THE PLANNING OF THE COMMUNITY TRANSPORT FROM THE VIEWPOINT OF WELL-BEING: APPLING AMARTYA SEN'S CAPABILITY APPROACH

Hiroto INOI
Research Associate
Graduate School of
Osaka University
2-1 Yamadaoka, Suita city, Osaka pref.,
565-0871 Japan
Fax: +81-6-6879-7609
E-mail: inoi@civil.eng.osaka-u.ac.jp

Yasutsugu NITTA
Professor
Graduate School of
Osaka University
2-1 Yamadaoka, Suita city, Osaka pref.,
565-0871 Japan
Fax: +81-6-6879-7609
E-mail: nitta@civil.eng.osaka-u.ac.jp

Abstract: Community transports are strongly required, to improve well-being of residents by enhancing mobility of residents, especially elderly people under poor public transport service. But in evaluating community transport, the viewpoint of to improve well-being has been rarely considered. In this paper evaluation is done according to the one of most remarkable theory of evaluating improvement of the well-being, called "Capability Approach" of Amartya Sen (Nobel Prize winner for economic, 1998). In this approach it is evaluated by the width of options of life. By being possible going out, community transport expands the capability. It measures whether capability is improving or not and equally or not.

Key Words: Local transportation planning, Evaluation methodology

1. INTRODUCTION

In Japan the buses on the routes were supplied in commercially. By motorization the number of users of bus has been declining.Then some the buses on the routes had been abolished. Those who cannot drive a car encounter difficulties to live in the place where they have lived because it becomes impossible to buy a thing required for daily life. Recently some Japanese local governments start to provide community transports in both rural and urban areas, in order to enhance the mobility of residents, mainly focused on elderly people under poor public transportation services. Most of them are suffering from fewer passengers and low cost-efficiency. So they are discussed to be abolished. Of cause it is necessary to examine how to increase the bus users. But it is more important to evaluate what kind of effect can be had on the well-being of residents, in evaluating the community transport.

Evaluating community transport in this paper is done according to the one of most remarkable theory of evaluating improvement of the well-being, called the "Capability Approach". This theory is advocated by Amartya Sen.

The main purposes are as following:

*To review the concept of "Capability approach". And to make it clear how to what is useful for evaluating community transport.

*To identify the main functions relating to Capability.

*To develop an evaluation method on Capability incorporating the change of quality of each function corresponding to transportation service change.

*To apply this evaluation method of the community bus service.

The purpose of community transport is to offer the opportunity to be able to live well to those

who are not provided with sufficient services by the present traffic system. It must be evaluated the degree to which community transport contributes to improvement in "well-being". Amartya Sen (Sen, 1995) pointed out the problem in evaluating well-being only from the viewpoint of "goods" and "utility". And he argued that well-being should be evaluated not only from these viewpoints but also in a width of option of life, which is called "Capability" by Sen.

2. OUTLINE OF THE "CAPABILITY APPROACH"

Capability Approach is summarized in three points shown below.

First: People's condition is evaluated using Capability, capability means the width of options of life. Capability is regarded between "goods" and "utility."
Sen pointed out the faults about the approach using utility, by explaining with some examples. In existence way of evaluation, "Satisfaction" and "complaint" can be selected as substitute for utility. But "Satisfaction" and "complaint" are subjective, so it might lead wrong conclusion. For example, there are two men. A man is poor and hungry and the other man is rich and with his stomach full. If the meal ticket is delivered based on a complaint, you would have to give the ticket to the rich man, because he complained strongly. And the poor man could not get out of hungry.
Sen pointed out the faults about the approach using "goods" too. To evaluating based on "goods", it is ignored that disabled people must pay much more than non-disabled people in order to get the same benefit. For example, disabled people have to use expensive taxis even for very short trips. Non-disabled people can walk easily in such cases.

