

## **A FUNDAMENTAL STUDY OF CAR-SHARING SYSTEM BY CITIZEN**

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**Abstract:** Most car-sharing systems in Japan are operated by a large organization. For example, they are companies, self-governing bodies, and foundations. Many of these are almost membership system rental cars. This type of system is operated as a rental car basis legally. Recently, in some areas, car-sharing system is operated by citizens. This is based on the contract of joint use. The latter is "permission of joint use" and is a first example as car sharing legally. In this research, we focus on an unprecedented car-sharing system in our country. We will try to clarify whether a small scale system goes well from cost efficiency view point.

**Key Words:** Parking lots, Small scale car-sharing,

### **1. INTRODUCTION**

The car-sharing system began from the late 1980s in Europe (Figure 1). Now, some systems started in Japan also. The system of Mitaka-City and Kita-ku were carried out as social experiments. A company is carrying out as business (CEV Sharing Corporation Website, 2004). The Japanese government, companies and foundations subsidize all of them. There are two kinds of systems now. One is a "membership system rental car" which companies, self-governing bodies, and foundations are performing. This type of system is operated as a rental car basis legally. Others are based on the contract of joint use. This started in Shiki-City, Saitama recently. Legally, it is the first case in Japan in the scheme of permission of joint use (NPO corporate body "The Ring of Shiki" Website, 2004).

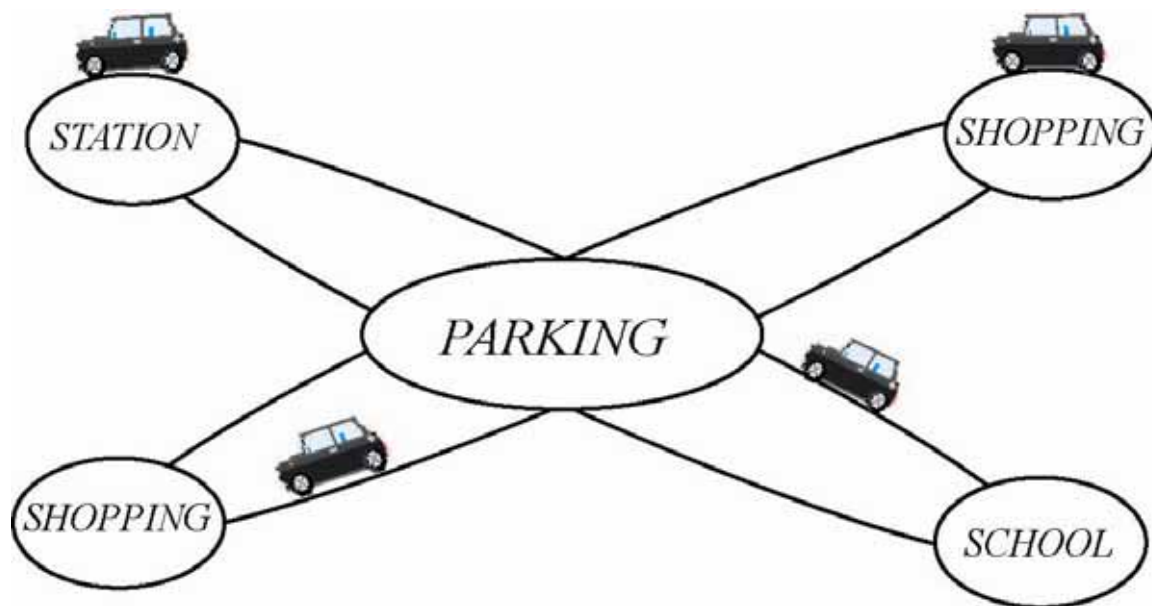


Figure 1. Image of Car-sharing System

In this research, the case of Shiki-City which is unprecedented in Japan is analyzed. The viewpoint is whether this type of small system can be manageable or not from financial aspects.

