STUDY ON COMMUNITY BUS DEVELOPMENT IN HISTORIC AREA[1]

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ABSTRACT

Public transport system should be improved by regulating the process of motorization and boosting district development. Community bus is the important part of multi-mode trip-chain. Taking community bus development in Shanyinlu historic area as the study case, this study put forward that reasonable design of community bus line could improve the community neighbourhood attraction, increase the internal trip-chain structure nodes, and promote a more balanced of place attraction strength. The study also found that the considerable demand was exist for community bus from the results of Disaggregate Model.
Keywords: Community bus, Historic area, Trip-chain, SP survey, Disaggregate model

INTRODUCTION

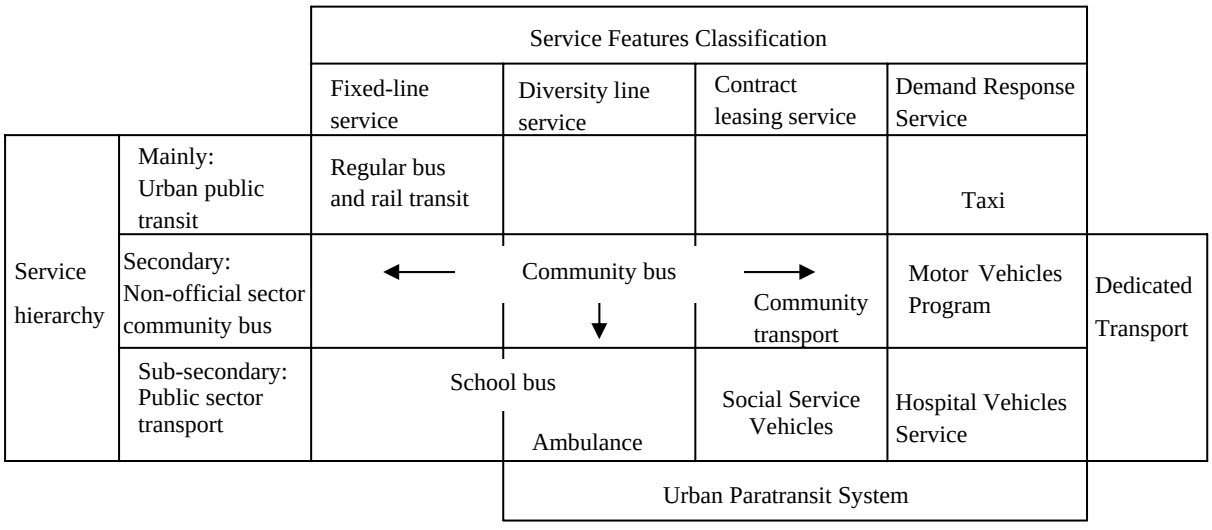

Figure 1 – Bus system structure design and function of community bus [1]

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Community Bus which operated by real estate developers and property management companies was designed to solve community residents travel problems at first. In recent years, Shanghai, Beijing and other big cities have set up community bus lines by urban bus company for some specific communities' connection, for example more than 30 community bus lines have been opened in the outlying areas of Shanghai. Community Bus can be used more flexible than small cars, for the route of Community Bus could be changed to adopt the demand based on sub-branch road network. Community bus is an important supplement to improve the urban passenger transport system as the diversification of secondary lines and internal lines. (Fig.1)

COMMUNITY BUS LINE ARRANGEMENT AND TRIP-CHAIN

General Principles of Community Bus Line Arrangement

The consideration elements of community bus line arrangement including rail transit-oriented convergence, line network coverage improvement, and the main region activities link nodes. The line arrangement should follow the following principles:

- Line arrangement should fully meet the traveller's travel characteristics, the convenience for passengers to get on and off, and minimizing the passengers' waiting and walking time outside the bus.
- Line arrangement should not affect the normal transportation system of the local main roads, especially for the intersections.
- Community bus lines should not be too long, and can set as the ring loop circuit. The vehicles could be used more flexible than small cars.
- Community bus lines can connect both leisure and tourism nodes in the historic areas，but prefer to the historic roads.

Trip-chain impacts on bus line arrangement

Trip-chain analysis is one of important study in travel behaviour study area. It can characterize the choice and sequence of the travellers' activities. It is not an isolated study on the travel in one moment or one place, but rather reflects the dynamic nature of travel. [2] The so-called trip-chain structure is a certain chronological link of different purposes of travel to describe an individual to complete one or more activities. There are some indicators to analysis of trip-chain including the number of travel links, trip-chain length and transfer frequency etc. [5]

The trip-chain has little impacts on the line arrangement for the community bus, it just plays the role to connect rail transport station or major transportation hubs. But there are lots of demand for connection and internal travel in the regions which need more analysis of the travellers' trip-chain structure. By increasing the length of trip chain, the stay time in the area can be extended and the scope of activities can be expanded. And the region attractiveness will be increased by improving the activity nodes' traffic location (Fig.2).

