

Analysis of Municipal Community Bus and Community Taxi Services in Japan Based on a Nationwide Urban Survey - Focusing on Sustainable Local Transportation for Daily Use -

Kaichi ICHIKAWA^a, Hisashi KUBOTA^b

Saitama University 255 Shimo-okubo, Sakura-ku, Saitama, 338-8570 Japan

^a *E-mail: ichikawa@dp.civil.saitama-u.ac.jp*

^b *E-mail: hisashi@dp.civil.saitama-u.ac.jp*

Abstract: This study investigates the introduction, operation and usage of municipal community bus services and community taxi (the shared-ride taxi) services as local public transportation for daily use in Japan, based on nation-wide urban survey and interviews. The result of analysis has revealed that there are remarkable differences in usage among those cities that have introduced municipal community bus services, depending on service frequency. Furthermore, it indicates that it is feared that community taxi services, especially ones with demand-based transportation (Demand Responsive Transportation=DRT) may lead to a continuous and swelling financial burden on the municipalities unless some sort of limit is established to relieve the burden of the operating expenses. It further suggests that the municipalities that have introduced DRT need to review carefully how to position those services as sustainable local transportation from the financial perspective.

Keywords: *Nationwide urban survey, Local transportation for daily use, Municipal community bus services, Municipal community taxi services, Sustainability*

1. INTRODUCTION

1.1. Background and Purpose of the Study

With an aging population and a rapid increase of the people who have trouble shopping, the introduction of municipal community bus and community taxi services is spreading as a surefire countermeasure to provide local transportation services throughout Japan. Though Japan is called a motorized society like Europe and the United States, it becomes difficult even for long-time drivers to continue driving later in life due to the decline of their physical strength. It is thus expected that the need for municipal community bus and community taxi services will increase in areas that private businesses tend to avoid due to low profitability, as depopulation and the aging of the society progress.

Furthermore, in the wake of these movements, policy enhancements are required on administrative levels, including both the local and national governments, such as the enactment of basic transportation laws to provide citizens with means of transportation. It can be said that there is an increase in the usability of basic information to understand the nationwide conditions of the introduction, operation and usage of municipal community bus and community taxi services for the new policy-making.

In light of these circumstances, this study aims to clarify the status of the introduction, operation and usage of municipal community bus and community taxi services in Japan to comprehend them thoroughly and integrally as local public transportation for daily use, and to

define and provide the necessary basic information of the conditions of sustainable local public transportation services with frequent usage and financial efficiency, which are becoming an important problem for the municipalities undertaking the introduction of local public transportation services.

1.2. Review of Past Studies and Positioning of This Study

Past studies present a host of accumulated knowledge concerning municipal community bus services. However, all of these studies, including those by Ito (2008), Takebayashi and Nitta (2010), Nakagawa and Matsunaka (2012), Takeuchi and Furuta (2008) and Terada (2006), covered only specific areas that have introduced this public transportation service. Meanwhile, studies on municipal community taxi services are also increasing. Although there are studies, such as the one by Hayakawa (2004) exploring generally the present conditions and challenges, studies covering only specific areas such as the one by Matsuzaki (2011) are more conspicuous.

Regarding nationwide surveys to cover both municipal community bus and community taxi services, except the several surveys conducted by the Ministry of Land, Infrastructure, Transportation and Tourism (2006, 2010, etc.) to formulate new policies such as the amendment of the road transport law of 2006, there have been few studies to cover only municipal community bus services. Those few studies include the ones conducted by Mimura (2011) and Uehata and Takayama (2011).

Mimura et al conducted a detailed nationwide survey and an analysis of the conditions of operating funds for the municipal community bus services. According to the result, municipalities operating municipal community buses accounted for approximately 70 % (644 municipalities) of the respondents. Municipalities with a revenue-to-expense ratio of less than 50 % stood at 86 % of the total. They further analyzed the differences in operating conditions induced by a variation in the revenue and expense, and revealed that those municipalities with a better revenue-to-expense ratio have more enthusiasm for the capital investment.

Meanwhile, Uehata and Takayama also implemented an interview survey of municipalities throughout the nation. Their survey covered not only the present conditions of the introduction of municipal community bus services but also the status and results of transportation policies, including undertakings by the municipalities to promote the use of local public transportation services. They also classified municipalities by principal component analysis and cluster analysis from the viewpoint of whether they are consolidated or depopulated municipalities, based on the results of the survey.

In contrast, this study is to uncover the nationwide conditions of the introduction, operation and usage of not only municipal community bus services but also community taxi services, categorizing them as local public transportation services for daily use. They are categorized as local public transportation services for daily use, because those municipalities having introduced mainly DRT community taxi services instead of suspending municipal community bus services or a part of their routes, are increasing rapidly nationwide, and also because it was considered necessary to understand municipal community bus and community taxi services integrally as local public transportation services.

A focus was placed on the frequency of usage by the residents since it was deemed essential first to increase the usage in order to achieve sustainable local public transportation services, in the wake of the low usage in many of the municipalities despite the recent spread

of the introduction of municipal community bus and community taxi services among them.

This study covers cities and wards only. However, as a nationwide study of local public transportation services including community taxi services has not been found so far, the uniqueness of this study is considered significant. It is further believed that it would be possible to suggest desirable sustainable local public transportation services, by proceeding with a nationwide survey and analysis of the present conditions.

1.3 Method of Study

In this study, analysis was based on:

(1) Data regarding the introduction, operation and usage of municipal community bus and community taxi services, collected as a part of the “3rd Nationwide Survey of Urban Sustainability Evaluation” (hereafter called “nationwide survey”) covering 786 cities and the 23 wards of Tokyo (809 municipalities in total) conducted by the Research Institute of Industry and Regional Economy of Nikkei Inc (Nikkei RIM) in July 2011 by mail, in order to evaluate and rate the sustainability of each city.

(2) Results of interview surveys of the municipalities having introduced those public transportation services.

