

DEMAND FORECAST OF DOOR-TO-DOOR SERVICE USING ACTIVITIES IN DAILY LIFE

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SUMMARY

In order to maintain the daily life of the all people, Door-to-Door (D2D) services play a role of safety-net. Because the cost of D2D service is high, it is necessary to know how many people need D2D services, in other words, how many people cannot use bus transportation. However, those who have not been able to leave home for long time may not be able to answer correctly what kind of transportation they can use. In this study, asking Activities of Daily Living is assumed to be the solution for this problem. From the answers it can be predicted whether person can use bus. We can predict the capability of using bus with an accuracy of 80.5%.

The estimation in city with 450,000 people tell that 5,789 physical impaired peoples cannot use low-floor bus, but only 120 physical impaired peoples use D2D service in Dec 2005. It is clear that supply of D2D services is smaller than its necessity.

Key Words: Mobility for Physical impaired people, Comparison supply and necessity, Activity of Daily Living

1. BACKGROUND AND PURPOSE

For realization of normalization, transportation is necessary that those who have restrictions in mobility can go out. However, it is unrealistic that transportation for people with difficulties is composed of only D2D services since the cost to provide D2D services is expensive compared with the cost of bus transportation. Planning the local transportation, it is important to provide proper transportation. In this study, the minimum requirements for such transportation system are considered. In this case, D2D services are provided for those who cannot use bus and bus are provided for those who can use bus transportation. Considering this system, it is necessary to know how many people need D2D services. In other words, it is necessary to know how many people cannot use bus transportation.

However, it would be useless or cause misunderstanding to merely ask “What transportation can you use?” or “Can you use bus transportation?” Those who have not been able to leave home for many years may not be able to answer correctly what kind of transportation they can use. In this study, asking ADL (Activities of Daily Living) is assumed to be the solution for this problem.

This research consists of the following topics.

- To define the questions which are available for judging whether a man can use “bus”, “taxi”, “taxi with human assistance”.
- In a case study
- To estimate that the number of the physically impaired who need D2D service.
- To compare the estimated number of D2D user with the number of amount supplied by NPO.

2. OUTLINE OF D2D SERVICE

(1) D2D service in this paper

D2D service starts at the door of his home and finish at the door of the destination. In some case service is provided from the bed at home to bed at destination. Vehicles with a lift or a slope are used for D2D service, to make it easy to take in and out. The target of D2D service is the elderly people and physical impaired people who cannot use public transport. There is also D2D service which operates by sedan type vehicles. In this case, the volunteer person looking after a patient has ridden together.

These services might be called as the special transport service (STS). STS is a one type of D2D. D2D in this paper is only for the elderly people and physical impaired people who cannot use public transport. So, D2D and STS mean the same thing.



(2) D2D service in Japan

AKIYAMA¹⁾ said that the first D2D service for physical impaired people in Japan is carried out by Machida-city government, using the vehicles with a lift. (1972)

In Japan, when carrying a passenger using a car and taking a charge, it is necessary to obtain license from the government. This license is evaluating sustainability of business, such as responsiveness to the damage from the accident, a safety of vehicles, and profitability. But in many cases of D2D service by NPO did not obtain the license. Because it was not easy for small-scale NPO. But road transport law in Japan was loosened in 2006. New category of license for D2D service by NPO was made. And this is one of the proofs that D2D service by NPO began to be popular.

3. METHODOLOGY

(1) Estimation of the numbers of those who needs D2D service

To estimate the numbers of those who need D2D service, it is necessary to know what kind of transportation they can use.

But it is not enough only to ask what kind of transportation they can use. To continue hopping for impracticable proposal put large mental stress. Since supply of D2D service was not enough, many people cannot use D2D service. So to leave home has been impracticable proposal for physical impaired people. So those who have not been able to leave home for long time may not be able to answer correctly what kind of transportation they can use.

In this paper, two questionnaires were conducted. One questionnaire is to collect the data to know the relation between what kind of transportation they can use and physical mobility, for the physical impaired people who go out high-frequency. The other questionnaire is to collect a full picture of physical mobility for all physical impaired people. From first questionnaire an equation which tell what kind of transportation they can use from the physical mobility.

However, the statistical data (i.e. the kind and grade of a physically impaired peoples' card, the level of care needed of care insurance service) is inadequate for expressing physical mobility. But asking physical mobility if a situation is not shown, it is difficult to answer. Then, the situation in everyday life is shown. That is, activities of daily living (ADL) are

asked and mobility is expressed.