Sen insists that "well-being" must be evaluated from the expansion of "capability", which expresses the set of "the range of options of life which people can choose". However, "the range of options of life which people can choose" is infinite. For practical evaluation "functioning" should be used in evaluation. "Closely related to the notion of functionings is that of *capability* to functioning. It represents the various combinations of functionings (beings and doing) that the person can achieve. Capability is, thus, a set of vectors of functionings, reflecting the person's freedom to lead one type of life or another." (Sen, 1991)

In short functioning stand for freedom in people's various states (such as levels of health or wealth, and actions like eating, walking and so on). People combine several kinds of functioning from the set of functionings from which they can choose when they spend their time living. Capability means this set of functioning which they can choose.

Moreover, Sen insists that non-consequentialist principles should be respected. Because It is because the surroundings should not force the way of life which the person himself/herself does not desire however it may be a good way of life. So evaluation has to done according to not what he/she have achieved, but what option he/she can select.

3. METHODOLOGY

3.1 EVALUATION METHOD REFERRING TO CAPABILITY APPROACH
The purpose of community buses is to offer services which were not offered by commercial

buses. The operating cost of community buses is usually higher than the income from passenger fares. Deficits will be compensated by local governments in many cases. The capability approach will be expected to give a basis to the reason for government subsidies to community buses.

We insist that the main purpose of community bus services is to prevent residents' unhappiness and improve their well-being. From this viewpoint, the capability approach is introduced to evaluate the service of community bus.

3.2 DEFINITION OF THE CAPABILITY INDEX

In order to evaluate the potential to achieve each functioning by each individual comprehensively, the following equation is defined.

$$e_i = W * A_i \tag{eq.1}$$

e_i : the index of opportunity set of comprehensive achievement of functioning by each individual i,

W : the vector of weight set of functioning,

$$W = (w_1, w_2, w_3 \cdots w_n)$$

w_j : the element of vector W for functioning j   ($0 <= w_j <= 1, 1 <= j <= n$),

A_i : the vector of opportunity set to achieve functioning,

$$A_i = (a_{i1}, a_{i2}, \cdots a_{in})$$

a_{ij} : the element of vector W for functioning j   ($0 <= a_{ij} <= 1, 1 <= j <= n$), and

$$a_{ij} = \begin{cases} 0 : \text{impossible for } i \text{ to achieve the functioning j,} \\ 1 : \text{possible for } i \text{ to achieve the functioning j.} \end{cases}$$

The range of e_i is not less than 0 and less than 1. By using this equation, we can estimate the change between the values of e_i before and after the introduction of community buses and evaluate the effect of the buses to each individual objectively.

3.3 HOW TO COMPARE e_i?

To evaluate with only average of capability would make wrong judgment. Because, even if only those who have high capability by natural get higher capability, value of the average of capability increase. Therefore, evaluating with average cannot describe equalizing divergence.

Gini coefficient is suitable for describing the equalizing divergence. But Gini coefficient is not suitable for describing improve or not.

As the result, both of the average and Gini coefficient should be used in evaluating.

The formula of Gini coefficient was shown in eq.2.

$$G = 1 - \sum (X_i - X_{i-1})(Y_i + Y_{i-1}) \tag{eq.2}$$

X_i : the cumulative ratio of individual whose e_i equals with e_i or less than e_i, and

Y_i : the cumulative ratio of e_i

In addition, G takes the numerical value between 0 and 1. Distribution is so equal when G is close to 0. On the contrary, it is unequal when G is close to 1.

