

A Review on Bus System in the City Centre: Comparative Study between Kota Kinabalu and Changsha City Centre

JIANG YUAN¹, QIANG CHENG², PEI GAO³, XINZI LUO⁴, MOHD AZIZUL LADIN⁵, LILLIAN GUNGAT⁶,
SITI NURMASYITTAH AG BESAR⁷

^{1, 2, 3, 4} School of Transportation Engineering, Changsha University of Science and Technology, Changsha 410114
China

^{1, 2, 3, 4, 5, 6, 7} Faculty of Engineering, Universiti Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia

Abstract- *In view of the problems existing in the bus system of Changsha and Kota Kinabalu (KK), this paper compares the differences in the demand, supply, line network and station of the two cities, analyses their respective deficiencies in the construction of the bus system, extracts their development experience, and provides some suggestions for Changsha and KK cities to speed up their public transport development. At the same time, it also puts forward development suggestions for the shortcomings of Changsha and KK in the aspects of public transport demand, public transport network and bus station construction.*

Indexed Terms- *public transport, Changsha bus, Kota Kinabalu bus, bus demand, bus line network*

I. INTRODUCTION

With the rapid growth of urban population and motor vehicles, urban traffic problems have become more and more prominent. It affected seriously the daily life of residents, which has become a bottleneck, restricting urban development. Furthermore, other issues have also come to surface. For example, the average travel time is longer; the travel efficiency is degraded; the road network has poor adaptability, and large-scale traffic jams are likely to occur in the event of an accident [1]. Most people in cities choose public transportation systems to travel, such as buses and subways. Giving priority to the development of public transportation has become the consensus of solving traffic problems in most cities [2].

In general, buses are the most common type of mass transit vehicle. A coach is a motor vehicle that carries passengers on a fixed route along a city road, with or without a fixed shift. The buses can be divided into

double-decker buses, single-level large buses, single-level medium buses and small buses by size. Choosing bus travel can make more efficient use of road resources and reduce road traffic congestion [3]. In 2018, Changsha once proposed, "Bus Priority", which aims to control the total amount of urban traffic, reduce the proportion of individual transportation modes, and improve the status of public transportation in the entire urban transportation system. According to statistics, the per capita energy consumption per 100 kilometres of buses is 8.4% of that of cars. If the same numbers of passengers are transported, the bus will save more than 80% of energy compared to the vehicle, based on picking up 100 passengers per coach. Besides, aluminium and carbon monoxide in the urban atmosphere, more than 60% nitrogen and hydrogen compounds and most of the contaminated particles, are derived from automobile exhaust. If public transport passenger traffic reaches 50%, carbon monoxide and nitrogen and hydrogen compounds emissions can be reduced by 90% [4]. However, some studies have shown that some citizen and tourists are reluctant to choose to travel by buses. They think that it is too time-consuming, overcrowded and the long waiting times to travel by buses in unpreferable [5, 6]. Due to such reasons, it has also led to hindrance in the government's development in public transportation, but public transport maintains to have a more significant impact on the travel of citizens and tourists [7]. Therefore, how to improve the public transportation system is a question worth considering.

Kota Kinabalu and Changsha city centre have been actively creating "bus city" in recent years. The public transportation infrastructure has been gradually improved, the density of the line has been

increasing, and the level of service has been steadily increasing. Kota Kinabalu is the capital city for the state of Sabah, and the Changsha is the capital of Hunan. Although they are both provincial capitals, and the level of urban development has remarkable similarities, but there are significant differences in the level of urban public transport development.

In order to study the differences of bus systems in different regions, this paper takes Kota Kinabalu and Changsha city centers as examples to analyse the development status of public transportation in two cities, analyses their development characteristics and experience so it can lay the foundation for the development of buses systems in other cities.

II. PROBLEM STATEMENTS

Traffic congestion is one of the reasons why we promote the use of public transport. At the same time, the use of public transportation is more environmentally friendly. Especially in the rush hours between 7:00 to 9:00, 12:00 to 14:00 and 17:00 to 19:00, the congestion of the leading import and export routes in the two cities is more critical. Most of the vehicles on the road are private cars, mostly carrying one or two passengers. Severe traffic congestion will bring great trouble to people's daily life, so it is necessary to promote the use of buses.