Second questionnaire is the complete count survey asking the achievement of ADL. One mobility influences two or more ADL. Therefore, it is necessary to examine which ADL should be use. On the other hand, in consideration of the difficulties of survey, it is necessary to lessen the number of questions. Therefore, it is necessary to clarify ADL useful to judgment of the possibility of use of D2D service or bus.

(2) The classification of transportation

The offer method of D2D service is classified according to the existence of the vehicles to be used and a care worker. The vehicles to be used consider sedan type vehicles and special vehicles.

Special vehicles equip a lift or the rotating seat. Both ease the burden of getting on and off to vehicles. That is, D2D service is classified into three, "sedan type vehicles without a care provider", "sedan type vehicles with a care provider", and "a special vehicle with a care provider." In addition, "bus service using a low floor bus" is considered for those whose D2D service is unnecessary. A means of transportation is divided into the above four kinds of services. "The D2D service using a special vehicle with a care provider" has the highest degree of the correspondence to move difficulty.

(3) The item expressing physical mobility

Operation similar to operation which is needed when using a vehicle was collected out of ADL and the list was created. For example, "a shift to a wheelchair from a bed", "maintain a posture on the seat of vehicle", etc. In addition, by referring to ICF²⁾ (International Classification of Function) the list was reinforced. The item chosen as Table 1 is shown.

Table 1 Items expressing physical mobility

A shift in a seating position	Going up and down of a short slope
Keeping balance of a trunk (bowing)	Acceleration is coped with sat down.
Setting tolerance	Using a assistive device at walking
Rise and fall of a level difference	A trot and quick footwork
Carrying of a baggage	Crossing of a trunk road
A walk mileage	Dealing with the acceleration in a standing position
Evasion of an obstacle	Movement right and left on the learning floor

4. OUTLINE OF QUESTIONNAIRE SURVEY

In order to select the items that are relevance with the capability of using transportation might choose the item showing strong mobility investigated to the physically impaired people. It is impracticable to ask all the items in Table 1 in a complete count survey. So, on the basis upon relevance with capability of using transportation chooses the item of mobility.

The questionnaire survey was performed to the physically impaired people. In this survey, the capability of using transportation and Mobility were questioned.

However, those who answer capability of using transportation need to be those who have ever to use. Then, the questionnaire was carried out to the recipient of a mobility supporting plan. Because it was supposed that recipient of a mobility supporting plan have used transportation more than more than an ordinary impaired people.

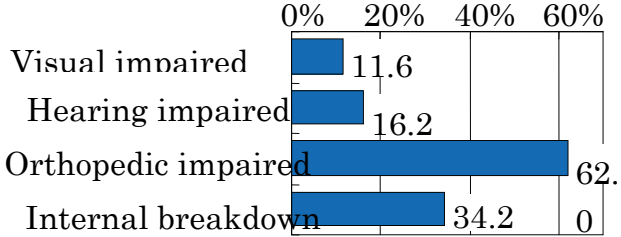
Survey was conducted in Amagasaki-city. Amagasaki-city locates in the Osaka metropolitan area. The Osaka metropolitan area is a second biggest metropolitan area in Japan. Amagasaki-city is the area urbanized highly.

Amagasaki-city provides three mobility supporting plans shown in Table 2. A receptor candidate chooses one from three plans.

Table 2 mobility supporting plans in Amagasaki-city

Kind of supporting plan	Bus ticket	Taxi ticket	Automobile with a lift
Type of vehicle	Low floor bus	sedan type vehicles	Van with lift
Objective	- Physical impairment class 1 to 4	- Visual impairment class 1 and 2 - Orthopedic impairment class 1 and 2 - Internal breakdown class 1	- Orthopedic impairment class 1 and 2 - Internal breakdown class 1

Those who want to receipt mobility supporting plans have to come to a welfare office every end of March. Because, they need to update their plan. The questionnaire was distributed to them. The questionnaire sheet was distributed in March, 2004 and April. The questionnaire of 796 volumes was distributed and 422 volumes were collected. The recovery rate was 53.0%. The composition of kind of physical impaired of respondent is shown in Fig. 1. And, the composition of class of physical impairment of respondent is shown in Fig. 2.