Moreover, local transportation survey results have already been presented in the “2011 (3rd) Urban Sustainability Evaluation of Nationwide Cities” survey report compiled prior to this study.

The concept of the strategy for this study is to add a detailed analysis with data and examples obtained from interviews reviewed from the perspective of sustainable local public transportation services because its result is very necessary as a basic guideline when local governments implement sustainable transport policy.

An overview of the survey of local public transportation services is shown in Table 1.

Table 1. Overview of Survey

Time of survey	July–September,2011
Survey method	Mailing and collection of questionnaire as “Survey of Sustainable Cities in Municipal Districts
Subject of survey	Planning related divisions of all municipal districts in Japan (786 cities and 23 wards, 809 in total at the time of survey)
Number of collected responses	631 cities and 23 wards, 654 in total (collection rate: 80.8%)
Survey items on the local public transportation services for daily use (Questions were asked about the community bus and the community taxi services, respectively) Regarding the community taxi services, types of service (DRT type, scheduled & fixed-route type, and combined use of DRT type and scheduled & fixed-route type) were additionally asked	<p>.</p> <p>–(1)Operators (municipalities, chamber of commerce, commercial and industrial associations, local residents, NPOs, private businesses, etc.)</p> <p>–(2) Total number of routes and total number of services per day (past records of FY 2010 and FY 2009)</p> <p>–(3) Types of fare (flat-rate, distance-based rate, block-rate systems) and amounts of fares (the lowest and highest amount for each of distance-based rate and block- rate systems)</p> <p>–(4) Number of annual passengers (past records of Fiscal Year 2010 and 2009)</p> <p>–(5) Annual operating expenses, amount of annual fare-revenue , annual operating expenses borne by the subject municipality (past records of Fiscal Year 2010 and 2009)</p>

Valid responses were received from a total of 654 municipalities; 631 cities and 23 wards. The response rate was 80.8 %. In conducting the survey, municipal community bus and community taxi services were defined according to the definitions provided in the survey

conducted by the Ministry of Land, Infrastructure, Transportation and Tourism in 2006, as follows:

- Municipal community bus service: A service that is provided regularly by the initiative of public institutions such as the municipalities and local chambers of commerce or residents in specific areas, and independent from commercial route bus services provided by private businesses, in order to resolve areas without any transportation service or convenient transportation service as well as to enhance convenience. It is a new type of bus service with fares and operation schedules devised to enhance convenience. Private businesses acting as operating bodies are included in the list of operators as long as they are granted operating subsidies by the municipalities.

- Municipal community taxi service = A new community transportation service provided by the initiative of the municipalities using vans or station wagons in areas including depopulated areas where there is not sufficient demand for commercial route bus or municipal community bus services, in order to enhance convenience for the residents.

2. STATUS OF THE INTRODUCTION AND OPERATION OF LOCAL PUBLIC TRANSPORTATION SERVICES

2.1. Conditions of the Introduction

First, the conditions of the introduction of municipal community bus and community taxi services were studied. Figure 1 shows the result of this study. 306 municipalities have introduced only municipal community bus services. 48 municipalities have introduced only community taxi services. 158 municipalities have introduced both services. These three groups add up to 512 municipalities accounting for 78.3 % of those that responded (654 municipalities).

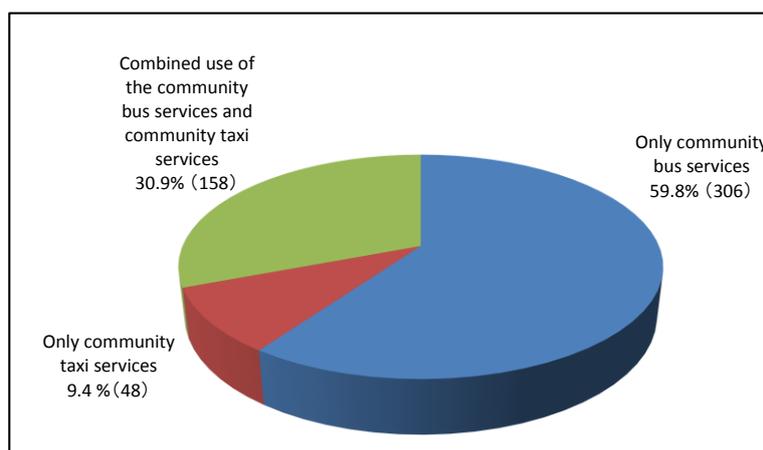


Figure 1. Types of local public transportation services for daily use introduced

According to a similar survey conducted in 2007, the number of municipalities that had introduced community bus services stood at 302 cities which accounted for 62.8 % of the respondents (481 municipalities). Meanwhile, in the 2nd survey of 2009 (641 municipalities responding), it increased to 421 municipalities accounting for 65.7 %. The survey conducted this time in 2011 (654 municipalities responding) indicates that it has increased to 464

municipalities, accounting for 70.9 % of the respondents (Figure2). Furthermore, in the survey of 2011, 12 municipalities responded that they planned to introduce municipal community bus services by Fiscal Year (FY) 2012 and, of the 12 municipalities that responded “other”, six gave positive responses that they are “studying” or “conducting test operations”.

Regarding municipal community taxi services on the other hand, the survey conducted this time in 2011 indicates that 206 municipalities have adopted this approach, accounting for 31.5 % of the respondents and having exceeded the 30 % mark for the first time. This means that the introduction rate has increased by a little over 10 points compared to that in the survey of 2009 (136 municipalities, 21.2 %) and by more than 16 points compared to the survey of 2007 (66 municipalities, 13.7%). The number of municipalities planning an introduction has reached 39 ones.

