An Evaluation method of Quality of Life in Urban Areas Combining "Method of Measuring Satisfaction" and "Dramatizing Method"

Noriyasu KACHI*, Kenichi SUGIHARA, Ikuo SUGIYAMA, Yukihiko YASUE, Hirokazu KATO, Yoshitsugu HAYASHI

*Unit of Sustainable Transport and Spatial Development, Graduate School of Environmental Studies, Nagoya University, Furo-cho, Chikusa-ku, 464-8603, Japan
Tel: +81-52-789-3828, Fax: +81-52-789-3837, E-mail kachi@genv.nagoya-u.ac.jp

Abstract

Urban planning has been evaluated by means of the indicators such as population, population density, productivity of land, traffic volume, environmental load, and so on. However, indicator system including visual elements such as town-scape will be required in order to evaluate urban planning from the viewpoint of Quality of Life

Therefore, the objective of this study is to develop an evaluation method of Quality of Life in urban area combining two complementary methods that are "Method of Measuring Satisfaction" and "Dramatizing Method".

Key words: Satisfaction Measuring Method, Dramatizing Method, Quality of Life

1. Introduction

In developed countries, economic development has reached to its period of saturation together with the increased public awareness on environmental issues and amenity. For the last decades, the role of urban planning had been meeting the claims that includes land use and location for effective industrial activities, quantitative requirement of residential spaces, and so on. However, in the recent years it has changed to focus on the improvement of Quality of Life (QOL) that includes amenity, preservation of nature and environment, safety, town-scape, and so on. This brought about the necessity of the improvement of QOL, which urban planners should realize. Planners and all other stakeholders require to learn the changes in citizens' QOL variations. Therefore, development and implementation process of urban planning require information disclosure and involvement of public and all stakeholders.

It is necessary to evaluate policy instruments of urban planning from citizen's viewpoints in order to grasp improvement of every person's QOL, accompanied with implementation of urban planning. However, it's difficult for residents to evaluate these factors with numerical information including population, traffic volume, housing space, environmental road, and so on, because residents' cannot image specific change of their daily life. Stakeholders and planners require information of changes in citizens' life and improvement of QOL as a result of implementation of urban planning respectively.

In the process of presenting the result of implementation of urban planning to residents, planners should disclose the information with a method that supports citizens with imaging specific change of their daily life clearly and realizing the associated changes in their daily life easily. In this aspect, animation is more clear and easy for residents than numerical information, and then these facts include the aspects of "resident participation", "accountability", and "information disclosure".

Therefore, the objective of this study is to develop "Satisfaction Measuring Method" and "Dramatizing Method", suggests an evaluation method of Quality of Life in urban area combining two complementary methods that are "Method of Measuring Satisfaction" and "Dramatizing Method".

2. Evaluating Urban Planning by combining evaluation of "Quality of Life" and "Dramatizing Method"

2.1. Measuring Satisfaction Method

2.1.1. Changes in Lifestyle and People's Sense of Value

People's attitudes and lifestyles are influenced not only by their social, economic and cultural backgrounds but also by their environment. Clearly this needs to be taken into consideration when imaging the goals of urban regeneration.

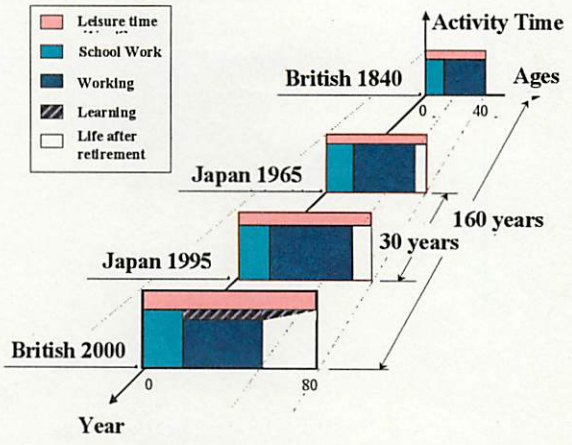


Figure 2.1 Anglo-Japanese Comparison of Lifetime Budget Transition

In Figure 2.1 the rectangle in the background shows the pattern of life in British in 1840, that in foreground shows that of 2000. Two rectangles in the middle show examples for Japan in 1965 and 1995. In the case of Britain the average working life has changed little, while the average life span has increased from 40 to 80 years. Thus today people have more opportunities for activities other than work. This change gives rise to a different way of thinking, namely the weight between quality of life (QOL) components is different from that in Sun Yat Sen's time when economic benefit was dominant in QOL.

