

# **APPLYING SEN'S "CAPABILITY APPROACH" TO THE EVALUATION OF COMMUNITY BUSES**

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## **SUMMARY**

Recently in Japan, many community buses have been provided in both rural areas and urban ones by local governments, in order to enhance mobility of residents, mainly focused on elderly people with poor public transportation services. However, most of them are suffering from fewer passengers and low cost-efficiency. In order to overcome these problems, it is necessary to estimate what kind of effect can be had on the lives of residents, including passengers on community bus services, and evaluate the adequacy for this system.

In this paper, the "Capability Approach" advocated by Amartya Sen is applied to evaluate a community bus service. The main purposes are as follows:

1. To clarify the concept of "Capability" in the view of travel.
2. To identify the main functions relating to Capability.
3. To develop the evaluation method on Capability incorporating the change of quality of each function corresponding to transportation service change.
4. To apply this method to the evaluation of community bus service.

## **1. Introduction**

Recently in Japan, many community buses have been provided in both rural areas and

urban ones by local governments, in order to enhance the mobility of residents, mainly focused on elderly people, with poor public transportation services. However, most of them are suffering from fewer passengers and low cost-efficiency. In order to overcome these problems, it is necessary to estimate what kind of effect can be had on the lives of residents including passengers on community buses and evaluate the adequacy for this system. The characteristics of travel demand for residents need to be accurately understood and an effort should be made to increase passengers.

In this paper, the former aspect is remarked upon and the “Capability Approach” advocated by Amartya Sen is applied to evaluate community bus services.

The main purposes are as following:

- To clarify the concept of “Capability” as it refers to travel.
- 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 method to the evaluation of the community bus service.

## **2. Outline of the “Capability Approach”**

The purpose of community transport is to offer the opportunity being able to live well to those who are not provided with sufficient services by the conventional traffic system. The degree to which community transport contributes to improvement in “well-being” must be evaluated. Amartya Sen (Sen, 1995) pointed out the problem produced 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 a way of life, which is called “Capability” by Sen.

Sen points out the faults about the approach using utility, illustrating some examples. “Satisfaction” can be selected as the main index of utility. Satisfaction is very subjective. Even if the degree of satisfaction a rich person received from food is the same as a poor person’s, different foods satisfy different people in different ways. For example, poor and hungry people might receive a large degree of satisfaction when eating only a piece of bread, but this satisfaction might be the same as the satisfaction of a rich person when drinking a very high-class wine, despite the big difference between a piece of bread and a bottle of wine in monetary value.

There is also another approach based on “goods”. It ignores 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 extent of the way of life which people can choose”. However, as this definition is vague, “functioning” is a realistic technique. “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 means 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.

### 3. Evaluation Method Using 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.

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

$$e_i = W \cdot A_i$$

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

$W$  : the vector of weight set of functioning,

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

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

$A_i$  : the vector of opportunity set to achieve functioning,

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

$a_{ij}$  : the element of vector  $W$  for functioning  $j$  ( $0 \leq a_{ij} \leq 1, 1 \leq j \leq n$ ), 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.

In addition, the degree of the distribution of inequality of  $e_i$  for each individual in some area can be estimated by using Gini's index  $G$ , which is shown in the following equation.

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

$X_i$  : 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. Application of the Capability Approach

Examining functioning is important. In this section, the community bus running in Suita-city, Osaka in Japan was taken up as a case study. The routes of this bus service are shown in Figure 1. The city is located in the second largest metropolitan area with the first New Town in Japan.

