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Thoughts on Urban Transportation Under the COVID-19 Pandemic

WANG Yu, XU Dingyuan, SHI Lin

China Academy of Urban Planning & Design, Beijing 100037, China

Abstract: The outbreak of COVID-19 pandemic has brought an enormous impact and changes to cities and lives in 2020. The three measures have been proposed in response to the pandemic: the wide application of telecommuting, the appropriate increase in the car-purchase quota, and the application of customized shuttle buses. By analyzing the impact of the above measures on urban transportation, this paper reflects on relevant problems of urban transportation and puts forward several suggestions. Firstly, it is recommended that the combination of telecommuting, flexible working and staggered commute time can help alleviate traffic congestion during morning and evening peak hours. Secondly, it is suggested that while car-purchase restrictions are relaxed to boost the economy of automotive industry, policies should be formulated to allocate the purchase indicators to families and advocate "securing a parking space before buying a car." Besides, the adjustment and control policies for users to pay for the external cost of cars should be speeded up in accordance with the principle of self-payment by the users. Thirdly, it is recommended to further promote the development of diversified public transportation service in combination with the promotion and application of customized shuttle buses to improve the service of public transportation in accordance with the change of demand. **DOI:** 10.13813/j.cn11-5141/u.2020.0305-en

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The outbreak of 2019 novel coronavirus (COVID-19) in early 2020 has been the most substantial public health emergency in China since 1949. Based on the assessment of urban transportation changes in three perspectives during the COVID-19 pandemic, this paper provides strategies to address the challenges and predicts the trends in transportation. First, a significant influence from the pandemic is the accelerated transformation to online economy driven by advanced information technology, which has boosted the wide application of telecommuting. It is necessary to explore the interaction of telecommuting with staggered commute time and traffic congestion. Second, to mitigate the economic impact of the pandemic and expand domestic demand to promote consumption, governments at all levels intend to enhance urban transportation development through relaxing car-purchase restrictions and boosting the automotive industry. Third, to avoid large-scale virus transmission due to excessive concentration of people taking public transportation, many cities have launched small-scale customized bus transit services and strategies to promote the diversification and marketization of public transportation.

1 Advocate telecommuting to alleviate traffic congestion

1.1 Telecommuting boosted by the pandemic

A major change brought by severe acute respiratory syndrome (SARS) in 2003 was online shopping, promoting rapid development of E-commerce. In contrast, the most significant impact of COVID-19 pandemic in 2020 is the transformation to digital economy driven by advanced information technology. In particular, telecommuting has changed its role as an emergency response plan for business reopening to a permanent work mode after the pandemic.

Due to social isolation during the pandemic, telecommuting has been widely implemented. Various remote meeting software tools, such as Tencent Meeting, DingTalk, and Lark, become increasingly popular, which technically support efficient communication in remote work. When the telecommuting policy was first implemented in early February 2020, many people could not adapt to it well. A variety of concerns have been raised about telecommuting, including the following: Is it possible to maintain clear communication?

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First author: WANG Yu (1988–), male, from Tangshan, Hebei Province, master's degree, engineer, is mainly engaged in the research on transportation planning and design. E-mail: hitwangyu@163.com

Are online meetings as effective as face-to-face meetings? Now people are changing their attitudes about remote work. An increasing number of meetings and lectures are successfully held remotely. Some people believe that remote meetings save commute time and are more efficient than in-person meetings. It should be noticed that while a growing share of the workforce has moved to telecommuting, most of remote work is carried out on the basis of employees' familiarity with existing projects. With the consulting work in urban planning as an example, in addition to writing proposals and performing technical discussions, most daily work also involves business negotiations, on-site field studies, program reporting, and participation in various academic forums. Technical communication, presentations, and various academic forums can be completely conducted through remote meetings, but in-person business negotiations, on-site investigations, face-to-face communication between clients and consultants, and the establishment of trustful relationships cannot be simply replaced by telecommuting. In other words, face-to-face communication is still the cornerstone of trust.

With more reliable 5G network technology and better functional online meeting software, the following trend in telecommuting is expected: Telecommuting would be the option of some work, but will not completely replace regular work arrangement. In the future, many industries will maintain flexibility by adopting a combination of both online and offline work options. Which option can become dominant will depend on future technological development, work conditions in different industries, and changes in the corresponding system.

Telecommuting, actually, has been increasingly demanded before the pandemic. Remote work is much needed when busy work schedule conflicts with long commute time; however, most companies do not have any formal policies to address the issue. At the same time, traffic congestion during morning and evening rush hours has been worse in many cities. In big cities, serious traffic jams often result in doubled or even longer travel time than that under off-peak conditions. Commuting with rail lines involves bad experience for travelers because they are usually extremely crowded. To alleviate the peak-time traffic congestion and improve commute conditions, many city governments have invested substantial financial resources to improve the supply of transportation facilities. For example, parallel roads have been built to add capacity if traffic congestion is serious in the same traffic direction. The same rationale is applied in rail transit improvement. However, these measures are short-term for congestion relief. Currently, most cities have limited land use and cannot provide sufficient room for expansion of transportation infrastructure [1]. Thus, innovative and effective solutions need to be found through balancing urban travel demand.