## 2. OBJECT OF CAR-SHARING SYSTEM IN SHIKI CITY

### 2.1 Background of System

The Shiki New Town (3,300 households) is known as a housing complex which is full of green area (Figure 2). Extension of parking lot may worsen a landscape, and asset value may decrease. Consequently, the car-sharing system is considered as an only means to solve a problem.

The Shiki New Town is in front of a station, and is easy to use shopping and a railroad. There are a lot of people with few chances to use the private car. It is comparatively easy to live without a car. Candidates of car sharing system are the residents of the following, "There is almost no necessity of having a car. However, it is uneasy to part with a car." "It is convenient if car-sharing system occurs."

The questionnaire survey about car-sharing system was carried out in some blocks (476 households) of the Shiki New Town in August, 2002. Consequently, they received a positive answer from 50 households. The interested people gathered, and "Shiki Car-Sharing study group" was launched in August 2003. The NPO "Ring of Shiki" was established management

subject. This is for appealing for the participation to study group body of the system. Permission of joint use was obtained in May, 2004. Car sharing system started in trial bases by five members.

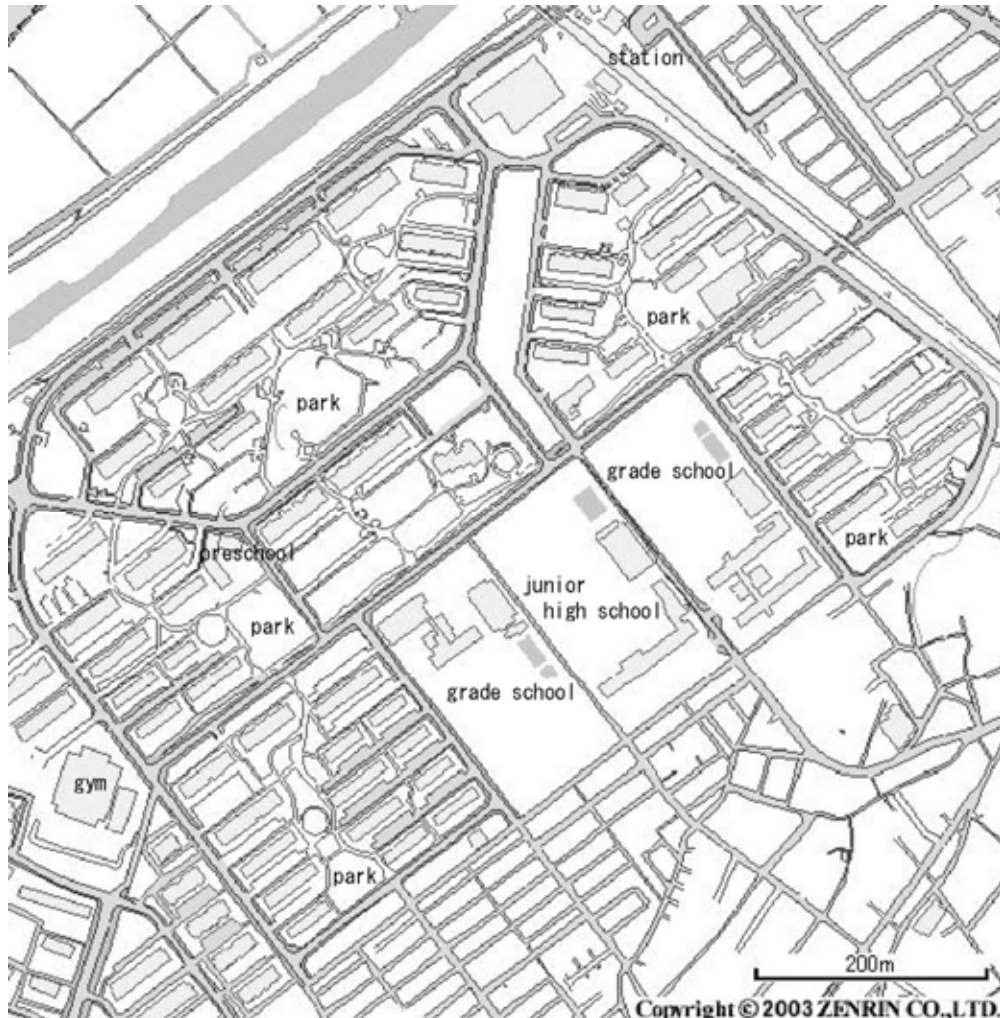


Figure 2. Map of Shiki New Town

In Japan, following two laws are relating to car a sharing system.