Number of Response are 389
Fig1 The composition of kind of physical impairment of respondent

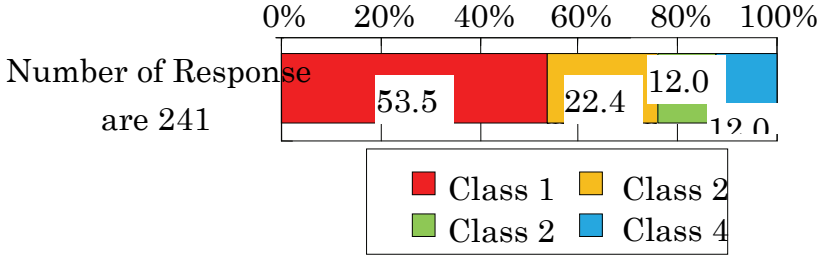


Fig2 The composition of class of physical impairment of respondent

As compared with statistics with Amagasaki-city, there is almost no deviation about the kind and class of a physical impairment. It is satisfactory as data showing a disabled person's situation of a sample.

5. CAPABILITY OF USING TRANSPORTATION AND PHYSICAL MOBILITY

(1) Transportation which can be used

In this study, transportation system for elderly and impaired people in the minimum level is considered. D2D service is provided for those who cannot use a bus but need D2D service in the traffic system of the minimum level. Those who can use a bus are provided with a bus. It is shown in Fig.3 proportion of the transportation with the lowest management cost in which is answered by a respondent.

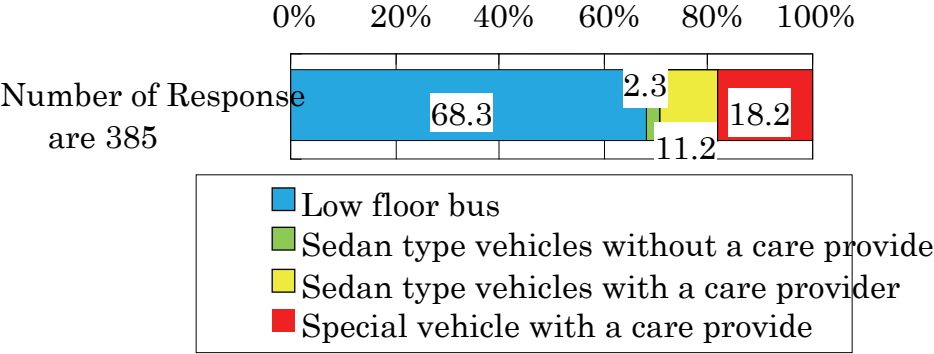


Fig.3 Proportion of the available transportation with the lowest management

It is verified whether the item of physical mobility is related to capability of using transportation. So the chi-square test was performed between capability of using transportation and the physical item of mobility. About the item of all the physical mobility, the independent hypothesis was rejected by 1% of significance level. Therefore all items of physical mobility are significant as items which judges capability of using transportation.

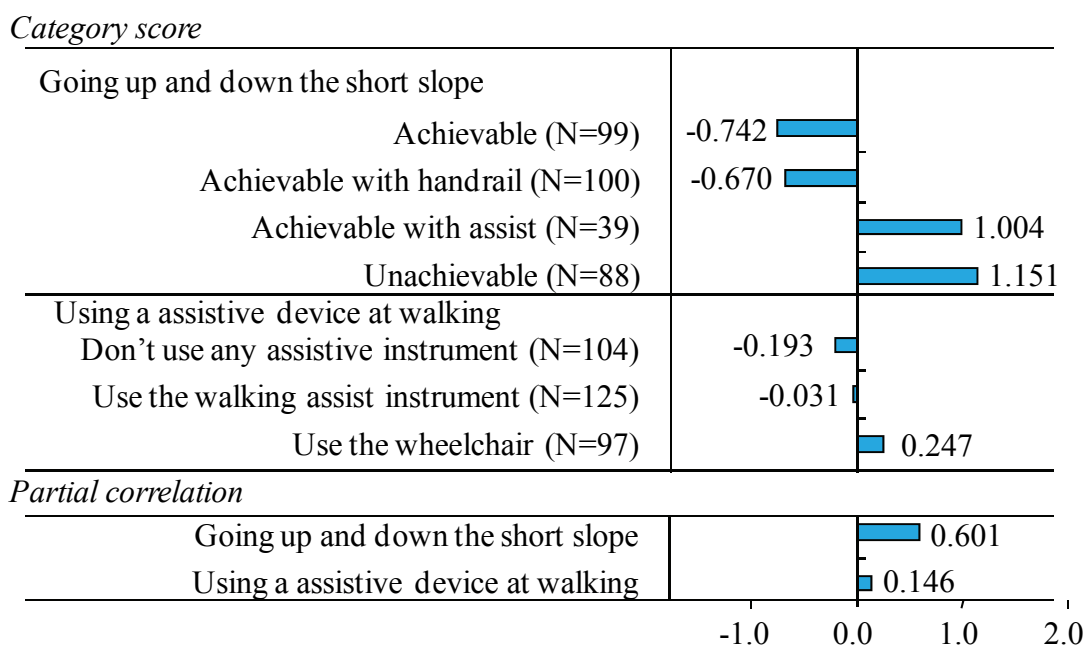
(2) Selecting the combination of physical mobility