4. OUTLINE OF CASE STUDY AND DATA

4.1 OUTLINE OF CASE STUDY

The questionnaire survey has done in Sumoto-city. Sumoto-city is the main city of Awaji-isl. Awaji-isl. has almost same size Singapore. Sumoto-city locate in the bay by the metropolitan city. Property of Sumoto-city is shown in Table 1. And Sumoto-city has 12district shown in figure1.
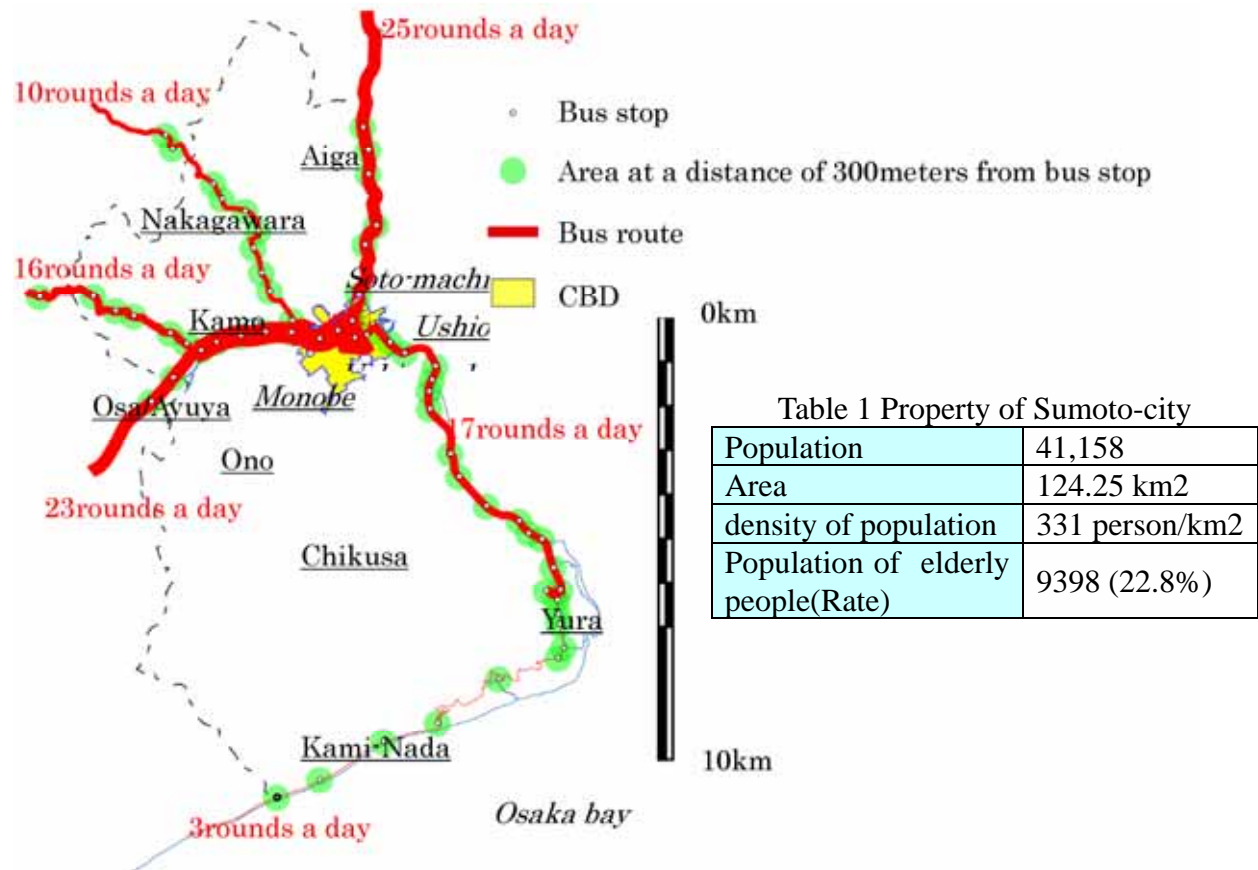
Table 1 Property of Sumoto-city

Population	41,158
Area	124.25 km2
density of population	331 person/km2
Population of elderly people(Rate)	9398 (22.8%)

Figure 1 Geographical Features of Sumoto-city

4.2 ITEMS OF FUNCTIONING

- Level of functioning

When expressing function, it can catch in various stages. Then, the action which people perform was arranged. Fig. 2 shows what kind of relation Functioning becomes. It is an example about "working".