- The Road Transporting Law, the 79th Article(Permission of joint use)
- The Road Transporting Law, the 80th Article, the 2nd Section(Prohibition of onerous transportation, and restriction of lease)

This system obtained permission based on the 79th article of the road transporting law. Now, they are submitting “Application for simplification or exemption of a permission of joint use” in the Road Transporting Law.

## 2.2 Outline of System

Table 1 shows the outline of a system. It was carried out on condition that all responsibility is shared within members. The intimate rule was excluded. When reservation overlaps, complementary measure is carried out with the special rentacar service for car-sharing members, under cooperation of a neighboring rentacar company.

Table 1. Outline of System

Car	One of a member's private car
Parking	neighboring elementary school personnel parking lot
Reservation of System	PC or Cellular Phone using time and distance entry
Upkeep of Key	Copy a key(Each user upkeep)
Membership Fee	Entrance fee: 2000yen (No membership fee) Time charge: 600yen/1hour Distance charge: 100yen/5km
Refuel Maintenance	Once a week
Payment	Every two month
Other	An owner pays the fixed expense of vehicles

## 2.3 Efficacy of System

The Shiki New Town was sold out in 1979. A number of parking lot installations at that time were small. It is difficult to supply a satisfactory parking lot. The green tract is converted to the parking lot, which spoils the sight.

Enforcement of a car-sharing system enabled efficient use of a car. The possibility of solution of a parking lot problem can be expected. If a system will permeate from now on, participant of a car-sharing system will increase, and expense efficiency will be considered to increase. There is a large merit in car-sharing system. Maintenance expense will reduce extremely for each person. And environmental load due to scraped car will decrease for society. This is because owners decrease in number.

## 3. PURPOSE OF RESEARCH

Now, this system is not recognized by many residents, and there is little member. There is only one sharing car. There is possibility that reservation may overlap with other members. In this case, they may give up reservation of a sharing car and use of a rental car. Efficient

management may depend on a member's use situation. In this research, we simulate this car sharing system in the present use state. And it is supposed to be a fundamental study on the activity in the future from the cost efficiency ratio.

#### **4. SIMULATION MODEL**

To reproduce the situation at the current state, we construct the simulation model. The simulations are erected to reproduce the current condition and changed condition. The results are analyzed mainly about the relation between the uses rate and expense efficiency.

The flow of a simulation model is shown below.

(1) Setting of System Parameters

Occur Probability of User, Setting of Using Time,  
Setting of Using Distance, Setting of Savings System

(2) Occur of User

Based on a Poisson distribution, a user is generated based on an actual use situation.

(3) Check of Sharing Car

Check whether a sharing car can be used as desired.

(4) Select of Rental Car

Choose whether member who does reservation uses a rental car.

(5) Change of Reservation Time

Choose whether reservation time is changed till the time which can use a sharing car.

(6) Setting of Using Time

Decide on use time.

(7) Give up Using

Give up reservation.

(8) Formation of Reservation

Reservation is completed.

Number of sharing-car will not change in this research. And a rental car will be allocated without restriction.