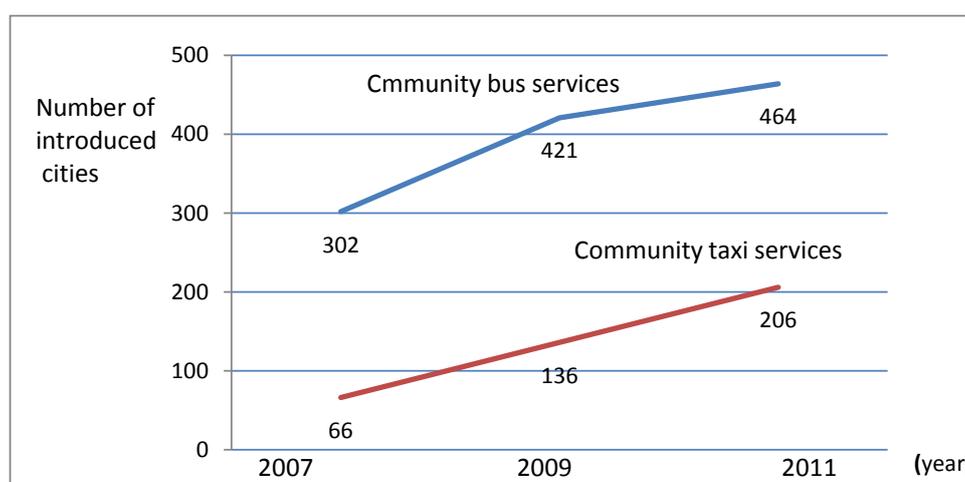


Figure 2. Number of cities that introduced community bus and community taxi services

This seems to be based on the context that,

- The initial investment is relatively small compared to municipal community bus services, even if vehicles are owned, except for a large investment in IT, as seen in some municipalities adopting the DRT approach.

- Thus, municipal community taxi services are gaining attention as an answer to resolve areas without public transportation services and to create new demands, as well as to facilitate the reorganization of the existing local public transportation services, including municipal community bus services less frequently used.

2.2. Conditions of Operation

Next, a study was conducted on the conditions of municipal community bus and community taxi services of the local governments that had introduced these services as of 2010. The result shows that the greatest number of municipal community bus operators (multiple responses) are the local governments, which stand at 72.4 % of the total. Private businesses (who are receiving subsidies from the municipalities) come next, accounting for 30.6 %, and local residents and NPOs follow, accounting for 5.0 %.

The result of the study of municipal community bus fares (multiple responses) is shown in Figure 3. The fare type that is most common is the flat-rate system (used in 367 municipalities). The distance-based rate system (used in 105 municipalities) in which fares are

calculated according to the distance travelled, comes next and the block-rate system (used in 81 municipalities) in which fares are set by predefined blocks, follows. The average amount of the flat-rates is 144.4 yen. The lowest and highest average amounts of the distance-based rates are 136.0 yen and 590.2 yen. The lowest and highest average amounts of the block-rates are 138.1 yen and 441.3 yen. In cases where the flat-rate system, distance-based rate system and block-rate system are adopted in combination, the average fare (in 454 municipalities) is 216.2 yen.



Figure 3. Types of fare of municipal community bus services (multiple responses)

A study was also conducted on the conditions of municipal community taxi services as of 2010. The result indicates that local governments are the most common operating bodies of community taxis (206 municipalities in total), standing at 51.2 %, exceeding half. Businesses (who are receiving subsidies from the municipalities) come next, accounting for 22.4 %, and local residents and NPOs account for 12.7 %. Regarding the types of services, DRT services provided in response to demands of passengers are increasing. Nearly half (47.1 %) of the municipalities responded that they have adopted “DRT services”. The “combined use of DRT services and scheduled & route services”, and the “use of scheduled & route services” tie for second position at 26.2 %.

As shown in Figure 4, the most common fare type (multiple responses) is the flat-rate system (144 municipalities), as is the case with municipal community bus services, and the block-rate system (58 municipalities) follows. The average amount of flat-rates is 248.2 yen. The lowest and highest average amounts of the distance-based rates are 173.9 yen and 601.7 yen. The lowest and highest average amounts of the block-rates are 228.4 yen and 651.8 yen.

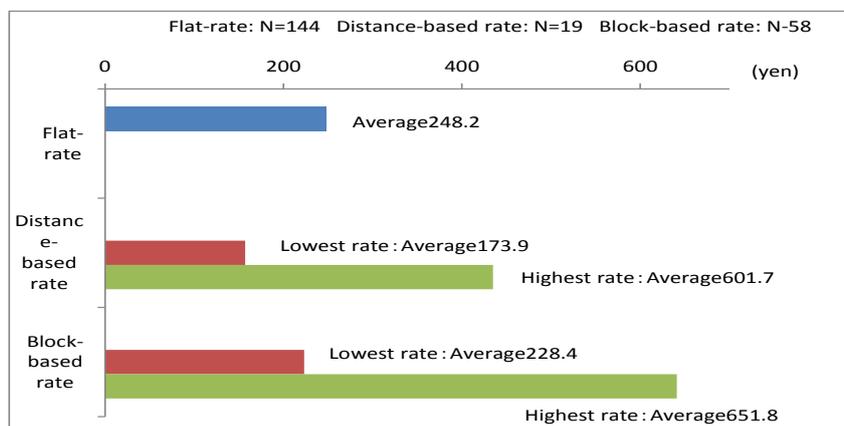


Figure 4. Types of fare of community taxi services (multiple responses)

3. LOCAL PUBLIC TRANSPORTATION SERVICE USAGE

3.1 Municipal Community Bus Service Usage

Next, the conditions of usage were researched. In the case of municipal community bus services, the average number of annual uses per capita (= number of annual passengers ÷ population as provided in the 2010 national census, preliminary figures) in 2010 was 1.749 uses (455 municipalities surveyed), which is a slight increase from 1.742 in 2009 (443 municipalities surveyed). Of the 294 municipalities where the local governments are the main operating bodies of municipal community bus services, 290 municipalities responded with the number of passengers. The status of usage in these municipalities is ranked as shown in Table 2. Musashino City of Tokyo is in first place with an average of 18.627 annual uses per resident. Minato Ward of Tokyo comes in second with 15.348 uses.

