Do you think parking is built near to the station of Linimo? / Is "parking near to the station" very good for you?

SN) Subjective norm:

SN1) Do you think you are expected to use Linimo by the society?

NBMC) Normative beliefs: NB×MC

NB1MC1) Using public transportation facilities:

Do you think that using public transportation is good for the society? / How much will you follow this subjective norm?

NB2MC2) Following media guide:

The media like TV suggest me to take Linimo? / How much will you follow the media?

NB3MC3) Following groups (other people):

Do you think many people will use Linimo for daily travel? / How much will you follow others to take Linimo?

PBC) Perceived behavioral control:

PBC1) Do you think it is easy to use Linimo?

PBC2) Do you think you can use Linimo freely just as you want?

CBP) Control beliefs: CB×P

CB1P1) Running time suitable for your schedule: Do you think that the proposed running time is suitable for your schedule? / Does "running time suitable for you schedule" make you easy to use Linimo?

CB2P2) Station near your house: Do you think the station is near to you house? / Does "station near to my house" make it easy for you to use Linimo?

CB3P3) Station on your way: Do you think station is on your way to your destination? / Does "Station on your way" make it easy for you to use Linimo?