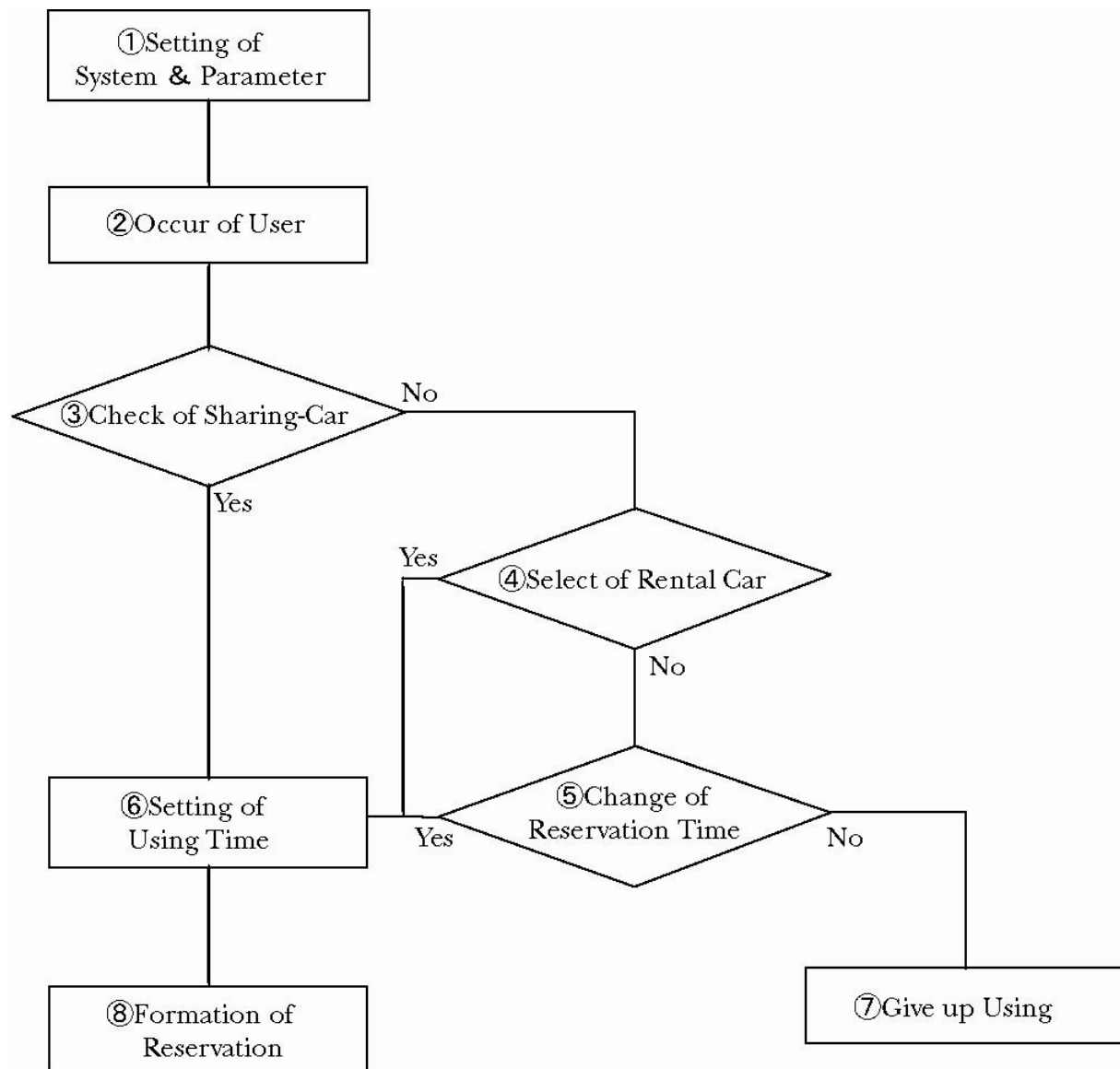


Figure 3. Flow of Simulation Model

## 5. CURRENT USAGE

Table 2 shows an actual use. This system started from May, 2004. There are a few users at present, because the members are those who do not use a car by everyday life. They think that a merit is high by sharing rather than owning. Figure 4 shows a time zone of use. A car is mainly used in daytime.