2.1.2. Components of QOL and its Measurement

Figure 2.2 shows a methodology, developed by the authors (Hayashi et al., 2003), for measuring QOL based on the satisfaction of an individual with five fundamental components or axes as shown in figure 2.2. Here, QOL is defined as

$$QOL = \sum \lambda_k S_k(X_k) = \sum \frac{\lambda_k}{DS_k(X_k)}$$

where

λ_k : weight of axis k

S_k : satisfaction level of axis k

DS_k : stress level of axis k

X_k : indicators of axis k

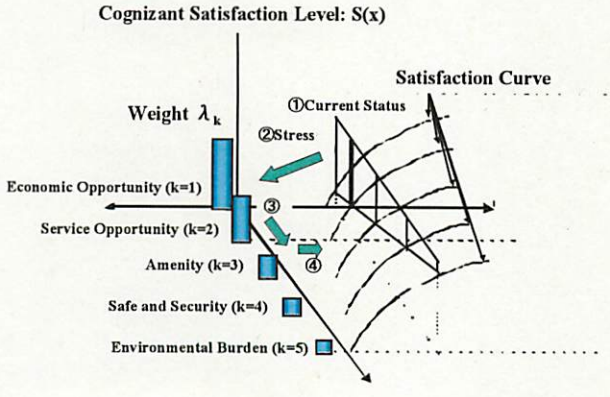


Figure 2.2 Weight Shift towards Environment

The sense of value is defined by the vector of weight λ_k which is obtained as a

substitution ratio between the values of axes. While, satisfaction level S_k is defined as the utility level which is obtained as a valuation of indicator X_k showed in figure 2.3.

As a country becomes mature, the weight λ_k moves from 'economy' towards 'environment'. In other words, a future QOL could be shown by observing the relationship between weights' changes and accumulated stress levels until that time.

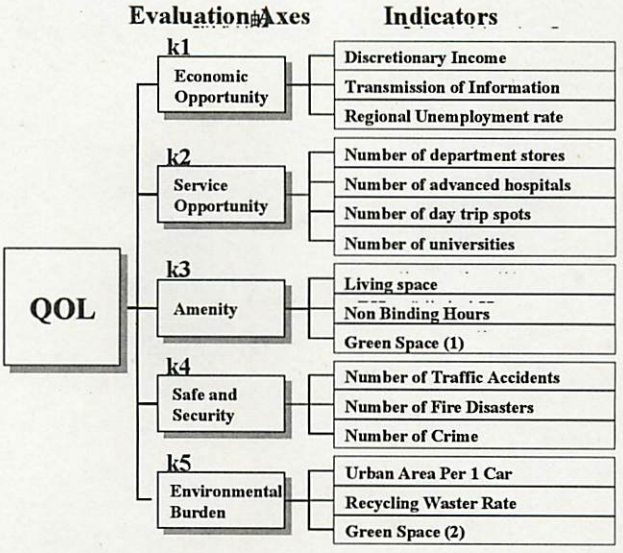


Figure 2.3 Evaluation Axes and Indicators

This process is expressed by the following procedures:

1) Level of stress DS_k is calculated by ideal level S_k^{100}, less the current level of satisfaction S_k obtained from the questionnaire survey.
2) As income grows, the stress $DS_{k=1}$ (axis of economy) diminishes.
3) Accordingly $\lambda_{k=1}$ decreases and the weight of the other axes relatively increases.
4) The vector of weight of axes shifts by these recursive processes.

Thus, the goals of urban regeneration can be set up by foreseeing future QOL.

2.2. Dramatizing Method

2.2.1. Procedure for evaluating Urban Planning by "Dramatizing Method"

Figure 2.4 shows the specific procedure for evaluating urban planning by "DRAMATIZING METHOD". The detail is described below.