There are four cities with more than 10 average uses per resident: Musashino City, Minato Ward of Tokyo, Toba City of Mie Prefecture (10.557 uses) and Yasugi City of Shimane Prefecture (10.329 uses). Of the ten highest ranked cities, all nine other than Toba City have adopted the flat-rate system. The fares in six of the nine cities are 100 yen/ride.

Table 2. Ranking in the average number of annual uses of the community bus services per capita

Ranking	Name of municipality	Number of annual uses per resident	Number of annual passengers	Number of routes	Total number of services per day	Average fare(yen)	Annual operating expense(1000yen)	Fare revenue-to-expense ratio	Amount of expense per passenger borne by municipality(1000yen)
1	Musashino City, Tokyo	18.627	2,585,690	7	381	100	288,290	82.7	0.02
2	Minato Ward, Tokyo	15.348	3,151,000	7	519	100	-	-	-
3	Toba City, Mie Pref.	10.557	226,049	5	80	450	128,864	33.7	0.38
4	Yasugi City, Shimane Pref.	10.329	429,709	15	174	200	231,762	21.7	0.36
5	Takashima City, Shiga Pref.	8.955	470,081	17	333	220	454,279	38.5	0.55
6	Koganei City, Tokyo	8.874	1,055,057	5	138	100	122,088	83.7	0.03
7	Kokubunji City, Tokyo	7.994	965,184	4	121	100	92,482	100.1	0.02
8	Taito Ward, Tokyo	7.756	1,365,715	3	150	100	226,293	-	-
9	Urayasu City, Tokyo	7.701	1,269,720	2	160	100	194,942	62.0	0.06
10	Kouga City, Shiga Pref.	6.800	630,297	35	510	250	317,054	28.2	0.36

(Note) Past records in FY 2010 of total 294 cities where municipalities are the operating bodies
 The bold face of average fare indicates flat rate
 Block-based rate is set in Toba City. (The lowest rate is 200 yen and the highest is 700 yen.)

The average annual uses per resident vary substantially by municipality as shown in Figure 5.

18 municipalities have more than five annual uses, including Musashino City, Koganei City, Kokubunji City and Taito Ward of Tokyo and Urayasu City of Chiba Prefecture. Only 78 have more than two annual uses. Nearly half of the total, or 139 municipalities fall below one use per capita.

What factors have caused the municipal community bus use variations between cities? Thirteen possible factors (=variables) were considered, including population density (= population per administrative area of 1km²), "Public transportation usage rate" (=This indicator referred to in this study is defined as the usage rate of railways and buses by the travelling population, based on the national census in 2000 that was updated at the time of this

survey), “Public transportation accessibility” (=This indicator represents the ratio of households within a distance of 500m from a railway station, provided in the 2010-year nationwide statistical survey of houses and lands), number of community bus services per day, and fare level (average fare in cases where there are multiple fare systems). The correlation between those variables and the average number of annual uses per capita was examined. (The subject of the study was 464 municipalities, excluding those with missing values.)

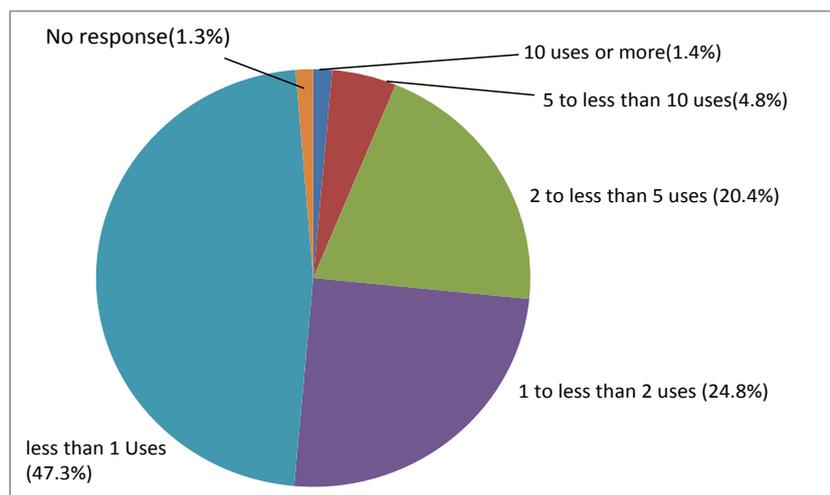


Figure 5. Composition ratio of cities in number of annual uses per capita

The result of the study is shown in Table 3. The index that shows a relatively strong correlation is the one representing the frequency of services, or the total number of services per day. The correlation coefficient is 0.557 or a 1 percent level, which indicates a significant correlation. (Figure 6 is a scatter chart.) Examples of the undertakings by Musashino City (population: 138,000) and Yasugi City (population: 41,000) revealed that highly convenient transportation services with frequent daily services are, in many cases, the decisive factors to attract passengers.

Table 3. Correlation Coefficient between Level of Usage and Related Variables (Total 13)

	Population per DID area (km ²)	DID population ratio to total population	Population per administration area (km ²)	Usage rate of public transportation services (%)	Transportation accessibility (%)	Number of private cars possessed per person	Financial capability index	Population of age over 65 per 100 residents	Number of retail stores per 1000 residents	Number of restaurants per 1000 residents	Total number of services per day	Average fare (=Fare level)	Ratio of operating expense born by municipalities (%)
Total (464 cities)	.166**	0.034	.190**	0.186**	0.152**	-.159**	0.123**	-.009	-.022	.066	.557**	.163**	-.348**
Less than 100,000 people (274 cities)	.075	.016	.023	.073	.020	-.057	.039	.010	-.035	-.019	.566**	.376**	-.292**
100,000-less than 300,000 people (142 cities)	.420**	.322**	.537**	.501**	.434**	-.473**	.368**	-.205*	-.110	.240**	.766**	-.146	-.562**
300,000 people or more (48 cities)	.123	-.062	.129	.026	.115	.064	.358*	-.136	-.052	.031	.605**	-.096	-.355*
Number of cities for which the correlation coefficients are calculated													
Total	410	464	464	464	464	464	464	464	464	464	444	454	424
Less than 100,000 people	220	274	274	274	274	274	274	274	274	274	267	268	252
100,000-less than 300,000 people	142	142	142	142	142	142	142	142	142	142	132	139	129
300,000 people or more	48	48	48	48	48	48	48	48	48	48	45	47	43