a) Low floor bus

In order to clarify the item which should be investigated, what is strongly related in capability of using transportation is chosen from the item of physical mobility. Discriminate analysis using categorical data was carried out (what is called qualification theory II). The purpose variable is capability of using transportation. And an explaining variable is an item showing physical mobility. All the combination considered from 13 explaining variables is made. Combination with multicollinearity was eliminated. In addition, the combination of an explaining variable is chosen based on the correlation ratio between the objective variable and an explaining variable. The result was shown in Table 3.

The combination of the chosen explaining variable was "Going up and down of a short slope", and "Assist instrument."

Table 3 Result of Discriminate analysis for capability of using low floor bus.



An estimation equation is made by the linear expression of these explaining variables. When the sum total of this linear expression is less than 0.873, a low floor bus can be used. This value is called the judgment middle point. Distinction hitting ratio was 87.6%. The correlation ratio was 0.532.

b) Sedan type vehicles without care

Then, using the same method, it analyzed for carrying out the objective variable of the capability of using of the D2D service by care-less sedan type vehicles. When the combination of an explaining variable was a "*Keeping balance of a trunk (bowing)*", "*Setting tolerance*", and "*the existence and the kind of a supportive device*", multicollinearity did not arise but the highest correlation ratio was obtained. At this time, a correlation ratio is 0.579, distinction hitting ratio is 86.5%, and the satisfying result was obtained. The score of the distinction middle point was 0.236. An analysis result is shown in Table. 4.

c) The capability of using of sedan type vehicles with care

Then, using the same method, it analyzed for carrying out the objective variable of the capability of using of the D2D service by sedan type vehicles with care. When the combination of an explaining variable was a "*Keeping balance of a trunk (bowing)*" and "*Using a assistive device at walking*", multicollinearity did not arise but the highest correlation ratio was obtained. Correlation ratios are 0.517 and 86.7% of distinction hitting ratio, and the satisfying result was obtained. The score of the distinction middle point was 0.533. An analysis result is shown in Table 5.

6. ESTIMATION OF THE AMOUNT OF SUPPLY OF THE D2D SERVICE OF A CASE STUDY

The case study was conducted in Amagasaki-city too. Transportation which can be used is guessed using three line form shown in Chapter 5. The data of physical mobility is 2004 for the physically impaired peoples' card holder in Amagasaki (1 class to 4 class). The sample data (N=487) of the questionnaire carried out for the year was used.

Table 4 Result of Discriminate analysis for capability of using Sedan type vehicles without a care provide