Elderly people's life
- Etc.
- Drawing one's income
  - Etc
  - Winning in a lottery — Etc.
  - Receiving a subsidy — Etc.
  - Working
    - Etc.
    - At construction site
    - At office
      - Etc.
      - Office located in commutable area
        - Etc.
        - Is there enough Commuting allowance
        - Is there accessibility transportation
      - Communication
      - Operation PC
        - Etc.
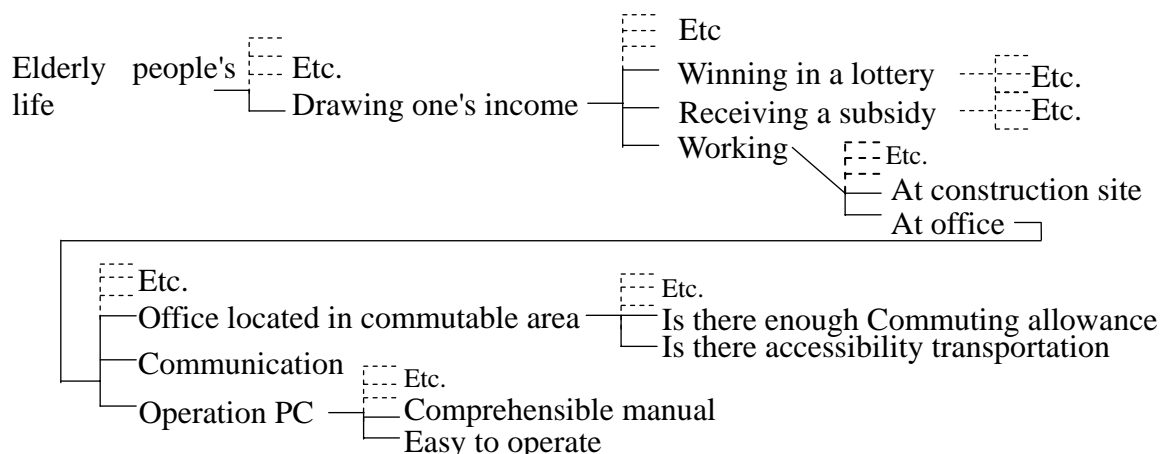   - Comprehensible manual
        - Easy to operate

Figure 2 Hierarchy Diagram of Functioning (example of Working)

In order to achieve the functioning of "office working", the functioning of "operating PC" and "communication" might be required. The former is called the upper ranked functioning and the latter is called low ranked functioning. It is more desirable to examine and specify the upper ranked functioning in order to capture the way of living for each person correctly and comprehensively. However, in order to do that, an enormous survey will be needed. In this paper, as we focus on community buses, the level of opportunity to achieve supposed "activities" was remarked.

- Selection of the items of functioning

These activities are collated by brainstorming about elderly people's everyday lives. Moreover, the list of functionings was checked and modified using ICF (International Classification of Functioning, Disabled and Health). It is impossible to ask all items of activities. Therefore, items were grouped using the KJ method considering the condition of the survey area. Finally, the following table, Table 2 is obtained.

Table 2 Selected Items of Functioning

Visiting hospitals	Hobby and sports
Shopping(daily necessities)	Watching movies and sports
Shopping(except for daily necessities)	Walking and hiking
Working, Volunteer	boarding-out, party
Meeting with family and friend	visiting a grave
Lesson, lifelong learning	Trip

4.3 OUTLINE OF QUESTIONNAIRE SURVEY TO CHECK THE ACHIEVABLE FUNCTIONING

The objectives of questionnaire survey are old man living alone, family of two elderly people and bedridden elderly in Sumoto-city. 3,721 people responded. There are 9,398 elderly people in Sumoto-city. The responses tell the exact situation of Sumoto-city. The outline of the questionnaire is summarized in Table3.