Note: The correlation coefficient is significant at 1%(0.01) level and with 5%(0.05) level (two-sided test)
 Population density per DID area of zero is treated as a deficit value. (since it is in calculable if DID is zero.)
 The DID population ratio to overall population could be zero. (when DID area is zero.)
 The original data with three decimal places is used after rounded to two decimal places.
 Processing of the deficit values has been completed.

In the case of Hino City of Tokyo as well, the number of passengers grew in most areas, even doubled in some areas. This resulted from their actions to cut three overlapping routes out of seven routes and to increase the service frequency from one service per 80 minutes to

one service per 60 minutes. (This information obtained from the interview of Taro Obata, Assistant Manager, Transportation Policy, City Planning Division, Hino City.)

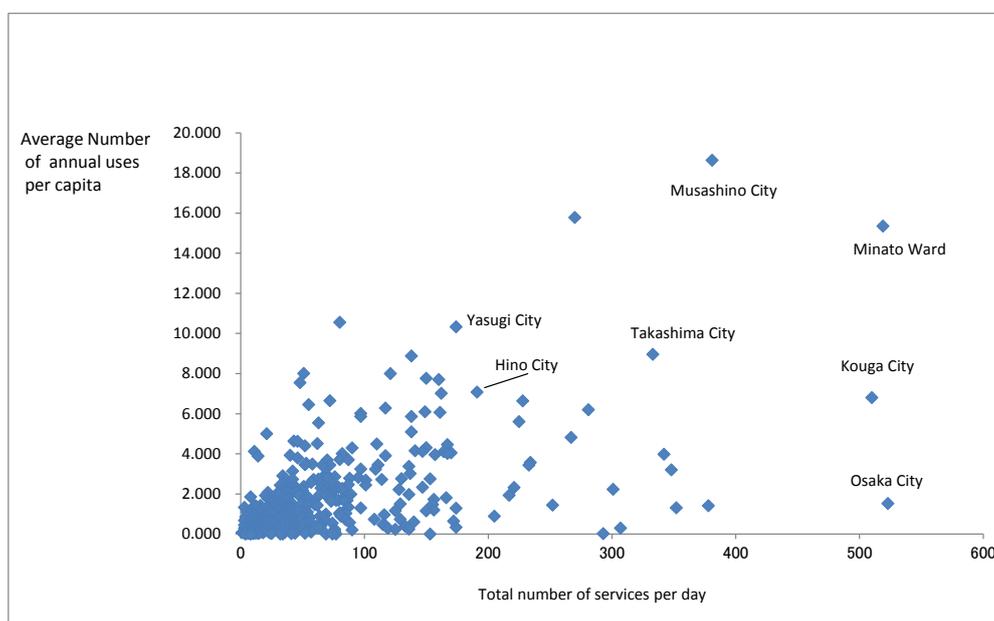


Figure 6. Relationship between the total number of services and number of uses per resident (for 444 municipal districts excluding those with deficit values)

Correlations of the total number of daily services and usage level are also supported to some extent by the statistical figures gained from the survey of the total trend.

A correlation analysis was attempted as well, according to the size of the population based on three classifications (populations of less than 100,000: small-size city, 100,000 to less than 300,000: medium-size city, 300,000 or more: large-size city).

Table 3 shows the result of this analysis. Looking just at the medium-size cities (including Musashino City), many of which provide urban community bus services, a number of correlations can be seen between the variables and the number of uses.

The correlation coefficient of the total number of services per day is 0.766. In addition, the correlation coefficients increase with the population density (= population per administrative area of 1km²) (0.537), the public transportation usage rate (0.501) and public transportation accessibility (0.434), as well. As for the average fare (=fare level), only a minor correlation is found. A number of people question the effect of the fare level on usage, and this thinking is supported to some extent.

Next, a multiple regression analysis (Stepwise procedure) was attempted, setting the usage level (= the average number of annual uses per capita) as an dependent variable and thirteen variables (the same as the variables in the correlation analysis) as independent variables (Subject for study: 444 municipalities excluding those with missing data similarly as in the correlation analysis). Table 4 shows a summary of the result.

The stepwise procedure is a method to select automatically the set most suitable for best explaining the dependent variable, from a number of independent variables that are subjected to analysis. Firstly, three independent variables of "total number of services per day", "ratio of expenses borne by municipalities" and "population per administrative area (1km²)" were

selected for entire 444 municipalities. Of those independent variables, the "total number of services per day" has the largest standardized regression coefficient = β coefficient which represents the magnitude of influence. It is, thus, expected that the more it increases, the more the frequency of uses grows.