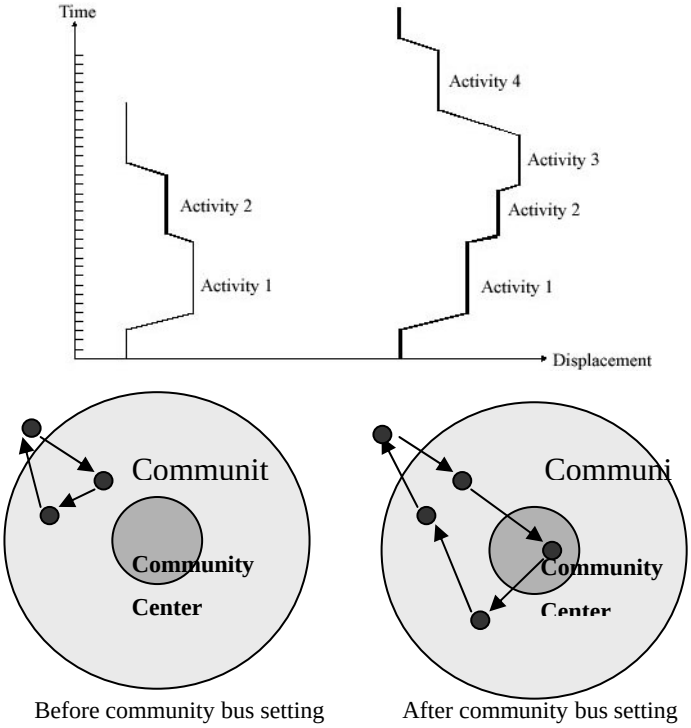


Figure 2 – Influence on trip-chain structure by community bus

COMMUNITY BUS LINE PLANNED IN SHANYINLU AREA

Overview of Shanyinlu Area

Shanyinlu historic area is one of the twelve historic areas in Shanghai. There are many problems of public transit developing in this area:

- Urban mass transit stations are set up outside of the area due to the historical buildings and other restrictive factors. The public activities and rail transport stations are not fully integrated in the core area.
- The feeder transport system to metro stations and convergence condition is poor, such as the bike parking space is limited.
- The road network is structural imbalance and dysplasia roads are usual low-grade. Regular bus line network has a high repetition coefficient which made the density of bus stop is low.

- The overall public transportation operation is in low efficient because of some traffic bottlenecks.

Figure 3 – Location of Shanyinlu area in Shanghai

Community Bus Planning

The main function of community bus planned in Shanyinlu area is to improve public transportation share rate, enhance public transportation and regional attraction. Specifically, the main principle of community bus line arrangement is that we should consider the reasonable scope of transit feeder system by walking and bus, the integration of public activity site with public transport nodes, as well as bus lines to meet the active node and hub of activity chain needs.

The community bus lines should connect to a major regional rail hub, public activity sites and the main residential area under comprehensive consideration of the rail transport station layout and traffic demand characteristics in Shanyinlu area. Based on the planning principle and consideration, a community bus route is planned to connect two rail stations (Hongkou stadium station and Hailunlu station) and four rail lines (Line3, 4, 8, and 10). The total length is 5 km. (fig.2)