<div align="center">Table3 Outline of Questionnaire Survey</div>

Objectives	Old man living alone, Family of two elderly people, Bedridden elderly	who live in Sumoto city
Date of distribution	April 2003.	
Distribution method	Distributing by visiting home of objectives	
Number of distributed	3,877	
Method of Collection	Collecting by visiting home of objectives	
Date of collection	End of April 2003.	
Number of respondent	3,721	
Rate of answers	96.0%	

- Questionnaire survey sheet

The length of this questionnaire sheet was limited, because this questionnaire surbey was done with some other questionnaires. At the same time, questionnaire sheet was needed to be easy to answer, in order to get the answer from several types of people. Several way to ask functioning which can be achieved was examined. As the result, better way to know functioning which can be achieved under the present situation is to ask functioning which can not be achieved. Because it is easier to imagine and answer for the question "What function cannot you achieve" than "What function can you achieve".

4.4 OUTLINE OF DISCUSSION TO DETERMINE THE WEIGHT VECTOR FOR FUNCTIONING

The set of weight for functioning shown in Equation-1 should be decided in the debate in which residents participated. However, in this paper, we decided their weights supposing the way of living of one highly elderly person by using AHP method.

-The information given before the discussion

The meeting in which report the results of the questionnaire survey was held with 26 welfare commissioners on January 17, 2004. In this meeting the achievement of Functioning and the state of transportation were explained. After acquiring this information, it investigated about the importance of each Functioning. Specifically, the following items explained about 1 hour.
- Physical ability
- Living
- The number of days going out
- Transportation
- Whether answers feel constraint
- Capabilities for each functionings

Residents have not participated in discussion about maintenance of local transport. So it is needed to show that residents could contribute to maintenance of local transport. Then, it is introduced the example that residents operates the bus.

- Assumption of the hierarchical structure of weight vector

To get weight vector of n Functioning(s) by performing one-pair comparison, n (n-1)/2 one-pair comparison are needed. In the example of this report, (for 12 functionings) 66 one-pair comparison are needed. But it is too many task to answer.

Then, we decided to compare by dividing comparison into a class.

A class consists of an item shown below.

- The final purpose :"While building the town, what is needed to be realized?"
- The concepts   :4 concepts which compose the final purports - which were considered
                    as a direction which should be aimed at while building town
                    - :The concepts are referred from the city planning.
- Functioning   :12 functionings which compose 4 concepts.

The relation between the last purpose, concepts and each Functioning was assumed as figure3.

The final purpose:

The state of a desirable city

The concepts

To be contacted with unique culture   Healthy and felt at ease.   Stabilized in money   To be able to be satisfied the interest

Functioning

Lesson, lifelong

walking and hiking

hobby and sport

Meeting with family and friend

Trip

Working, Volunteer

Visiting a grave

Boarding-out,

Watching movies and sports

Shopping(daily necessities)

Visiting hospitals

Shopping(except for daily necessities)

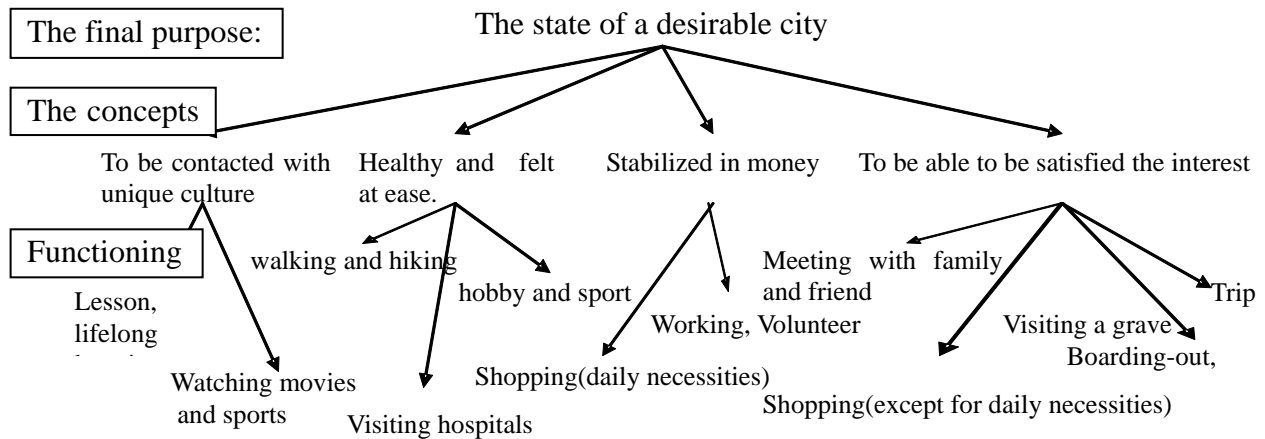Figure 3 The Hierarchical Structure of Weight Vector

*Question of weight vector
In the questionnaire, the concept and item of functionings were asked by the one-pair comparing method. The example of question about weight vector is shown in table 3.