Table 4. Result of multiple regression analysis (β coefficient: standardized regression coefficient)

Independent Variables	A. All cities (444 municipalities)			B. Medium size cities (municipalities with a population of 100,000 to less than 300,000)				
	model A-1	model A-2	model A-3	model B-1	model B-2	model B-3	model B-4	model B-5
Total number of services per day	0.509 *** (11.095)	0.449 *** (9.985)	0.429 *** (9.533)	0.722 *** (11.187)	0.618 *** (11.555)	0.599 *** (11.687)	0.572 *** (11.425)	0.543 *** (10.544)
Ratio of operating expenses borne by municipalities(%)		-0.265 *** (-5.880)	-0.236 *** (-5.187)					-0.120 * (-2.051)
Population per administrative area (km ²)			0.139 ** (3.079)		0.428 *** (8.005)	0.380 *** (7.205)	0.433 *** (8.093)	0.374 *** (6.261)
Financial capability index						0.181 ** (3.491)	0.334 *** (4.799)	0.303 *** (4.329)
Ratio of population of age over 65 per 100 residents							0.227 ** (3.153)	0.184 * (2.484)
Adjusted coefficient of determination(R ²)	0.257	0.322	0.338	0.517	0.688	0.716	0.737	0.744

Note: Dependent variable: number of annual uses per capita
t value in parentheses(significant level(p): *: $p < 0.05$,**: $p < 0.01$,***: $p < 0.001$)

The "ratio of expenses borne by municipalities" is the next most influential independent variable. Its β coefficient is a negative value, which indicates a tendency that the larger the "ratio of expenses borne by municipalities" is, the less the frequency of uses becomes. It can be also viewed that increasing the amount of expenses borne by municipalities without careful consideration does not necessarily increase the frequency of uses. Moreover, there is a tendency that the larger the population per administrative area (1km²) is, the larger the frequency of uses grows. This implies a general consensus that it is difficult to increase the frequency of uses in rural areas, is being built.

However, the adjusted coefficient of determination, R² of the multiple regression model using these three independent variables is 0.338, which explains only 33.8% of the variation in the degree of uses. It is possible to obtain statistically useful information, such as the one pointed out in the above, concerning the measures and policies to increase the frequency of uses. Power of explanation is, however, not empirically strong since the adjusted coefficient of determination is considerably lower than 0.5.

One of the major reasons for this is considered to be due to a difference in the necessity and the condition of operation of community buses depending on the size of population of city.

Therefore, cities were divided into three groups by the size of population as in the table 3 and multiple regression analysis was conducted for each group.

As a result, number of independent variables selected as influential variables increased to five in the cities with population of 100,000 to less than 300,000 and relatively large number of community bus services, and the adjusted coefficient of determination grew to 0.744. Adjusted coefficient of determination of more than 0.7 means that it explains more than 70% of the variation. It can be, thus, said experientially that the power of explanation is quite high.

These five independent variables include not only three independent variables selected for the entire multiple regression analysis but also the "index of financial condition" and "ratio of population of age of 65 or more per population of one hundred".

In this case as well, the "total number of services per day" is most influential as is in the entire analysis. The β coefficient is 0.543, larger than 0.429 in the entire analysis, and it becomes even more important.

The "population per administration area (1km²)" is the second most influential variable and the "index of financial condition" comes to the third.

It can be thought that it is easier for cities with large financial capacities to promote use of the community buses since those cities are capable of improving the public facilities that generally lead to growth of demand.

In addition, the "ratio of population of age of 65 or more per population of one hundred" is the fourth most influential variable. This represents that increase of elderly people who tend to use community buses more than private passenger cars should lead to the improvement of the frequency of uses.

As for the "ratio of expenses borne by municipalities", the β coefficient is negative in the cities with population of this size as well. There is also a tendency that the frequency of uses is less in the cities with higher ratio, but its importance is the lowest among the five independent variables selected.

The multiple regression analysis conducted this time revealed that the "total number of services per day" has the largest power of explanation even in the medium-size cities only.

This applies to the case where the values of other variables are assumed to be the same.

In reality, however, increasing the number of services may create a substantial increase in operating expenses for the municipalities. This is because, in the case of municipal community bus services, the fare revenue is too small to cover the expenses. This study also indicates that the average fare revenue-to-expense ratio of the municipalities with community bus services_in 2010, is 25.9 %. (Said ratio: fare revenue/operating expense; the study was

based on the 420 municipalities that entered the operating expenses and fare revenue) The remaining 74.1 % represents a deficit, of which operating expenses borne by the subject bodies account for 71.4 %.

In large city areas with high population densities, such as Musashino City, the fare revenue-to-expense ratio is generally high. However, smaller cities (which ranked high in the number of average annual uses per capita) ranked lower in the fare revenue-to-expense ratio. In the case of Yasugi City, the fare revenue-to-expense ratio is 19.7 %. The fare revenue (52.92 million yen) covers only about 20 % of the operating expense (268.8 million yen) and the rest is subsidized by the city (156.23 million yen, 58.1 %), prefectural and national governments. Municipal community bus services will not, hence, be regarded as sustainable local transportation services if the operating expense burden on the municipalities reaches levels that put pressure on their budgets.

Figure 7 shows the relationship between the total number of services per day and the expense burden of the municipalities, as a scatter chart. Even among the cities where the total number of services per day is large, some cities have relatively small expenses while other cities bear larger expenses. It is therefore advisable to increase the frequency of services to secure more passengers, but to consider and balance the financial burden as well.

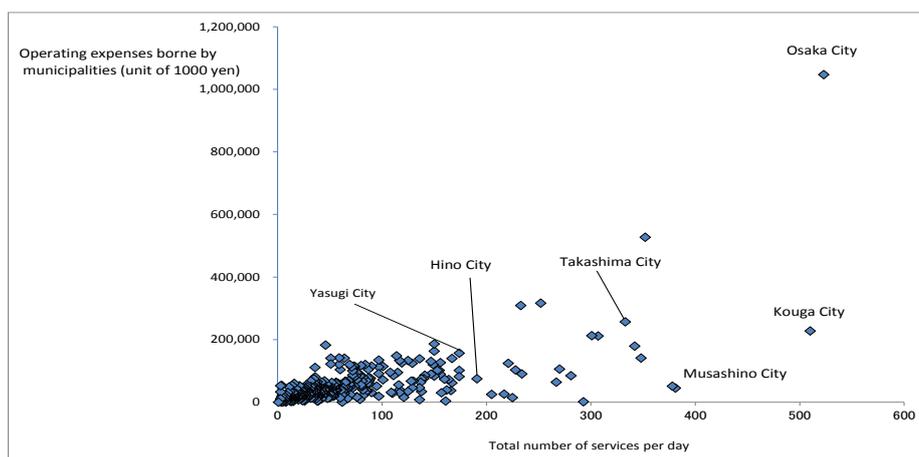


Figure 7. Relationship between the total number of services and operating expenses (for 422 municipal districts excluding those with deficit values)

3.2 Municipal community taxi service usage

A study of municipal community taxi services was also conducted. Looking at the number of annual uses per resident, the average was only 0.167 uses in 2010 (in 194 municipalities), a slight decrease from that in 2009 (0.173 uses in 155 municipalities). This seems to be because small vehicles are used for the municipal community taxi services, and also the residents are not yet familiar with how to use them.