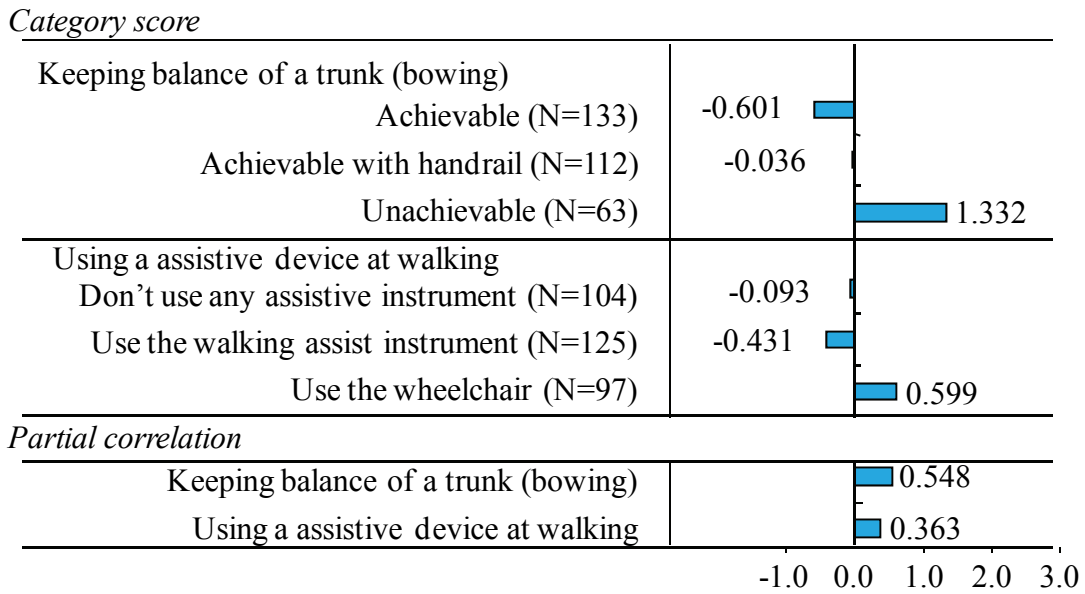
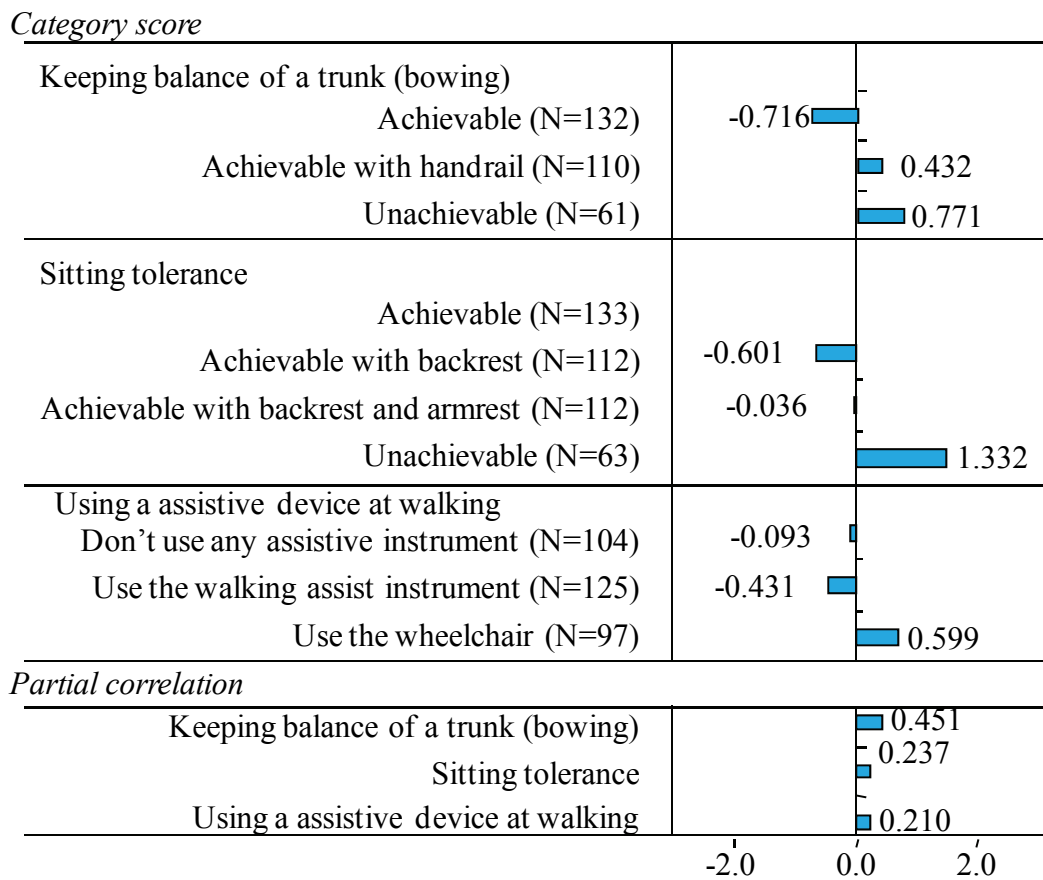


Table 5 Result of Discriminate analysis for capability of using Sedan type vehicles without a care provide



As a result, the physically impaired people conjectured that use of a low floor bus is possible is 67.7%. The physically impaired people who can use the D2D service by sedan type vehicles without a care provider is 2.9%. The physically impaired people who can use the D2D service by sedan type vehicles with a care provider is 6.1%. The physically impaired people who can use the D2D service by a special vehicle is 23.3%.