Table 3 The Example of Questionnaire Sheet to Ask Weight vector of Functioning

<u>Question</u>
In order to make the city where dwellers can live healthy and tranquilly, which do you think it is more important?
 	
<u>Alternatives</u>
    - "Visiting hospitals" is much more important than "Walking and hiking".
    - "Visiting hospitals" is more important than "Walking and hiking".
    - "Visiting hospitals" is a little more important than "Walking and hiking".
    - "Visiting hospitals" and "Walking and hiking" are as important.
    - "Walking and hiking" is much more important than "Visiting hospitals".
    - "Walking and hiking" is more important than "Visiting hospitals".
    - "Walking and hiking" is a little more important than "Visiting hospitals".

5. DATA

5.1 THE ACHIEVABLE FUNCTIONING

The achievable Functioning of elderly people in Sumoto-city from questionnaire is shown in Figure 4.
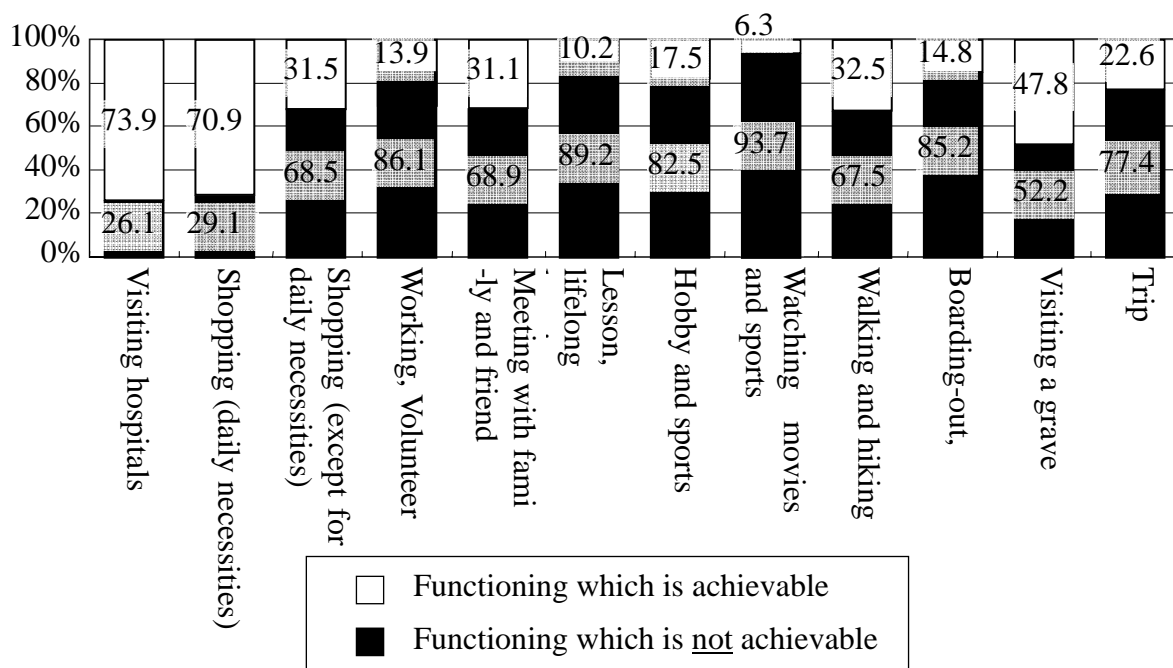
Figure 4 The Achievable Functioning (Elderly people in Sumoto-city)

It is about 70% of people answer that they can achieve "going to hospital regularly" and "shopping (everyday article)." However, there are the items which are only 6.3% of people answers that they can achieve. For example, "Watching movies and sports", "Working, Volunteer"… In order to attain achievement of "work and a volunteer", it is needed not only to improve the local transport, but also to offer the opportunities of working and volunteer work.