The annual number of uses per capita also differs from municipality to municipality, though the difference is not as large as that of municipal community bus services.

Table 5 shows the ranking of municipal community taxi service use. Only four municipalities have an average of one or more uses per capita: Chiyoda Ward of Tokyo is in first place (2.483 uses), Tainai City of Niigata Prefecture is second (1.403 uses), Toumi City of Nagano Prefecture is third (1.318 uses) and Akitakata City of Hiroshima Prefecture is

fourth (1.256 uses). In the case of Chiyoda Ward, the number of uses is high, because municipal community taxi services have a strong image of being "welfare taxi services" and the fare is free for elderly people and disabled people.

Table 5. Top list in the average number of annual uses of community taxi services per capita

Ranking	Name of municipality	Number of annual uses per resident	Number of annual passengers	Number of annual uses per elderly person	Service type	Number of routes	Total number of services per day	Average fare (yen)	Annual operating expenses(1000yen)	Fare revenue-to-expense ratio(%)	Annual expenses borne by municipalities per passengers (1000yen)
1	Chiyoda Ward, Tokyo	2.483	117,154	13,910	□	3	25	100	75,953	1.9	0.64
2	Tainai City, Niigata Pref.	1.403	44,103	5,296	◎		100	300	50,107	26.7	0.62
3	Tomi City, Nagano Pref.	1.318	40,476	5,637	○	5	16	200	38,501	17.1	0.79
4	Akitakata City, Hiroshima Pref.	1.256	39,549	3,682	◎	6	68	400	49,041	22.1	0.99
5	Kakuda City, Miyagi Pref.	0.984	30,845	3,760	◎	5	40	300	-	-	-

(Note) Record of total 206 cities in FY 2010
 Service type: ◎=DRT type, ○=combined use of DRT type and scheduled & fixed-route type, □=scheduled & fixed type

The revenue-to-expense ratios are lower than those of municipal community bus services. The average revenue-to-expense ratio in the 184 municipalities that reported both operating expenses and fare revenues (except Mutsu City of Aomori Prefecture and Sanjo City of Niigata Prefecture having no all year operating records) is only 19 %. It seems to be affected by the low cost-benefit performance. In many cases, the operating expense burden is light because the vehicles are leased from taxi companies, but many of the community taxis are actually used by only one passenger. The deficit-recovering ratio of the municipalities is 77.0 % on average. The remaining expenses are covered by subsidies of the national and prefectural governments.

In many cases, the more the number of services increases for the more common DRT approach in particular, the more the financial burden on the local governments will grow to cover the operating expenses including personnel costs for drivers. This is partly because relatively low fares are set for the DRT approach. Tainai City of Niigata Prefecture, which introduced a full DRT approach with door-to-door service city-wide in 2009, as an alternative to the route bus services, is one of the typical municipalities with that characteristic. The comparatively cheap flat rate of 300 yen per trip has caught on and secured a good number of passengers, making the average number of annual uses one of the highest in the country.

However, according to the interview survey (information obtained from the interview of Minoru Sugai, Assistant Manager, General Policy Planning Division of Tainai City), the fare revenue-to-expense ratio is only 26.7 % and the rest is covered by the city (54.7 %) and national subsidies, despite the decrease of the financial burden of local public transportation services by some 2 million yen as compared to the route bus services (55 million yen).

Passengers are increasing also in Sanjo City of Niigata Prefecture which has adopted the DRT approach with predetermined depots for passengers getting in and out in 2011. Nevertheless, the subsidies for services already reached 71.49 million yen in the final accounts of FY 2011.

Although the bus routes subsidized were reduced following the introduction of municipal community taxi services, the subsidies for bus services still amount to 35.40 million yen (in the final accounts) exceeding 100 million yen with both subsidies combined as Table 6 shows.

The city's financial burden for local public transportation services for daily use swelled

larger than before the test operation of municipal community taxi services. (The subsidies for bus services were 66.81 million yen in FY2008.)

An interviewee (Masae Ota, Assistant Manager, Environment Division of Sanjo City) said that the initial purpose of the introduction of municipal community taxi services was to expand the utilization of local public transportation services by enhancing their convenience. He also remarked that the number of local public transportation passengers is growing steadily, but the financial burden on the city has increased more than expected, since municipal community taxis were used by only one passenger in many cases.

Table 6. Comparison of both annual operating expenses of Bus and DRT service borne by Sanjo City

	FY 2008 (1,000yen)	FY 2011 (1,000yen)
Bus service	66,811	35,400
DRT service	0	71,494
Total	66,811	106,894

As mentioned previously, the interview surveys of the municipalities also revealed that municipal community taxi services, especially DRT services, are more difficult than municipal community bus services to balance the convenience and the financial burden.

It is a common problem afflicting many municipalities that want to establish efficient local public transportation systems for residents under the constraints of their financial conditions. From the interview surveys, it is clear that municipalities are seeking an answer to these problems. Kodaira City of Tokyo is one of the municipalities endeavoring to build a local public transportation network in alliance with residents by initiating a study organization to prompt the residents to assume some degree of the responsibility.

Since January 2004, they have been operating municipal community buses that loop around the central area, commissioning a large private bus company to conduct the operation.