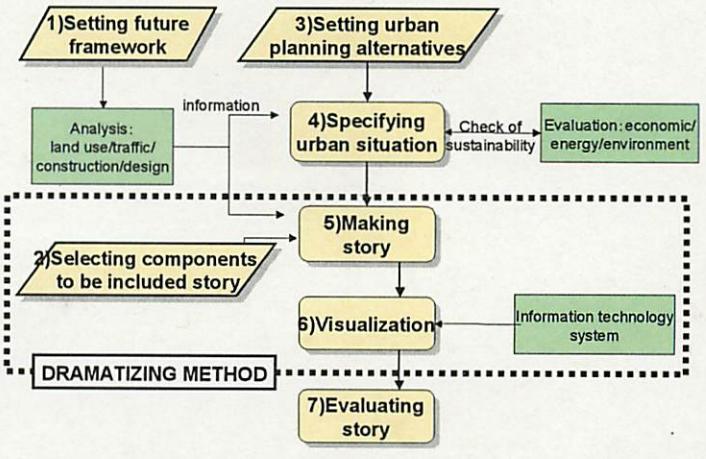


Figure 2.4 Procedure for evaluating urban planning by "Dramatizing Method".

1) Setting future framework

The components expressing urban situation are forecasted based on dormitory population, which is a fundamental approach in Urban Planning, given as a scenario previously.

2) Selection of the component to be included in "Drama" animation

There are two specific notes in terms of dividing daily life to each part which comprising it. In this study each part is named "scene", and "DRAMA" animation is the combination of these scenes. The fact is to select the scenes that are changed

accompanied with implementation of urban planning such as town-scape because this study considered evaluating urban construction. The other is that it's necessary to select daily life pattern of typical personal attribute because daily life pattern is very dependent of each person's attribute preciously.

3) Setting of urban planning alternatives

The distribution of dormitory population is given as urban planning alternatives, and the distribution of daytime population is estimated by macro commerce and service location model because daytime population is expressed by the distribution of dormitory population and the state of traffic infrastructure. In addition, land use patterns in each district are estimated based on the distribution of dormitory and daytime population.

4) Specification of urban situation in each alternative

They are estimated by each model that specific design of building and underground space, various activities such as traffic, energy consumption, and environmental load.

5) Making daily life story in each urban planning alternatives

The changes of the scenes selected in phase 2) are estimated by urban situation determined in phase 4), and then daily life story is determined by combining the each scene.

6) Visualization of daily life story

The daily life story determined in phase 5) is visualized.

7) Evaluation of daily life story

The daily life stories are disclosed on the Internet. The respondents access the homepage and evaluate the each story after seeing them.

2.2.2. Framework of "Dramatizing Method"

Figure 2.5 shows the procedure of "Dramatizing Method". The detail is described below.

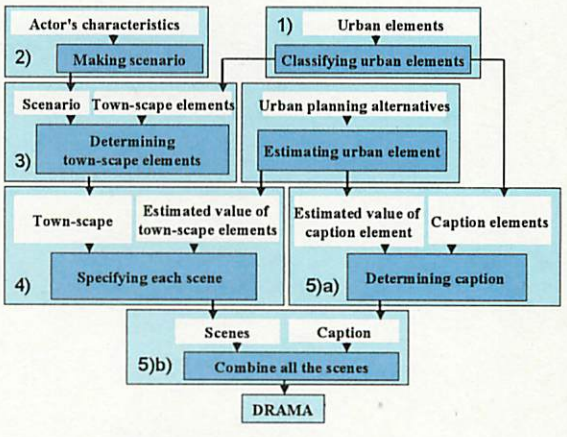


Figure 2.5 "Dramatizing Method" framework

1) Classification of urban elements

In this phase, urban elements are classified to "town-scape elements" and "caption elements". "town-scape elements" are elements that can be expressed by animations such as urban situation, traffic volume, "Caption elements" are elements that should be represented such as tax, environmental load, although they cannot be expressed by animations.

2) Assumption of actor's characteristics and behavioral pattern

In this phase, actor's characteristics such as age, sex, residence, office place, are assumed to make actor's daily life pattern (scenario) which makes it possible

"DRAMA" animations of the sampled resident's daily life style.

3) Determining town-scape elements

In daily life "DRAMA" animations with successive scenes, it's necessary to express urban situation that changes by implementation of urban planning alternatives. Therefore, it's necessary to specify town-scape elements determining the each scene. This makes it possible to eliminate scenes that are not relevant to town-scape elements for exclusion of "DRAMA" animation maker's individual way of thinking.

4) Specification of each scene by estimating town-scape elements

The each scene is specified by estimating town-scape elements, and visualized from viewpoint of residents.

5) Sequencing all scenes

This phase makes "DRAMA" animations in each scenarios a) inserting caption elements as numerical information are necessary and b) arranging all scenes.