In the central area of Changsha City, traffic is heavy and congested because of the high population density, employment and intensive financial and trade activities. Although Changsha's public transport system has gradually begun to improve in recent years and has made significant progress, new energy public transport has also started to be widely used, but there are still some problems in the design of public transport routes. Changsha's population density is substantial compared with KK. According to statistics, Changsha's permanent population has reached 81,547,700 in 2018 (Changsha's Statistical Bulletin of National Economic and Social Development 2018), and the uneven spatial and temporal distribution of personnel also leads to intermittent traffic congestion. Some bus routes are too long, drivers are prone to fatigue after driving for a long time, and some of the long journeys will pass through densely populated commercial areas, densely

populated cities require more bus shifts, which will reduce the revenue of public transport system for sections with less passenger flow. However, in areas with low population density, there will be problems such as long waiting time for passengers and long distance between passenger destinations and stations. There are also a large number of shared bicycles in the central area of Changsha. These bicycle flows have a significant impact on the driving of motor vehicles and buses, resulting in the slowdown of the speed of bus operation and the decline of service quality.

The main sort of buses in KK is Local Bus, City Bus, Long-Distance Bus and Airport Bus. Local buses take the passengers to the countryside near KK, city buses run just around the city, while long-distance buses take people to other towns or cities. As the name suggests, airport buses transport passengers between the airport of KK and the city area.

There are very few buses with prescribed routes. First, since the city has well-developed tourism, there are many tourist buses, and their paths are determined by travel agencies, which are often uncertain. Second, large organisations like Universiti Malaysia Sabah have their own buses that are responsible for picking up their students and employees. Third, because the price of fuel is low, the number of private cars is vast, and people go about by driving.

Through investigation, KK is found to have fewer bus stops and with no information about the bus. In contrast, the bus stations in Changsha will provide the route to all the buses passing through the station, the time of the first and last buses, and the interval between each bus. And people can use the mobile app to know how long it will take to get the bus, to plan a better schedule. The people in KK do not even see the timetable of the bus. It may take a long time to wait at a site to get a bus to their destination. And passengers generally reflect that the bus system in KK is not very satisfactory, employing crowded, small dilapidated buses and with long waits, hence KK people do not like using the bus. Only some people with lower incomes choose to take the bus, and Noor determines the components of public bus service satisfaction in Kota Kinabalu, Malaysia. From the dimensions of public bus services, the

ability to achieve comfort and safety, factor analysis is used to analyse people's satisfaction, and found that night overcrowding and feeling unsafe are the most critical factors affecting their satisfaction. The consequences of numerous private cars and underdeveloped bus systems are traffic congestion and environmental pollution, therefore this problem needs to be resolved.

III. COMPARATIVE STUDY

A. Comparison of bus demand

The comparison of bus transportation demand is mainly from the two aspects of total transportation volume and transportation structure. The total transportation volume refers to the sum of urban rail transit, rapid transit and conventional bus transportation; the transportation structure refers to the proportion of public transportation in total transportation.

a) Total transportation

The total amount of public transportation in Changsha is 2.22 million people per day, the overall transportation volume of KK is 88,800 people per day, and Changsha is 25 times that of KK. At present, there is no rail transit in KK, and the demand for rail transit in Changsha has reached 185,000/day. There is no bus rapid transit (BRTs) in Changsha and KK compared to other cities.

Table 1 Comparison of the current situation of Changsha and KK bus demand

City	Project	Rail	BRT	Regular bus
Changsha	Average daily traffic/ (Ten thousand passengers / d)	18.5	—	203.8
	Proportion/%	8.2	0	91.8
KK	Average daily traffic / (Ten thousand passengers / d)	—	—	8.88
	Proportion/%	0	0	100

b) Transportation structure:

From a macro perspective, the sharing rate of public transportation in KK accounts for about 3% of the total mode of transportation, and that of Changsha is as high as 59%, indicating that KK public transportation is relatively fast and has dominated the city's comprehensive transportation system. On the micro-level, the regular bus sharing rate in Changsha accounts for 91.8% of the total public transport, and KK is 100%, indicating that KK bus passengers all rely on conventional buses, while Changsha's bus transport structure is relatively reasonable, but it also lacks BRT. In general, the development of the bus system in Changsha is relatively complete, and the bus system is operating well, but there is still a big gap compared with the developed cities in China and abroad. For example, the total share of public transport in cities such as Hong Kong, Japan, and Singapore are as high as 75 %. Therefore, both KK and Changsha should optimize the structure of public transport, especially in KK, which needs to focus on strengthening the construction of medium and large-volume public transport and improve the efficiency of public transportation.