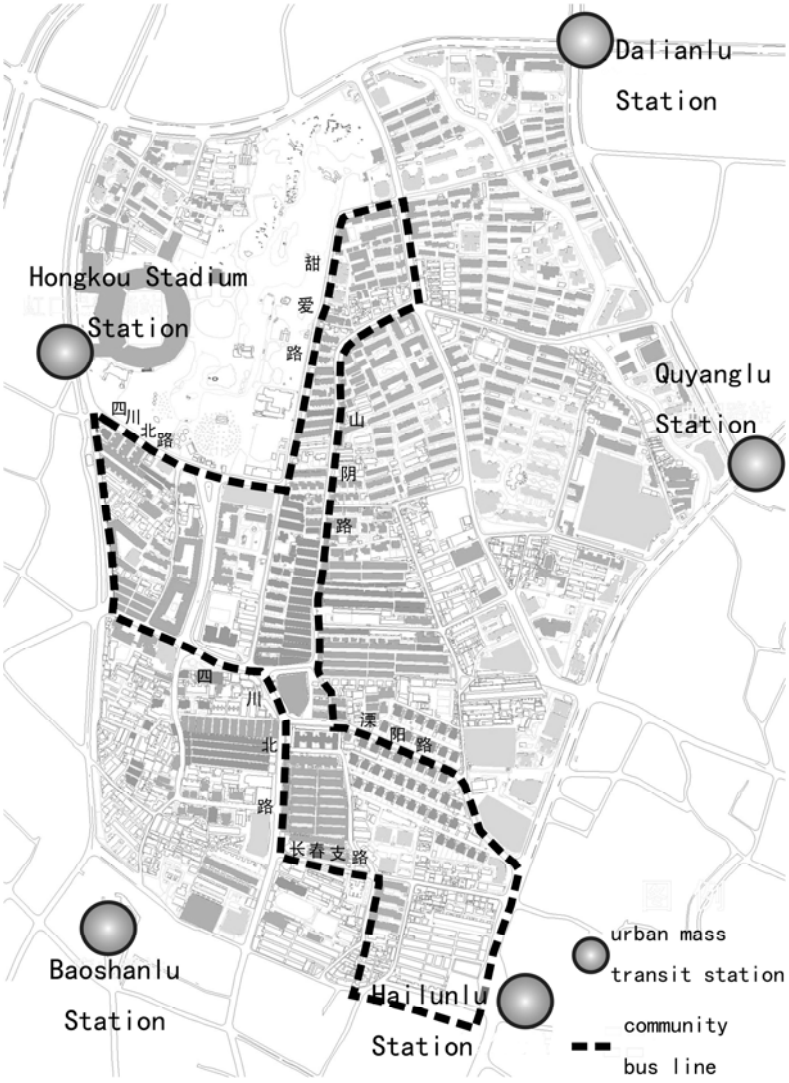


Figure 4 – Community bus line planned in Shanyinlu area

The community bus is clockwise running, and the total running time is about 30 minutes according to the speed which from the survey received in Shanyinlu area.

EFFECT ANALYSIS OF COMMUNITY BUS

We carried out SP survey for residents and tourists in Shanyinlu area and received 300 valid questionnaires. Several aspects will impact residents' dairy travel by community bus according to the survey results, including the residents' acceptance, structural changes of trip-chain, and changes of destination choice etc.

People's Acceptance of Community Bus

According to the survey, nearly half of the total respondents (44.7%) will often choose to use community bus, and fewer respondents (36.3%) likely to use community bus.

Overall, people's acceptance of community bus is on a higher level, factors such as gender, age, income, occupation etc have a slight influence for people want to choose it(table1). It shows that the existing public transport system are not yet fully meet people's travel demand, community bus can improve the hierarchy structure and service level of public transportation system.

Table I – Proportion for using community bus of segment groups

Factor	Categories	Proportion	Factor	Categories	Proportion
Age	Less than 25years	41.8%	Household per capita income	Less than 500 RMB	54.5%
	26～35years	53.0%		501～2000 RMB	44.4%
	36～45years	42.6%		2001～4000 RMB	39.8%
	46～60years	31.8%		4001～6000 RMB	48.8%
	Above 60years	61.5%		Above 6000 RMB	54.2%
Profession	students	48.5%	Household size	1～2 person	42.3%
	Enterprise management	44.4%		3 persons	48.1%
	Factory workers	55.0%		Over 3 persons	40.4%
	Enterprise staff	42.9%	Car ownership	no	45.3%
	Public Service and Institutions	25.6%		yes	41.4%
	Self-employed	50.0%	Source	local residents and workers	44%
	Retirees	48.6%		Leisure groups	45%

Changes of Trip-chain Points

Table II – Compare of changes in number of nodes of traveller' trip-chain in Shanyinlu area