2.3. Merits and demerits of two methods

To evaluate Quality of Life changing along with implementation of urban planning, it is preferable that residents of a city where urban planning implemented simulate their daily life in the urban space changed along with implementation of urban planning. However, it is impossible to create urban space changed along with implementation of urban planning.

Therefore, Satisfaction Measuring Method calculates Quality of Life from the indicators representing urban contexts changed along with implementation of urban planning and the residents' sense of value. And Dramatizing Method creates urban space changed along with implementation of urban planning by computer graphics and makes the residents simulate their daily life in the urban space changed along with implementation of urban planning by exhibiting the animation of their daily life like television dramas and make the residents evaluate Quality of Life directly.

Satisfaction Measuring Method has a fundamental problem that the elements of Quality of Life are defined arbitrarily by researchers and cannot evaluate elements other than them. In addition, it is difficult to evaluate visual elements such as landscape by this method. However, Dramatizing Method solves a problem that the elements of Quality of Life are defined arbitrarily by researchers and can evaluate visual elements such as landscape.

On the other hand, Dramatizing Method represents a part of urban contexts changed along with implementation of urban planning, for example, visual elements of Quality of Life such as landscape, and it is difficult to represent other elements. However, Satisfaction Measuring Method can consider all possible urban contexts by statistics representing urban contexts.

Therefore, combining these two methods makes it possible to compensate for each demerit. In particular, Dramatizing Method can compensate for the lack of visual elements such as landscape in Satisfaction Measuring Method.

3. Case study for Nagoya city

This case study uses urban planning alternatives in project of Nagoya Industrial Science Research Institute.

3.1. Introduction of the case study

3.1.1. City chosen for case study

This case study examines Nagoya city zone (it is radius of 20km within the circle centering on center of Tokyo) and target year is 2020.

3.1.2. Alternatives

This case study uses population distribution scenarios as urban planning alternatives, within three different scenarios; 1) BAU (Business As Usual): Population distribution changes with current trend, 2) Concentration in vicinity areas of Rail-interchanges: Each characteristic population distributes in the existing vicinity areas of rail-interchanges, 3) Concentration in city center: Concentrated population in city center developed in the future.

3.1.3. Contents of urban element used in this case study

The main contents of urban element used in this case study are 1) Traffic volume: based on generation/aggregation traffic in city center, 2) Daytime population: based on estimating employee population, 3) Shape of building: volume model calculated by as a result of estimating the required floor area.

3.2. Making "DRAMA" animations

3.2.1. Classification of urban elements

Table 3.1 shows the result of classifying urban elements to "Scene determining elements" and "Caption elements".

Table 3.1 Classification of urban elements

Town-scape elements		Caption elements
・Population	・Passenger traffic volume	・Environmental load
・Production	・Fleight traffic volume	・Construction cost
・Pop. of station influenced sphere (S.I.S)	・Park & Ride	・External cost
・Floor area of S.I.S	・Parking in city center	・Investment
・Location of residence	・Demanded floor area	・Tax
・Location of office	・Building design	

3.2.2. Assumption of actor's characteristics and behavioral pattern

In this case study, respondents are university students. Table 3.2, 3.3 show the result of assumed actor's characteristics and behavioral pattern, living in Hongo (Suburb).

Table 3.2 Actor's characteristics

Occupation	Student
Age	19
Sex	male
Residence	Hongo(Suburb)
Office	University: Chikusa Part time job: Sakae(City center)

Table 3.3 Daily life pattern

Time	Behaviour	Place
6	Rest	Hongo(Residence)
7		
8		
9		
	Breakfast	
10	Commuting	Hongo-Chikusa
11	University	Chikusa
12		
13		
14		
15		
	Commuting	Chikusa-Sakae
16	Shopping	Sakae
17	Part time job	
18		
19		
20		
21		
22		
	Returning home	Sakae-Hongo
23	Rest	Hongo(Residence)
24		

3.2.3. Determining town-scape elements

Table 3.4 shows relationship between scenes and town-scape elements. After eliminating scenes that are relevant to town-scape elements, three scenes are selected.

1) 16:00 ～ 18:00 shopping (downtown: Sakae): actor walking and shopping at downtown in Sakae

2) 22:30～22:40 return home (to station): actor walking from part time job office to station on the way to home

3) 22:40 return home (platform of station): view from platform of station

Table 3.4 shows specific town-scpae elements of these three scenes. 1)～3) are scenes described in table 3.5.