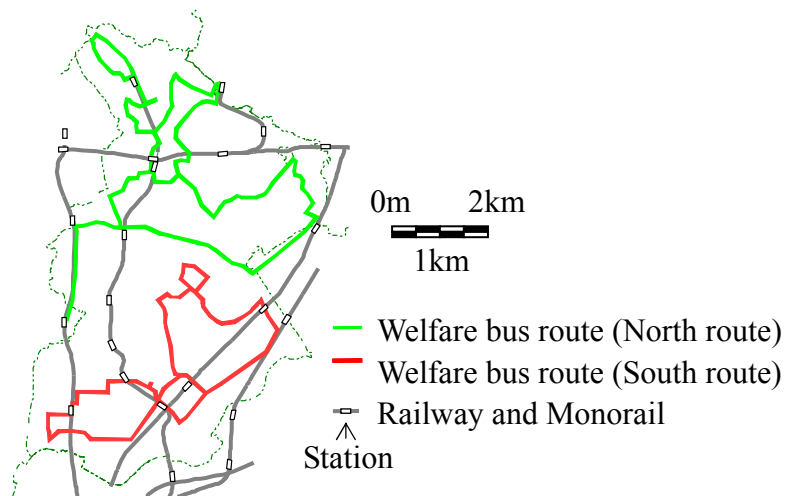


Figure 1 Geographical features of Suita-city

##### 4.1. Outline of case study

The outline of community bus service was shown in Table 1. The local commercial bus routes are arranged like the spokes of a wheel centered on a railroad station. These buses do not directly connected urban public facilities like hospitals, assembly halls and so on. The main purpose of community buses is to connect these facilities directly.

Table 1 Outline of welfare buses in Suita-city

Target	Elderly and disabled people living in Suita-city
Fare	Free
Frequency	North route :3 buses a day
	South route :4 buses a day
Working day	Monday to Friday
Others	Conductor on the bus to help passengers on and off
	Low flower bus servicing in north route

### 4.3. Items of functioning

#### 4.3.1. Level of functioning

Functioning is ordered in terms of a hierarchy displayed in Figure 2. For example, in order to achieve the functioning of "office working", the functioning of "operating PC" and "communication" may 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.

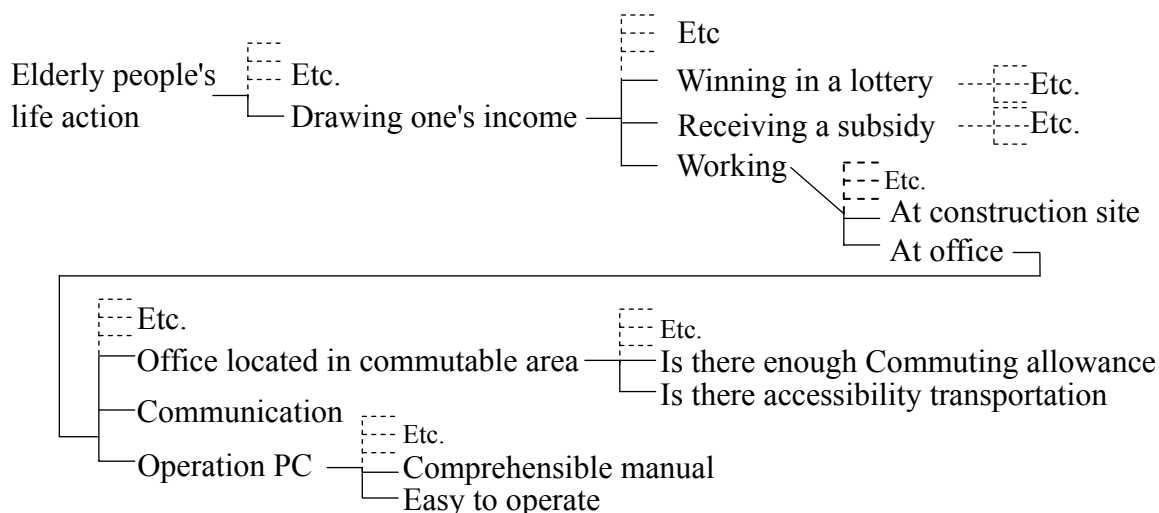


Figure 2 Hierarchy diagram of Functioning (example of Working)

#### 4.3.2. Selection of the items of functioning

These activities are collated while 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 list 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 was obtained.