Figure 5 shows a time length of use. Two hours use is most frequent. There are few users who used for a long time. The relation between a time length of use and a distance of use is shown in Figure 6. The long time users tend to use for a long-distance. There is a distance variation in two hours users.

Table 2. Status of Use (May & June.2004)

Date	Rate: 600 (yen/1hour)			Rate: 100 (yen/5km)			Total Fee (yen)
	Using Time	Using Unit	Fee(Time)	Using Distance	Using Unit	Fee(Distance)	
22.May	2.00	2	1200	17.00	4	400	1600
22.May	1.00	1	600	4.00	1	100	700
23.May	1.80	2	1200	11.00	3	300	1500
26.May	1.30	2	1200	15.00	4	400	1600
30.May	1.70	2	1200	20.00	5	500	1700
1.June	1.70	2	1200	33.00	7	700	1900
3.June	5.00	5	3000	51.00	11	1100	4100
6.June	1.50	2	1200	4.00	1	100	1300
8.June	1.50	2	1200	38.00	8	800	2000
15.June	0.90	1	600	13.00	3	300	900
total	18.30	21	12600	206.00	42	4200	16800
average	1.80	2.1	1260	20.60	5	470	1730

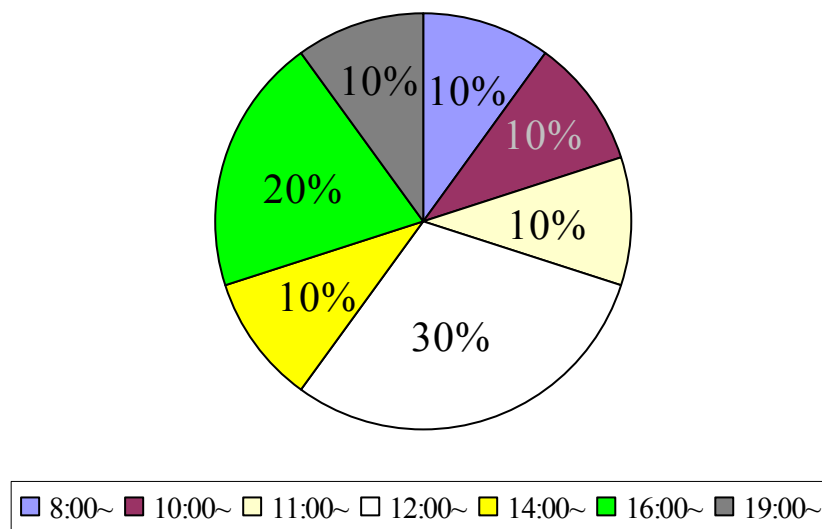


Figure 4. Time Zone of Use

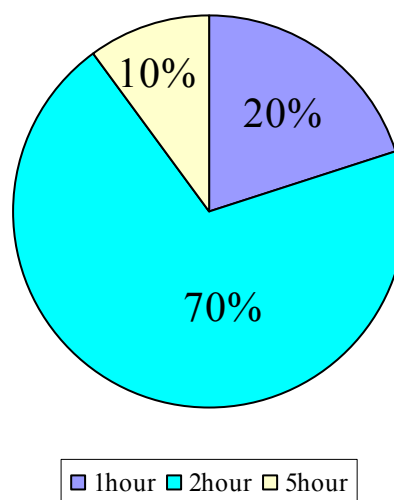


Figure 5. Rate of Using Time

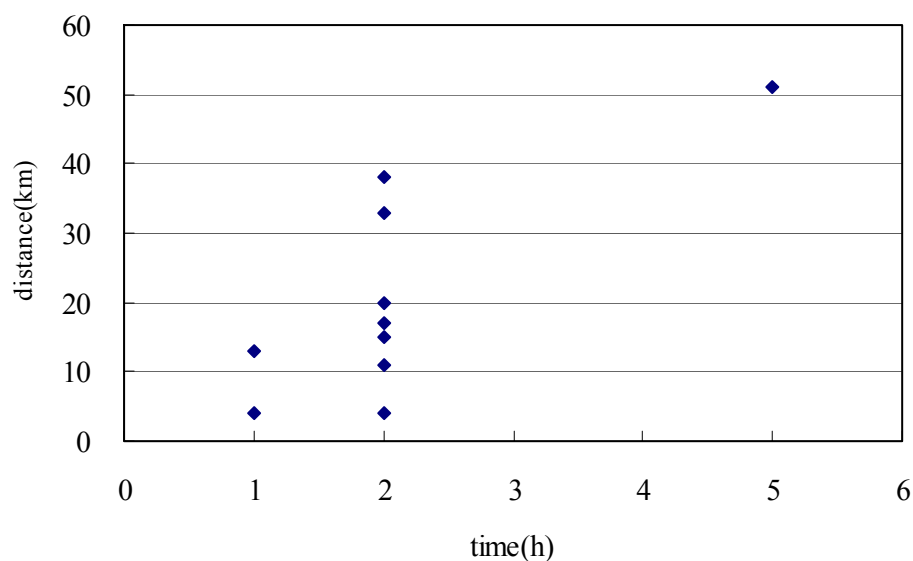


Figure 6. Relationship of Time and Distance

## 6. APPLICATION ON RESULT OF SIMULATION MODEL

A simulation result is shown in Table.3. It shows that the simulation model approximated the actual value, and that.

Table 3. Result of Simulation (1)

	Number of Reservation (people)	Number of Using Sharing-Car	Number of Using Rentacar	Failure Rate (%)	Total of Using Time (hour/month)	Total of Using Distance (km/month)	Reserve (yen/month)
Actual	10.00	10.00	0.00	0.00	21.00	206.00	16800.00
Simulation	11.14	10.86	0.28	2.34	21.40	217.05	16971.00

When the system user increases, the member who gives up reservation increases. In this case, user of several percent that hopes for the use of the sharing car cannot be used. A social experiment in Mitaka-shi and Kita-ku was reported as follows (Foundation for Promoting Personal Mobility and Ecological Transportation, 2002). A proper number is 17 persons per car, when a use is mainly on a weekday. 3.7 percent of members cannot use a sharing car. From this, the maximum of the rate (failure rate) which cannot use a sharing car define 3.7% in the simulation.