Table 3.4 Example of town-scape elements' value

Town-scape element	Shape of city	Traffic Volume		Population		
Factors dependent on Town-scape element	Shape of city	Pedestrian (Downtown) [Sakae]	Pedestrian (Commuting) [Sakae]	Pedestrian (Downtown) [Sakae]	Pedestrian (Commuting) [Sakae]	Station [Sakae]
Senario		Vehicles (vehicles)		Pedestrian (persons)		People in platform (persons)
Scenario-1	Model-1	6	3	6	6	7
Scenario-2	Model-2	6	3	6	6	9
Scenario-3	Model-3	6	3	16	16	9

Table 3.5 Urban elements relevant to each scene in "DRAMA" animation

Time	Scene	Urban situation to be represented	Urban elements											
			Population	Production	Population of station influenceds phere(SIS)	Floor area of SIS	Location of residence	Location of office	Passenger traffic Volume	Freight traffic volume	Park&Ride	Parking in city center	Demanded floor area	Buildings design
9:00	Home [Hongo]	Room size	○		○	△	○						△	△
		View through window	○		○		○	△	○	○			△	△
9:50	Walk to station [Hongo]	Conjgestion of sidewalk	○		○		○	△						
		Conjgestion of road	○						○	○	△	△		
		View	○		○		○	△	○	○			△	△
10:00	Station[Hongo]	Conjgestion of subway	○		○		○	△	○		△	△		
		Conjgestion of concourse	○		○		○	△	○		△	△		
		Conjgestion of platform	○		○		○	△	○		△	△		
	Train [Hongo～Chikusa]	Conjgestion of subway	○		○		○	△	○		△	△		
		View	○		○		○	△	○	○			△	△
10:20	Walk to University [Chikusa]	Conjgestion of sidewalk	○		○		○	△						
		Conjgestion of road	○						○	○	△	△		
		View	○		○		○	△	○	○			△	△
10:30	University [Chikusa]	Room size	○		○	△	○						△	△
		View through window	○		○		○	△	○	○			△	△
15:30	Walk to station [Chikusa]	Conjgestion of sidewalk	○		○		○	△						
		Conjgestion of road	○						○	○	△	△		
		View	○		○		○	△	○	○			△	△
15:40	Station[Chikusa]	Conjgestion of subway	○		○		○	△	○		△	△		
		Conjgestion of concourse	○		○		○	△	○		△	△		
		Conjgestion of platform	○		○		○	△	○		△	△		
	Train [Chikusa～Sakae]	Conjgestion of subway	○		○		○	△	○		△	△		
		View	○		○		○	△	○	○			△	△
16:00	Shopping (Citycenter) [Sakae]	Conjgestion of sidewalk	○		○		○	△						
		Conjgestion of road	○						○	○	△	△		
		View	○		○		○	△	○	○			△	△
18:00	Parttime job [Sakae]	Room size	○		○	△	○	△					△	△
		View through window	○		○		○	△	○	○			△	△
22:30	Return home (way to station) [Sakae]	Conjgestion of sidewalk	○		○		○	△						
		Conjgestion of road	○						○	○	△	△		
		View	○		○		○	△	○	○			△	△
22:40	Return home (station platform) [Sakae]	Conjgestion of subway	○		○		○	△	○		△	△		
		Conjgestion of concourse	○		○		○	△	○		△	△		
		Conjgestion of platform	○		○		○	△	○		△	△		
	Train [Sakae～Hongo]	Conjgestion of subway	○		○		○	△	○		△	△		
		View	○		○		○	△	○	○			△	△
23:20	Walk to home [Hongo]	Conjgestion of sidewalk	○		○		○	△						
		Conjgestion of road	○						○	○	△	△		
		View	○		○		○	△	○	○			△	△
23:30	Home[Hongo]	Room size	○		○	△	○						△	△
		View through window	○		○		○	△	○	○			△	△

○ considered in this study
△ necessary to consider (not considered in this study)

3.2.4. Combining all scenes

Based on daily life pattern specified in the above section, all scenes are emerged considering time assignment of each scene, and "caption elements" is inserted in the last of "DRAMA" animations. In addition, the title of "DRAMA" animations and the literature information are inserted as supplementary explanations. The title of "DRAMA" animation includes the name of urban planning alternative and its outline with the background of three-dimensional image of population distribution. (Figure 3.1) The information, that includes the purpose of action, time zone, place, is easy expression for understanding of respondents but should be paid attention not to interrupt seeing