Table 2 Selected items of functioning

Going to Hospital	Playing sport
Shopping	Enjoying art and sports watching
Business at municipal office, bank, e	Walking and hiking
Haircut	Dining out and party
Meeting with family and friends	Visiting a grave
Working and volunteer	Travel
School	

#### 4.4. Outline of questionnaire survey

The outline of the questionnaire survey to examine the opportunity to achieve activities is shown in Table 2. In addition, the availability of various forms of transportation was surveyed. These included driving a car, riding in a car together with family and taking the bus or train.

Table 3 Outline of questionnaire survey

Objectives	Passenger of community bus
Date	January, 2003.
Method	Distributing on the board and collecting via post.
Number of distributed	245
Number of receiving	144(58.8%)

#### 4.5. Achievement opportunity of functioning

In the questionnaire, two kinds of achievement opportunity for the states of with/without the introduction of community bus were asked. As community bus services were already introduced at the survey time, in the case without community buses, respondents answered questions relying on their imagination. The result was shown in Figure 3.

There are many people who cannot achieve "Going to hospital", "Shopping", "Business to Municipality and bank", and "learning something" when the absence of community buses is assumed. We can say that the community bus is a big contribution to these activities for elderly people.

#### 4.6. Relations between opportunity to achieve functioning and attribution

To examine details of whom welfare bus give the effect, the relation between the respondent's individual properties and the opportunity set was examined. Since the

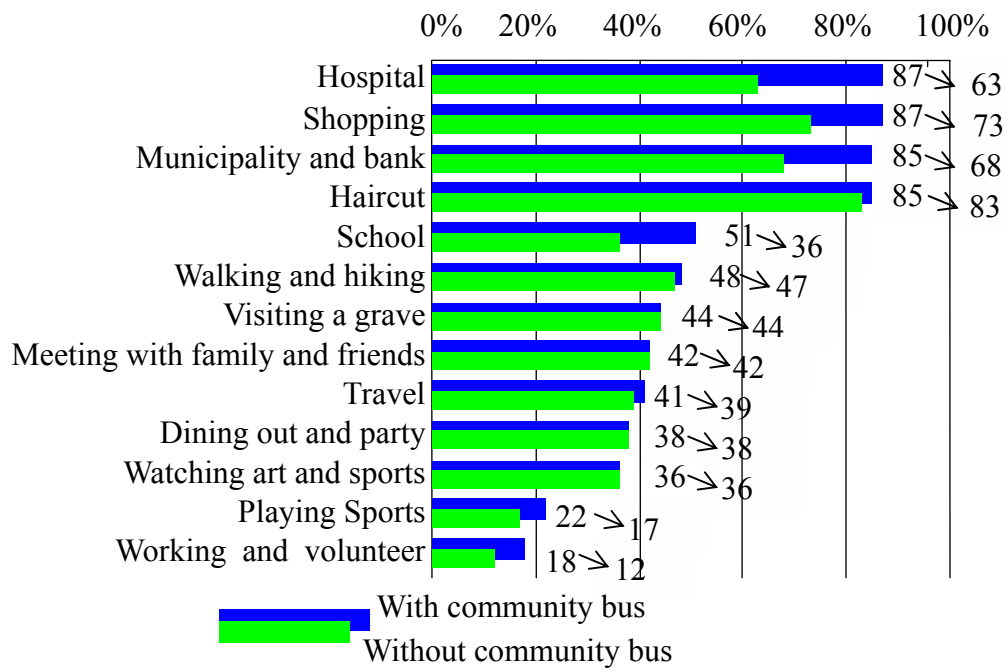


Figure 3 Achievement opportunity of functioning

welfare bus service tries to ease physical difficulties (i.e. connecting the house area and some institutes), it is assumed that the welfare bus service affects those who have physical difficulties. Subjective replies about going up and down stairs are adopted as an index showing physical difficulty.

And, since the fare of welfare bus is free, it is assumed that the welfare bus service affects those in financial difficulty. The subjective reply to the question of whether respondents are short of funds is adopted as an index showing financial difficulty. Table 4 shows the results of the chi-square test with 5% significant level for examining these relations.