5.2 THE WEIGHT VECTOR FOR FUNCTIONING

The answer that the coherent index of all questions was 0.15 or less is rejected. There are 15 available answers. The weight vector is computed for every respondent. And standard deviation of the weight vector is calculated in each case.

Table 4 Dispersion of Weight Vector for Functioning W

	Standard deviation		Standard deviation
Visiting hospitals	0.124	Hobby and sports	0.037
Shopping(daily necessities)	0.092	Watching movies and sports	0.048
Shopping(except for daily necessities)	0.061	Walking and hiking	0.038
Working, Volunteer	0.056	boarding-out, party	0.032
Meeting with family and friend	0.053	visiting a grave	0.033
Lesson, lifelong learning	0.051	Trip	0.036

The large standard deviation means that the reply varies widely. Therefore, especially the argument shows the required item towards agreement. The standard deviation about "Visiting to hospital regularly" and "shopping of daily necessities" is large. The variation in the opinion about whether going out used as the foundation of a life should be secured is large. It is necessary to discuss more.

*Adopted weigh vector
The geometric average of each reply was carried out. This was considered as the result. A geometric average is performed about 15 respondents. The result was shown in Table 5.

Table 5 Weight Vector for Functioning W

	geometrical average		geometrical average
Visiting hospitals	0.129	Hobby and sports	0.070
Shopping(daily necessities)	0.131	Watching movies and sports	0.099
Shopping(except for daily necessities)	0.048	Walking and hiking	0.072
Working, Volunteer	0.112	boarding-out, party	0.040
Meeting with family and friend	0.084	visiting a grave	0.065
Lesson, lifelong learning	0.094	Trip	0.056

5.3 THE CAPABILITY INDEX e_i

To know other people's weight vector for Functionings give the people the chance to reflect upon oneself and view own opinion critically and the help to form the public right.
Then, substituting this value of Ai and W which is indicated in 5.3.4. in Equation1 yields e_i (the Capability index). The result is shown in Table 6.

Table 6 The Capability Index e_i

Number of respondents	3,425
medium value of e_i	0.31
Average of e_i	0.349
Standard deviation e_i	0.198

6. DISCUSSION

6.1 CHARACTERISTIC OF COMMUNITY TRANSPORT FOR EACH DISTINCT

It is considered for which area it should operate traffic. So It analyzes about the characteristic of required community traffic for every area. The characteristic of capability index is clarified for every group.
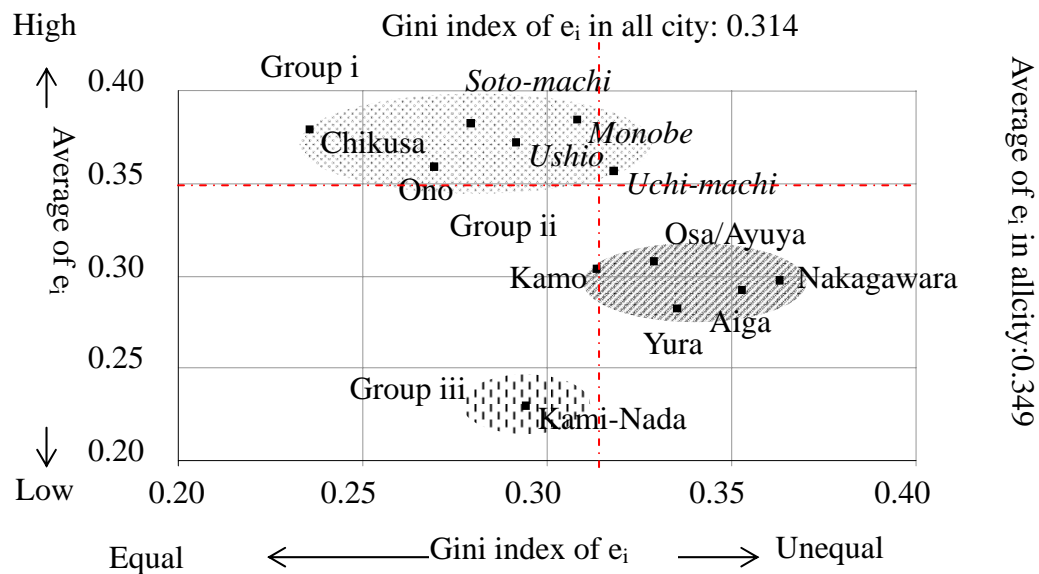
Figure 5 Characteristics of Community Transport for Each Distinct