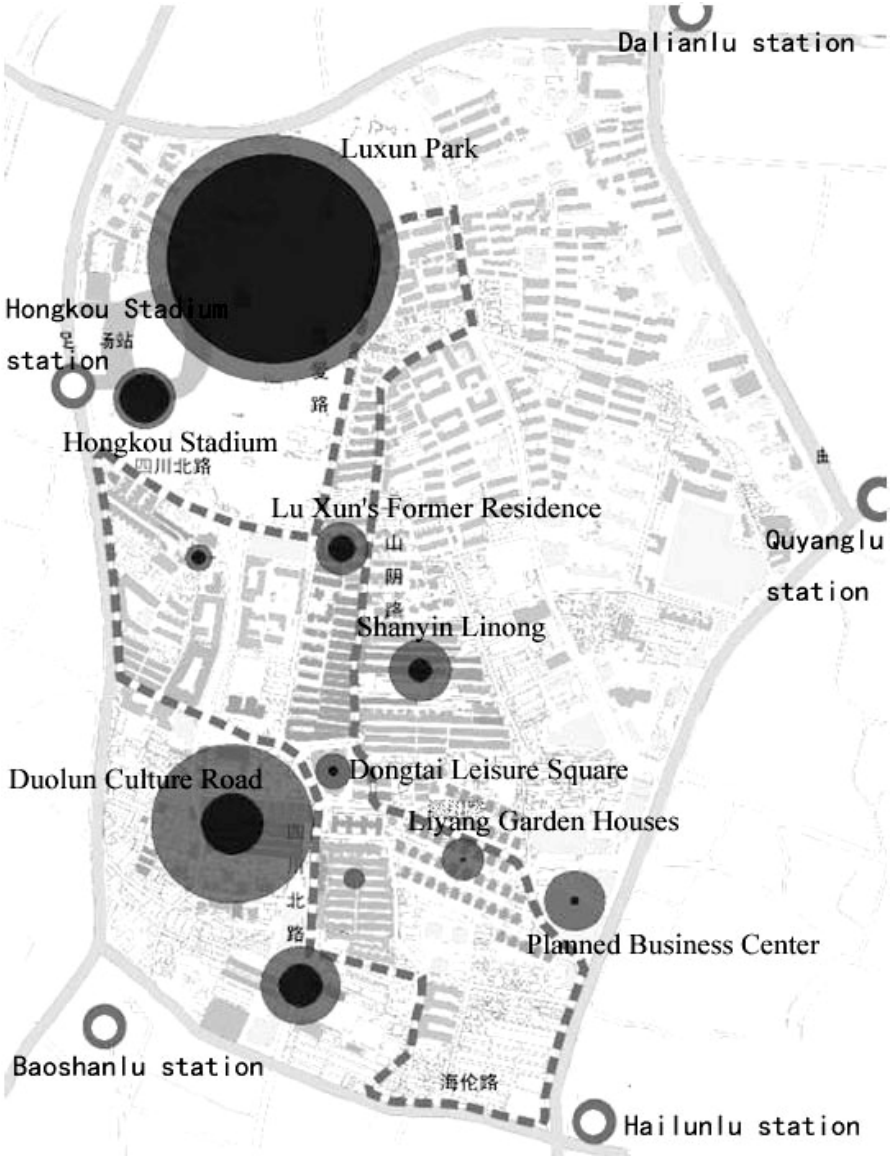
	Number of current trip-chain points		Number of trip-chain points after community bus set up	
	persons	Proportion	persons	Proportion
One point	37	80%	1	2%
Two points	7	15%	22	48%
Three points and above	2	5%	23	50%

Currently most of the rail travellers' trips for activities are single point trip in Shanyinlu region. The internal trip-chain length will increase after community bus is operated, and the traveller' trip-chain structure will be more than two points according to the survey. (Table 2)

Destination Choice

According to the survey, 76.4% of residents and travellers will choose to take community bus to the rest of the region, while 73.3% of the travellers for leisure purpose said they would increase the number of times to visit this region because of the community bus. It seems that

improve public transport service system will increase the destination choice competitiveness for leisure activities at the same time.



Notes: Dark inner circle means the current attraction strength of activity nodes, light outer circle means the future attraction strength according to the SP survey.

Figure.5 – Attraction intensity change of activity nodes in Shanyinlu area

People's activities scope will increase significantly if the community bus is operated based on the results of questionnaire survey in Shanyin-Lu region. Some historic sites could get benefit from the community bus system, such as Duolun Road Culture Pedestrian Street, Liyang Garden Houses, Dongtai Leisure Square, North Sichuan Road and the planned business center. The reason is that distance from rail transport station in these areas is beyond reasonable walking distance, and community bus will effectively improve the transport accessibility. The strength of activities nodes attraction in Shanyinlu district is more balanced after the community bus system set up. (Fig 4)

The Transfer of Individual Motorized Mode

More than a half of commuters who use individual motorized means may choose to use public transportation frequently, however only 9 to 27% of non-commuter will do the same chosen after community bus set up according to the survey. Transit improvement plays a significant role to guide the traveller transfer from individual motorized means to public means, especially for commuters in peak-hour. (Table 3)

Table III – Proportion of different travel mode groups choosing to use community bus

groups	walk	bicycle	Car and motor-bicycle	taxi	rail	bus
Commuters	42%	40%	57%	50%	42%	50%
Non-commuters	48%	29%	9%	27%	65%	48%