Table-4 Relation between Opportunity to achieve functioning and Attribution

Functioning	Attribute	Significance probability
Going to hospital	Physical	0.00*
	Monetary	0.58
Shopping	Physical	0.36
	Monetary	0.95
Business at municipal office and bank	Physical	0.01*
	Monetary	0.55
Learning something	Physical	0.06
	Monetary	0.08

It turned out that the welfare bus service has an influence on persons with low physical strength on the achievement of the functioning "going to hospital" and "business at municipal office and bank".

#### 4.7. Weight for functioning, $w_i$

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.

Table 5 Weight for functioning,  $w_i$

Going to Hospital	0.27	Playing sports	0.02
Shopping	0.20	Enjoying art and sports	0.04
Business at municipal office and bank	0.09	Walking and hiking	0.03
Haircut	0.14	Dining out and party	0.02
Meeting with family and friends	0.08	Visiting a grave	0.04
Working and volunteer	0.02	Travel	0.02
School	0.03		

#### 4.8. Estimation of $e_i$ and its inequality

Multiplying weight by possibility,  $e_i$  is computed for every individual. The statistics of  $e_i$  are shown in Table 6. From the viewpoint of summing the opportunities to achieve functioning are improved by welfare bus service.

Table 6 The statistics of  $e_i$

	Without	With
Average	0.62	0.77
Variance	0.048	0.012
Median	0.67	0.76
Number of respondent	144	

The degree of inequality of opportunity (G) to achieve functioning is 0.08 with welfare bus and 0.20 without welfare bus. G is improved and distribution of opportunity to achieve functioning is equalized.

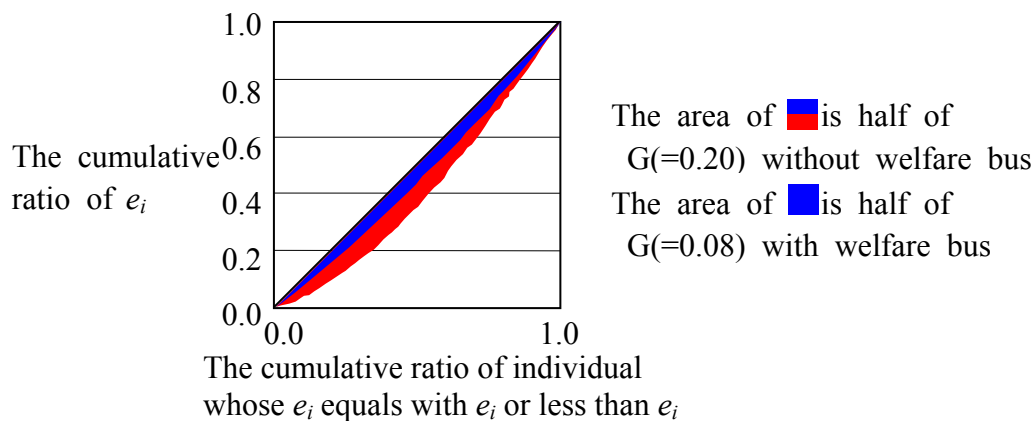


Figure 4 Inequality of  $e_i$



However, one of the reasons why welfare buses had a big effect in equalization of distribution of achievement Functioning is that this analysis is based upon responses of welfare bus users. Therefore, investigating among the residents of the large attribute reflecting the situation of an area is needed.

## 5. Conclusions

In this study, the following results were mainly obtained.

- 1) The method of estimating the effect by the community bus from possibility to achieve functioning based on Capability Approach was developed.
- 2) Based on this method, it was clarified that the welfare bus of Suita-city, which was taken up as a case study, contributed to the enhancement of  $e_i$ , the degree of opportunity set of comprehensive achievement of functioning, particularly for those who had heavy physical difficulties going to hospital and work in a public organization financial institution.
- 3) In addition, the total of  $e_i$  increased and the degree of inequality G was improved. Judging from fulfilling these both conditions, a welfare bus has a good effect on both enhancing the total of capability and solving inequalities among citizens.

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