Each distinct are divided into three groups from the situation of achievement of the function.

*Group i

The average value of index of the potential to achieve Functionings is high, and Gini coefficient is small. That is, in these areas, there are many people with a high potential to achieve functionings and there are few people with a low potential to achieve functionings. So, compared with the area of other groups, the urgency to introduce a community bus is low in the area of this group.

*Group ii

The average value of index of the potential to achieve Functionings is low, and Gini coefficient is big. The area included in this group shows that both a person with the high achievement possibility index of Functioning and a low person exist.

In the area belonging to this group, maintenance of the community bus which offers the high service level which improves Functioning of persons with low Functioning, such as a traffic difficult person, is especially considered to be required. Specifically, the following community buses can be considered. A route is lengthened to the back of the area to which it is coming only to the center of an area. Distance along which he walks is shortened by devising the route of the community bus in the central part. In order to realize these points, you should examine the demand response type (DRT) community transport.

*Group iii

The average value of index of the potential to achieve Functionings is low, and Gini coefficient is small. The area included in this group shows that there are many people with the low achievement possibility index of Functioning.

First, the operation number of a basic bus on a regular route is required.
You also have to consider offer of a community bus which offers a high service level like

Group ii.

6.2 THE VALUE OF RESULT

Thinking from the petition about local transport which comes out from districts, the districts in which have inconvenient in traffic is Ono and Chikusa. But thinking from the analysis shown above, Ono and Chikusa is not so inconvenient. Roughly speaking, the petition reflects the dissatisfied to local traffic in each districts. Therefore, by evaluating with "utility", it is concluded that Ono and Chikusa has the most remarkable problem. That is, in analysis of this research, the difficulty of movement which was not able to be discovered by the "utility" is able to be discovered.

7. Conclusion

In this study, it is proposed that the method of planning the community bus from possibility to achieve Functioning based on Capability Approach.
Sumoto-city is taken up as a case study and the application of planning of the community transport is shown. And characteristic of community transport which elderly people was made clear.
However, municipality expenditure is not avoided by community transport, and there is a burden on the resident. The burden is not taken into consideration in this analysis. The relation with the burden is taken into consideration in discussing and deciding in residents what kind of weight to attach to functioning. However, this research offers one measure into the discussing the burden. This measure provides a useful basis for debate.

Acknowledgement

REFERENCES

- Sen.Amartya.K.(1995), **Inequality reexamined**, Clarendon Press, Oxford.

- Study group of welfare for the handicapped, **International Classification of Functioning, Disabled and Health (ICF) (Japanese translated version)**, Chuohoki, Tokyo.(Original version published from WHO)

In order to write Chapter 2 and Chapter 3, the following Sen's literary works that are translated in Japanese and Japanese refernces concerned with Capability approach and Sen's theory are referred to.
- Ikemoto Y. (1997). **Inequality reexamined**, Iwanami Tokyo.

- Suzumura K.(1988) , **Economics of well-being-good and capability**, Iwanami, Tokyo.

- Goto R.(2002) **Economic philosophy of Justice – Rawls and Sen.**, Keizai Shinpo-Sya ,Tokyo.