DISAGGREGATE MODEL AND DEMAND ANALYSIS

Design of Choice Branch

By using the survey data, the community bus passenger volume can be calculated by disaggregate model. According to the layout principles of community bus line arrangement, this study aimed at design the choice branch of the SP survey for the rail transit transfer passenger. Walking mode is a physical-type mode of transportation and is the first choice within reasonable walking distance. Private cars which are usually used to connect rail transport station are not realistic in Shanyinlu historic area because of lacking of parking space in rail transit station. Therefore the choice branch design is mainly considered the competition among bicycle, taxi, regular bus and community bus. (Fig.5)

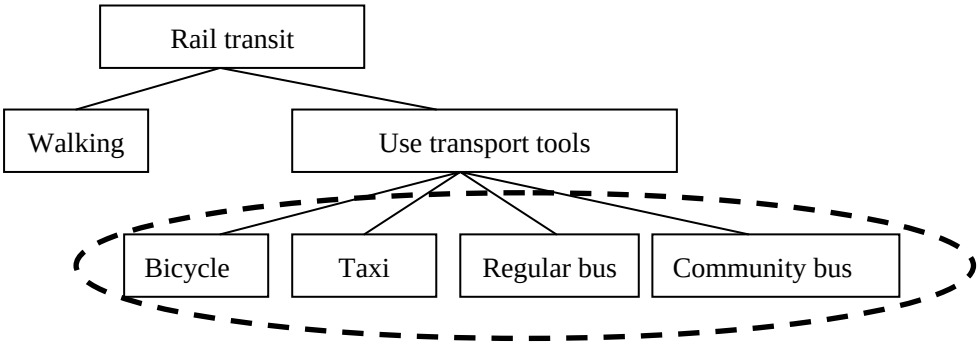


Figure.6 – Choice branch design of community bus SP survey in Shanyinlu area

Disaggregate Model

According to the choice branch design, a multi-logit model is built and the probability of individual i choosing j mode is as follows:

$$P_{ij} = \exp(V_{ij})v / \sum_{j \in J} \exp(V_{ij})$$

The time and cost are considered as choice characteristics and the utility function is as follows:

$$V_{ij} = \beta_t \times t_{ij} + \beta_c \times c_{tj} + \varepsilon_{ij}$$

1174 sample data were screened to calculate in the 300 valid questionnaires. The model calibration results are as follows:

Table IV – Model calibration results

variable	Parameters	Standard deviation	T-test	P[|Z|>z
Time	-0.0745	0.029	-2.609	0.009
Cost	-0.275	0.131	-2.101	0.035
Taxi fixed entries	2.081	1.315	1.582	0.114
Community bus fixed entries	1.463	0.224	6.531	0.000
Regular bus fixed entries	1.012	0.227	4.446	0.000

Likelihood function value is -1456.308, and Maximum likelihood ratio R^2=0. 105.

Analysis of Basic Passenger Volume

Community bus can take about 30% ~ 40% of all the feeder passenger flow by those using transport means to connect rail transit based on the disaggregate model if the community bus fare is 1 yuan RMB and its departing interval is about 5 ~ 10 minutes.

San-Lu region's current daily passengers are about 30 million person-times. 9% of the whole passengers use rail transit and 60% of them are outside of reasonable walking according to the Shanghai's OD data. The basic passenger volume of community bus will be above 3000 person-times per day. The rail transit passenger volume will be about 15 person-times in the future according to the Shanyinlu historic area's land use planning, and the basic passenger volume of community bus will be about 1 million person-times per day. It seems that the passenger volume in Shaninlu historic area has already met the demand of setting up a community bus line.

CONCLUSIONS

From the case of Shanyinlu area, travellers around the rail station are easy to use mass transit after community bus running, while community bus can also attract part of travellers whose trip purpose is leisure or entertainment to choose rail mode. Thereby community bus can increase the radiation capacity of rail transportation to ease the pressure on some peak periods of roads. Reasonably designed community bus lines can promote the community

neighbourhood attraction, increase the internal trip-chain structure nodes, and promote a more balanced of place attraction strength. Development of community bus in China is in the initial level and most of them are taken in urban outlaying areas. From the investigation and analysis of Shanyinlu area, we can find that areas such as old town area and historic area which have poor road conditions and rail transport are hard to reach need to develop community bus. Community bus could ease traffic pressure in these areas, and play the role of promoting regional development and rehabilitation. Thus community bus development in these areas has a considerable demand and based-market according to the SP survey. It is necessary to do further research on the travel demand, line mode, and operating mode of community bus. It is also important to make the community bus become an effective complement for urban public transport system.

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