The notable point is that they began a study to divide the city into four areas, and introduce municipal community taxis in each area (one taxi accommodating up to nine passengers). They chose to make that move in response to requests for new routes in other areas. That decision was based on the thinking that it would be difficult to build new routes for the municipal community bus services due to the city's narrow roads on the whole, and its financial constraints.

Furthermore, the process they used to achieve their goal is also interesting. They first requested the areas desiring new routes to establish local study organizations called "Meeting to Think about Community Taxi Services" that consisted of residents, shops, hospitals, and other local businesses. The meeting was to foster a consciousness of community support and development among the residents. In this meeting, the people worked together with the city to consider a basic operating plan, including the selection of routes. Generally, when municipalities decide operating plans such as the selection of routes, the residents' feeling of simply relying on public administration tends to grow and the demands they place on the administration become irrational. The undertaking of Kodaira City attracts our attention as a good example to put an end to such negative effects and to prompt citizens to be more autonomous and responsible.

According to the interview survey (information obtained from the interview of Megumi Sato in charge of public transportation, City Development Division, Kodaira City), based on the study results of the Meeting to Think about Community Taxi Services, the city has started to introduce municipal community taxi services (Figure 8) in two areas since September 2009. Both of those routes are in operation at about thirty-minute intervals from Monday to Friday (16 services in total per day). Jumbo taxis using mini-vans accommodating up to nine passengers are used for both routes. The utilization rate (=number of passengers/vehicle capacity) is more than 40 % on average.



Figure 8. Community taxi services, Kodaira City

The city is also trying to have the residents assume a certain financial responsibility. The city estimates approximately five million yen as the maximum operating expense per route that can be borne by the city, based on the calculation that the number of passengers is 70 per day. As a point of reference, the amount of expenses borne by the city in the settled accounts of FY 2010 fell below the maximum, at 4.79 million yen as Table 7 shows (the ratio to operating expenses: 70.4 %). Although this maximum of five million yen was determined solely by the city, without the consensus of the Meeting to Think about Community Taxis, the city expects that the figure itself will serve as a means to maintain a certain fiscal discipline to put a brake on swelling operating expenses as well as to foster utilization by the residents.

Table 7. Comparison of both annual operating expenses of community bus and community taxi service borne by Kodaira City

Fiscal Year	Types of local public transportation	Annual operating expenses(including depreciation cost)	Annual fare revenue	Annual operating expenses borne by municipality	Fare revenue-to-expense ratio(%)
2008	Community bus service	57,765,429	33,159,355	24,606,074	57.4
2009	Community bus service	57,118,497	32,909,942	24,208,555	57.6
	Community taxi service	7,544,955	1,079,140	6,465,815	14.3
2010	Community bus service	56,758,719	33,037,550	23,721,169	58.2
	Community taxi service	6,809,487	2,013,050	4,796,437	29.6

Note: Community taxi service is that of Onuma route

The municipal community taxi services of Kodaira City are not DRT type. However, they provide many ideas, as a successful means of maintaining fiscal discipline with a maximum limit set on the financial burden to the municipality and increasing the frequency of use, and also as a model for future local public transportation services including community bus services.

4. CONCLUSION

The information and knowledge learned from this study and issues for the future are provided as follows:

First, cities having introduced either municipal community bus services or community taxi services reached close to 80 % of the municipalities that responded (654) in 2011. Of these municipalities, those having introduced municipal community bus services account for a little over 70 % or a 5-point increase compared to that of two years previous. Meanwhile, the introduction rate of municipal community taxi services shows a rapid growth with a little over 30 % or just over a 10-point increase compared to two years previous. As in the case of Sanjo City, some municipalities adopted the DRT approach, giving priority to the achievement of local public transportation services with more convenience than the conventional route bus services, even if it leads to an increase of the financial burden. On the other hand, a number of local governments got aboard the municipal community taxi bandwagon, shallowly thinking that would create new demand at a relatively small amount of expense.

Secondly, it is important to pay attention to the relationship of service convenience including service frequency and level of usage. The recent undertakings and studies of local public transportation services also suggest that it will yield higher service usage if efforts are made to enhance the service convenience. Such relationships are supported also by the analysis of municipal community bus services in this study, to some degree.

As a result of the correlation analysis of the municipal community bus services usage rate (the average number of annual uses per capita), the correlation with the index representing the service frequency or the total number of services per day is found to be relatively strong. In addition, in those cities with a population of 100,000 to less than 300,000, and especially those operating many urban community buses, that correlation is strong.

However, even if the service frequency is increased, municipal community bus services cannot be regarded as a sustainable local transportation system if they weigh too much on the local governments financially. This study has revealed that even with municipal community bus services, fare revenues cover only about 25 % of the operating expenses on a national average. It has also been found that the municipal community taxi service revenue-to-expense ratio goes below 20 % and many cities are making up large amounts of the deficits.

Municipal community bus and community taxi services are being watched as sustainable local public transportation services. However, DRT type community taxi services in particular, require that the local governments introducing the services need to deliberate thoroughly as to whether they ought to be positioned as sustainable public transportation from a financial viewpoint. This is because it may lead to a swelling financial burden unless some sort of upper limit is put on the amount of operating expenses to be borne.

Nevertheless, the interview survey revealed that in order to promote local public transportation services for daily use with more convenience and efficiency, with limited finances, the approach of Kodaira City, prompting the residents to assume some responsibility for the operation, could be a model for the future.

Lastly, there are many subjects left unanalyzed in this study, including a more detailed data analysis of the influence of measures to enhance the convenience (such as service frequency) on the usage level of municipal community buses, a desirable division of roles of local governments and residents toward the achievement of sustainable local public transportation services, managing both the convenience and financial burden of the rapidly increasing DRT type community taxi services, differentiation from the common taxi services, and the approaches taken by other towns to local public transportation services. These are thought to be subjects for future study.

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