B. Comparison of bus supply

The comparison of the bus supply mainly compares the bus supply situation of the two cities from the aspects of bus capacity and supply quality.

a) Capacity scale

KK has a total of 150 bus trams, Changsha City has a total of 7425 standard buses, about 50 times more; Changsha City has a public transport rate of 18.88 standards, KK city public transport rate of 3.67 standards, with the development of public transport. With the continuous increase in investment, the 10,000-person bus retention rate in Changsha has reached the requirements of "bus city", and the capacity has basically reached a high level. KK city has a low bus ownership rate, and the government needs to increase public transport investment.

b) Bus quality

In terms of green public transportation, the ratio of green buses in Changsha is about 67%, and "green travel" has been realized. The city of KK has not yet considered this aspect. In terms of intelligent transportation, Changsha City completed the

construction of 180 smart bus platforms and launched special bus services such as community buses and "customized buses". However, KK is still in the exploration stage in these areas and needs to accelerate development.

c) Bus network comparison

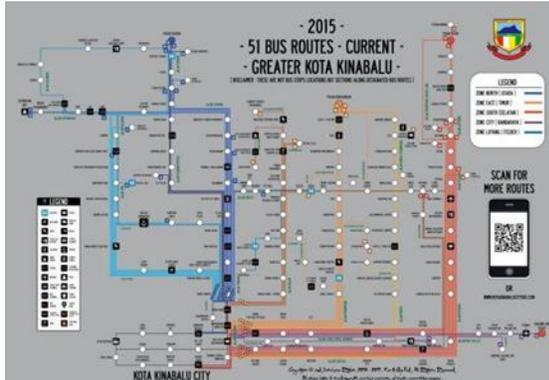


Fig.1 Current Bus Route in Kota Kinabalu

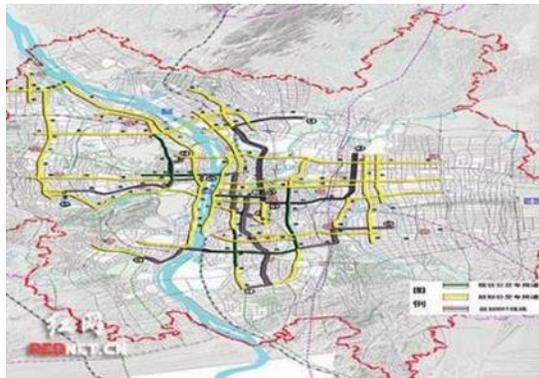


Fig.2 Current Bus Route in Changsha

From the bus network of the two cities, we can see that the coverage of Changsha's bus network is much higher than that of KK, covering a larger area, more bus lines and many overlapping routes. Changsha's bus stops are somewhat far apart, and the bus lines are generally longer than KK's. This is because the population density of Changsha City is far higher than that of KK, and the population distribution of Changsha City is more uneven in time and space. Therefore, Changsha City urgently needs to develop public transport and bus vigorously is the primary mode of public transportation. Hence, Changsha has made great efforts in the design of the bus system.

d) Comparison of Bus Stops

This paper compares the construction status of bus stations in the two cities from the two aspects of land use level and station coverage.

- Bus station site

There are about 152 bus stops in Changsha. The site area is about 857,700 m², the average land level of the bus station is 116.17/standard station. There are about six bus stops in KK; the land area is approximately 1.69 m², the average land level of the bus station is 2.29/standard station. About the average land use level of bus stations, the Chinese general experience value in the industry is 200m² conventional stations. Changsha and KK have a long distance with this goal.