## 7. RESULT AND CONSIDERATION

A simulation result is shown in Table.4. When the number of reservations in this simulation is 2.3 times as large as an actual number of reservations, it is limit value which exceed failure rate. An increase of the great number of reservation has the possibility of raising a failure rate.

Table 4. Result of Simulation (2)

	Number of Reservation (people)	Number of Using Sharing-Car	Number of Using Rentacar	Number of Cancel	Failure Rate (%)
Simulation Value	22.73	21.88	0.25	0.60	3.49
	Average of Using Time (hour)	Total of Using Time (hour/month)	Average of Using Distance(km)	Total of Using Distance (km/month)	Reserve (yen/month)
Simulation Value	1.93	42.23	20.70	451.58	31369.00

The fee of a car-sharing system can fully cover the operation costs. It can be judged that the system is working satisfactory from cost view point. However, when fixed costs are considered, it is thought that management is difficult in this number of reservation. When profitability is considered, it is thought that the rate of use or the membership increase would be necessary. However the user increase may be difficult considering member's characteristics. It is thought that increasing the number of members and charging the monthly membership fee are necessary.

## 8. FUTURE RESEARCH

In this simulation, only the use fee in a car-sharing system was analyzed. It is necessary to analyze the following aspects; refueling, car inspection, insurance. It is required to analyze correlation of the probability occurrence according to a user's time zone, use time, and distance etc.

The car-sharing systems in the Shiki New Town were started from the shortage of a parking lot in a housing complex. There are many housing complexes or apartments where the number of parking lots is insufficient. It is necessary to raise the degree of cognition of a car-sharing system. By that, it is expected to increase user.

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