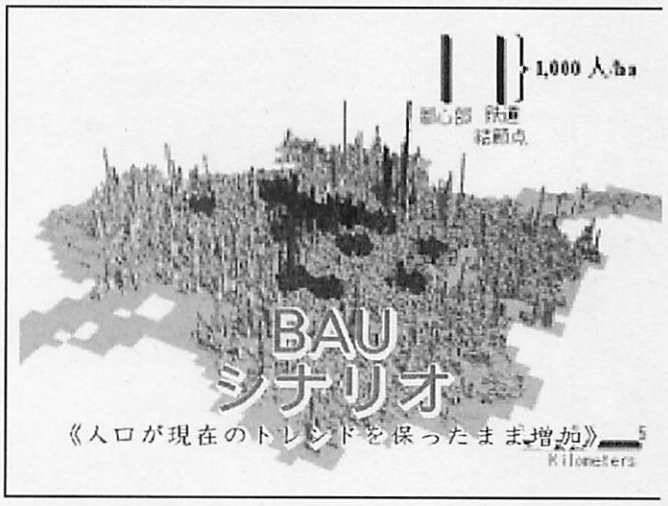


Figure 3.1 Example of title of "DRAMA"

"DRAMA" animations.

3.2.5. "DRAMA" animations

Figure 3.2 shows "DRAMA" animations in each scenario. In the scene of shopping and going to station, shape of city, population and traffic volume are represented as volume model, pedestrians, moving cars respectively. There is clear difference in population represented as pedestrians. However, there are no clear differences in shape of city and traffic volume represented by volume model, moving cars respectively.

In the scene of platform, shape of city, population and traffic volume are represented as volume model, pedestrians, moving cars respectively. After seeing all "DRAMA" animations, "caption element" that includes emission of CO2, NOX is presented as bar

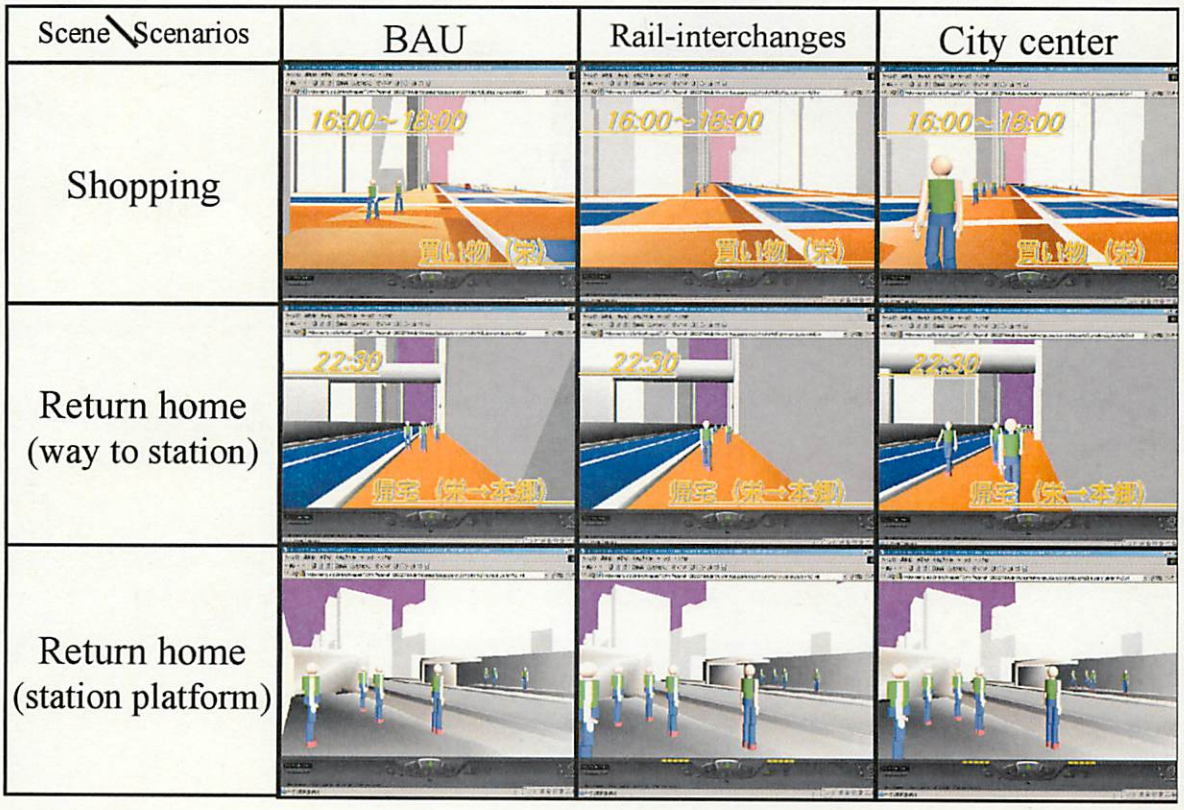


Figure 3.2 Example of scene in "DRAMA"