- Site coverage

The bus service radius can reflect the convenience of a city bus. The coverage of Changsha and KK radius sites is shown in Table 1. According to Chinese "Urban road traffic planning and design code", bus station coverage within 300m radius should not be less than 50% of urban land area, bus station coverage within 500m radius should not be less than 90% of metropolitan land area. According to Table 2, the coverage level of Changsha city has reached the standard requirements. But there is a long distance to improve standards for creating the "bus city" (It requires bus station coverage of 500m in urban built-up areas to reach over 90%). But KK is far from the standard requirements and has a sizeable improving space.

Table 2 the site coverage of Changsha and KotaKinabalu

Radius of the bus/m	Area	Site Coverage	
		Changsha	Kota Kinabalu
300m	First	83.45%	22.38%
	Ring		
	third	36.93%	8.68%
500m	Ring	97.43%	39.11%
	third		
	Ring	57.45%	21.39%

IV. RECOMMENDATION

A. Changsha Problem Solution

There are many unreasonable points in Changsha's bus route design. For the long bus routes in some areas, they can be shortened appropriately, and the mode of segment operation can be adopted.

For some areas with less passenger flow on public transport lines and long-distance between stations, the revenue of the public transport system is low, and the service level of public transport is low. These areas can cancel public transport routes under appropriate conditions and change to urban traffic mode that responds to demand. This can not only improve the service level of public transport but also make use of existing resources.

There are many problems in the central area of Changsha, such as the slowdown of bus operation speed and the decline of service quality caused by the irregularity of shared cars and private cars, which can limit the flow of bicycles in the central area, give priority to the release of buses at intersections, build bus lanes, and require to improve the bus system as the attraction is the high-speed public transport system.

B. KK Problem Solution

Through comparative analysis, the operation of Changsha bus system is relatively proper, but it needs to be further strengthened; KK bus development has certain deficiencies in bus demand, bus line network and bus station, etc. It should learn from each other and continue to improve the bus system.

a) Strengthening public transport investment and establishing the concept of bus priority

With KK city buses, which generally belong to travel agencies and schools, there are fewer choices for citizens and individual customers. The government should take the implementation of bus priority strategy as the critical task of urban management. Increase investment in public transportation and improve public transport infrastructure. At the same time, we will strengthen public opinion and guidance, advocate the concept of "low-carbon transportation, green travel", guide the citizens to change the idea of travel, and create an excellent social atmosphere that

supports public transport priority and practices bus priority.

b) Improve the regulatory policy system and introduce public transport priority policies

The government can formulate relevant local laws to provide legal and legal guarantees for urban public transportation market access, capital investment, land development, road rights priority, and operation management.

c) Optimize the layout of bus lines and promote the implementation of bus lanes

In KK city, the bus route is not clear; citizens and tourists can't accurately understand the bus information. In this regard, KK should optimise the bus line network to form a city bus with a parallel structure, complementary trunk line and sub-main line and branch line. Network; focus on adjusting bus lines in areas such as the city centre and more passenger traffic, expanding and extending bus services, and ensuring access to public transport.

d) Strengthen the construction of bus stations and accelerate the development of intelligent transportation

KK City should improve site coverage by improving bus station facilities. Through the comprehensive application of public transportation information and smart means, capable bus stations can be set up in the central area, and the intelligent level of the public transportation system can be improved by using the mobile app and smart public transportation display cards.

V. CONCLUSION

In this paper, by comparing and analysing the public transportation systems of Changsha City and KK City, and integrating the current status of public transportation research in the two cities, the following conclusions are drawn:

- 1) The development of the bus system in Changsha is relatively complete, but there is still a big gap compared with the developed cities in China and abroad. Both KK and Changsha should optimise the structure of public transport, especially in KK, which needs to focus on strengthening the construction of medium and large-volume public

transport and improve the efficiency of public transportation.

- 2) KK city has a low bus ownership rate, and the government needs to increase public transport investment. KK is still in the exploration stage in these areas and needs to accelerate development.
- 3) Changsha City urgently needs to develop public transport vigorously, and the bus is the primary mode of public transportation. So, Changsha has made great efforts in the design of the bus system.

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