Comparison of a "sample" and "actual data = people with the physically impaired persons' card in Amagasaki" is conducted. Percentage was almost the same among both sample and actual data about age, the kind of impairment, and the class of impairment. Therefore, in the estimation of the traffic which the disabled person of the whole Amagasaki-city can use, simple extension of the composition rate obtained from sample data was carried out. In Amagasaki, there are 17,924 persons with from the class 1 of a physically impaired peoples' card to the class 4. Since the number of sample data is 487, magnifying power is set to 36.8. A result is shown in Table 6.

Table 6 Result of estimation

Kind of transportation	Ratio	Number of estimation(users)
Low floor bus	67.7%	12,135
Sedan type vehicles without a care provider	2.9%	520
Sedan type vehicles with a care provider	6.1%	1,093
Special vehicle	23.3%	4,176
Sum	100.0%	17,924

7. DISCUSSION

To understand size of result of estimation, it is conducted the comparison between present supply of D2D service and result of estimation.

(1) The D2D service in Amagasaki

The amount of providing of the D2D service in Amagasaki is surveyed, the number of users, the number of vehicles, and the number of times of operation. Then, the questionnaire was carried out to NPO and the social welfare council in December, 2005. The numbers of distribution organizations were ten organizations, and the numbers of recovery organizations were nine organizations. Among them, the organizations which provide D2D service were seven organizations. The result of a questionnaire is shown in table 7.

Table 7 The D2D service in Amagasaki

Number of registered Member	449
Number of User in Dec.2005	312
Number of Physical impaired user in Dec.2005	120
Number of vehicles	26
Number of Special vehicle	19
Number of Operation in Dec.2005	1,246
Number of Operation for hospital in Dec.2005	673

(2) Comparison

a) Number of user

It was estimated that there are 4,176 physically impaired card holders who need special

vehicle when they go out. As shown in table 7, there were 120 physically impaired peoples' card holders which actually use D2D service in Dec.2005. It is clear that size of supply is smaller than the number of those who need D2D service by special vehicle.

b) Number of vehicles

The number of special vehicles which the D2D providers own is 19. It was estimated that there are 4,176 physically impaired card holders who need special vehicle when they go out. Thus, it is 220 users per special vehicle.

It is assumed that the number of usage is 1 round trip per month per person. And, it is assumed that each special vehicle operates for 30 days for one month. A special vehicle will go and come back 7.3 times per day. It is very difficult to achieve this number.

c) Number of Operation (going-to-hospital-regularly frequency)

In additionally the actual condition is taken into consideration. This condition is "going to hospital regularly", because it is the main outgoing purpose when D2D service user use D2D service. If D2D services provide enough, frequencies of going to hospital regularly of those who was not provided the D2D service would increase. In short we have to consider not only the present number of usage but also the potential number of usage. To consider situation that D2D service is fully provided, it refers to the questionnaire survey was conducted to the user of D2D service in Hyogo Prefecture.

It was 52.1%, the percentage of the D2D service users who go to hospital regularly less than 2 times per month (N= 118). It assumes, "Going to hospital regularly provides D2D service by the number of times which is not filled twice per month to 2 or less times of people per month." As a result, needed traffic serves as every month 4,891 times.

As shown in table-9, the number of times of operation of D2D service is 1,246 times/month. The number of times which was the going-to-hospital-regularly objective among them is 673 times/month.

The present amount of supply was much less than needed.

d) D2D service is insufficient?

As shown in a, b, and c, "D2D service is insufficient?" was considered from 3 viewpoints, the number of users, the number of vehicles, the number of times of operation. From every viewpoint, it can be concluded that supply of D2D now completely runs short.

And the number of required persons estimated in this research is the minimum number. Moreover, it is the number limited only to the physically impaired people. There are many people who need D2D service, such as a mentally impaired people and elderly people.

7. CONCLUSION

The analysis links a relationship to answers on ADL and the capability of using bus transportation or D2D services. As the result, the capability of using bus transportation or D2D services can be judged by four questions shown below.

- Can you bow?
- Can you hold the posture on a chair?
- Can you climb up and down a short lump?
- Do you use a supportive device in walking?

It turned out that there are few amounts of supply of D2D service compared with the minimum level of those who need. The taxi company is criticizing that D2D service affects

their management. However, there was no amount of supply of D2D service so that it had influence, but I understand. It is more desirable for a taxi company to offer various services and to unearth a potential user. This estimation is conducted only for physical impaired peoples. But many older persons need D2D service too. Determining the D2D demand for the elderly is a topic for future research.

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