graph to respondents. (Figure 3.3)

The presentation of "DRAMA" animation considers that the same total time is appropriate for respondents to understand difference between each scene and not to be boring. (Table 3.6)

3.3. Questionnaire

3.3.1. Procedure of questionnaire

Questionnaire is carried out to investigate whether respondents feel change of Daily life as a result of seeing

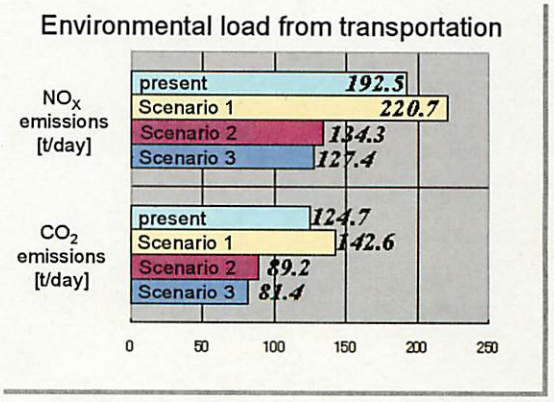


Figure 3.3 Caption element

"DRAMA" animations. Procedure of questionnaire is the following;

1) Explanation of "DRAMA" animations, and urban planning alternatives

2) Presentation of "DRAMA" animation

3) Questionnaire

Table 3.6 Assignment of time in "DRAMA" animation

Scene	Time
Title	7 sec.
Pedestrian (Downtown) [Sakae]	31 sec.
Pedestrian (Commuting) [Sakae]	30 sec.
Station [Sakae]	11 sec.
Sub total	1min. 19 sec.
(1 min 19 sec) × (3 dramas) =	3 min. 57 sec.
Caption element	13 sec.
Total	4 min. 10 sec.

3.3.2. Contents of questionnaire

Purpose of questionnaire is evaluation of satisfaction and grasping influence of each scene on evaluation. Respondents are twelve university students who live in Nagoya to match actor assumed in "DRAMA". Contents of questionnaire are;

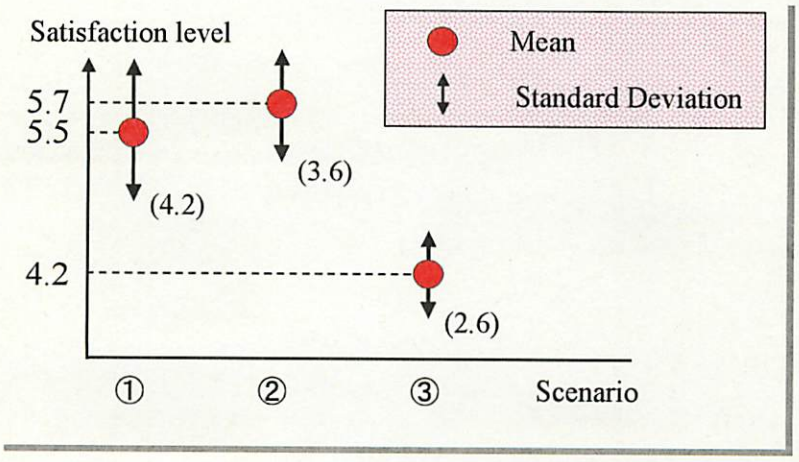
1) Marking each scenario (urban planning alternatives) with maximum mark is ten.

2) Checking impressive scenes affecting evaluation

3.3.3. Result of questionnaire

3.3.3.1. Satisfaction level of each scenario

Figure 3.4 shows satisfaction level of each scenario as a result of questionnaire. Mean and standard deviation are almost same value in scenarios of BAU, and concentration in vicinity areas of rail-interchanges. However, they are extremely smaller value in city center concentration scenario than other two scenarios. It's concluded that almost respondents remark smaller value in city center concentration scenario.



①: BAU, ②: Concentration in vicinity area of Rail-interchanges, ③: Concentration in city center

Figure 3.4 Result of questionnaire (Satisfaction level)

3.3.3.2.Expressive scenes affecting evaluation

Table 3.7 shows summarized the scenes for evaluation, and it can clearly be seen that several respondents check scenes in city center concentration scenario. In each "DRAMA" animation, number of pedestrians is only represented. Comparing population in table 3.5, 3.7, several respondents feel that scenes in which large proportion of population play a role in their evaluation. Because all respondents mark lower value in city center concentration scenario than other two scenarios, it's concluded that residents can feel difference of Quality of Life in "DRAMA" animations.

Table 3.7 Result of questionnaire (Number of scenes influencing evaluation)

Scene / Scenario	Shopping	Return home (to station)	Return home (platform)
①BAU	2	1	1
②Rail-interchanges	1	3	3
③City center	5	9	6

4. Conclusion

This study develops "Satisfaction Measuring Method" and "Dramatizing Method" as a new method for evaluating urban planning alternatives with the viewpoint of Quality of Life. In addition, the merits and demerits of each method are examined and it is suggested that two methods compensate for their demerits each other. Thus, the procedure of "Dramatizing Method" as a method compensating for the demerits of "Satisfaction Measuring Method" is described. "Dramatizing Method" makes it possible the followings.

1) Exclusion of "DRAMA" maker's individual way of thinking

It's important to select only the scenes that is relevant to town-scape elements before making "DRAMA" animation. Therefore, the scenes, which are less relevant to town-scape elements, should be eliminated since exclusion of "DRAMA" maker's individual way of thinking, and "DRAMA" maker can make "DRAMA" animation efficiently.

2) Considering individual viewpoint

It's important to makes "DRAMA" animation form the citizen's viewpoint as the height of eye, because Quality Of Life such as amenity, preservation of nature and environment, safety, town-scape are relevant to urban situation that residents can see and pass through.

3) Clearly expressing tool by animations other than presentation with numerical information

The process of urban planning requires information disclosure and dissemination

from planners to stakeholder and public involvement from stakeholder to planners. It's necessary to use clearly expressing tool by animations other than presentation with numerical information, for planners to get the information about improvement of Quality Of Life accompanied with implementation of urban planning. "DRAMATIZING METHOD" makes it possible to show residents the change of urban situation by implementation of urban planning with animation clearly.

Nagoya case study proves efficiency of "DRAMATIZING METHOD" as a new method for evaluation of urban planning alternatives. The result of questionnaire describes 1) Difference of satisfaction in each "DRAMA" animation, 2) Difference of amounts of expressive scenes, which means that respondents can feel difference of daily life from "DRAMA" animation.

References

Yoshitsugu HAYASHI, Ikuo SUGIYAMA (2003): De-Suburbanization and Social Capitalization, Dual Strategies for the Environmental and Financial Goals of Sustainable Cities, Special Issue of Built Environment "Sustainable Cities - Transport and Development"

En-Mi Lim and Tsuyoshi Honjo (2003): Three-dimensional visualization forest of landscapes by VRML, Landscape and Urban Planning Vol.63, Issue3, pp.175-186

Tsuyoshi Honjo and En-Mi Lim (2001): Visualization of landscape by VRML system, Landscape and Urban Planning Vol.55, Issue3, pp.175-183

Andreas Muhar (2001): Three-dimensional modelling and visualisation of vegetation for landscape simulation, Landscape and Urban Planning, Vol.54, Issues1-4, pp.5-17

Eihachiro Nakamae, Xueying Qin and Katsumi Tadamura (2001): Rendering of landscapes for environmental assessment, Landscape and Urban Planning, Vol.54, Issues1-4, pp19-32

Stephen R. J. Sheppard (2001): Guidance for crystal ball gazers: developing a code of ethics for landscape visualization, Landscape and Urban Planning, Vol.54, Issues1-4, pp.183-199

Takashi Yamamoto and Shin Yoshikawa (2003): Three-dimensional urban modeling for cityscape simulation, The 8th International Conference on Computers in Urban Planning and Urban Management, pp.241-242

Kenichi Sugihara and Yoshitsugu Hayashi (2003): 3-D Urban model by automatic generation and its application, The 8th International Conference on Computers in Urban Planning and Urban Management, pp.215-216