1.2 Remote work combined with regular work arrangement

Traffic congestion during peak time could be effectively mitigated if telecommuting policies are applied with a flexible working schedule and implemented as a pilot program in metropolitan or mega cities, where tertiary industries have been well developed. Previously the application of flexible work schedule system with staggered commute time was not as successful as expected. A main reason is that people who commute during off-peak time have a hard time making general arrangement, given that their work schedule cannot synchronize the overall pace of the society. To ensure that people who commute during peak hours and adapt to the flexible working schedule system can keep pace with the overall society, the following two measures are suggested to leverage the growing telecommuting during the pandemic period.

1) Integrating staggered commute time with remote meetings and regular work schedule

In certain big cities, the tertiary industry is relatively advanced and has a large number of employees. With Beijing as an example, by the end of 2018, the number of employees in the tertiary industry accounted for more than 80% of the city's overall employment; these employees have become the dominant share of the commute population [2]. In the tertiary industry, Internet technology, financial analysis, as well as design and consulting are computer-based occupations, which are less restricted by working locations and machineries. Usually, these employees have meetings with clients or co-workers on weekday mornings. A good approach is to allow them to participate remote meetings from home for 1 to 2 hours before going to working places. This approach can help reduce the peak traffic pressure caused by large commute population and industrial agglomeration in big cities. In addition, it will greatly reduce the commuting time and improve the quality of travel with rail transit.

2) Allowing remote work on certain weekdays

According to specific work needs, employers can allow employees to work from home and communicate via remote access software. The reduction of daily commute trips will help mitigate traffic congestion.

With the urban traffic operation of Beijing as an example, the proportion of work-based or school-based commute trips within the Sixth Ring Road in Beijing is as high as 56.8%; the congestion is particularly serious during morning and evening peak periods. Morning peak (between 7:00 a.m. and 9:00 a.m.) traffic and evening peak (between 5:00 p.m. and 7:00 p.m.) traffic account for 24.6% and 20.6%, respectively, of the daily total traffic [3]. The average trip distance of passenger cars in Beijing is 13.1 km. Assuming that most drivers use urban expressway, Beijing's 2019 Fourth Quarter Traffic Report by Amap has suggested that the average travel speed on the second and the third ring roads during morning peak time is 17.3 km/h [4]; the corresponding average travel time is

45 min. If 10%, 20%, or 30% of drivers choose to work remotely during morning peak and commute to work during off-peak time or choose to work from home for the whole day, traffic conditions can be improved as predicted by the BPR model ($\alpha = 0.50$, $\beta = 3.58$ [5]) as shown in Tab. 1.

Tab. 1 Improvement of traffic condition by different percentage of staggered commute time during peak hours

Average driving speed before improvement /(km/h)	Off-peak travel percentage/%	Average driving speed after improvement /(km/h)	Average increase rate of speed/%	Average travel time before improvement /min	Average travel time after improvement/ min	Percentage of time decrease/%
17.3	10	22.9	33	45	34.3	25
	20	30.4	76		25.9	43
	30	39.7	130		19.8	57

The analytical model suggests that only 10%–30% of the travelers who commute during off-peak time can improve average travel speed, reduce average travel time, and alleviate traffic congestion. During the peak period, traffic flow is close to or has reached saturation; driving time may vary significantly with any changes in saturation flow and small changes could result in substantial impact.

Therefore, if employers in the tertiary industry can effectively boost the popularity of telecommuting and off-peak commuting with supportive policies, urban roadway and rail traffic congestion can be substantially mitigated during peak hours.

2 Conditionally increase the number of license plates for new vehicles

2.1 Growing demand of vehicle license plates

The COVID-19 pandemic has a serious impact on economy, so the Central Committee of the Communist Party of China (CPC) and the State Council implemented strategies to expand domestic demand and mitigate negative outcomes. Promoting automobile purchase and consumption of other important commodities are examples of increasing domestic demand. At the meeting of Standing Committee of the Political Bureau of the CPC Central Committee when studying the response to the COVID-19 pandemic, President Xi Jinping mentioned to "encourage cities with car-purchase restrictions to properly increase the number of license plates for new vehicles to promote the consumption of cars and related products." Subsequently, many local governments introduced policies to remove car-purchase restrictions. For example, the Hangzhou Municipal Office for Passenger Car Regulation and Control announced the plan to increase quota of 20,000 passenger cars in 2020 [6].

In cities with car-purchase restrictions, on the one hand, since the implementation of related policies, unmet demand has been constantly accumulating. On the other hand, under the Pandemic, travel demand and car consumption demand are changing. During the severe pandemic period, public transportation in some cities is shut down. To avoid cross-infection, necessary travels heavily depend on individual transportation. The investigation report on the impact of the pandemic on consumers' willingness to purchase cars, published by J.D. Power, has recently indicated substantial reduction of willingness to use public transportation during the pandemic (see Fig. 1); nearly half of the respondents said that they planned to buy passenger cars [7]. Therefore, once the quota of car purchase is increased, car consumption is expected to grow significantly.

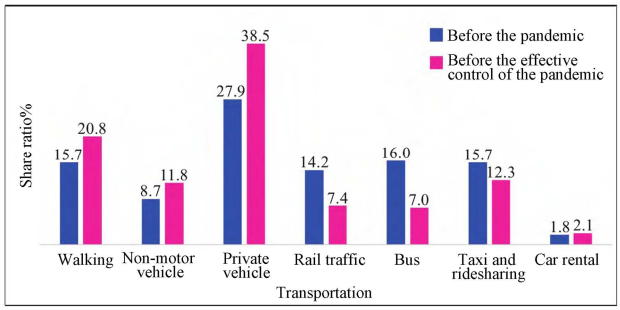

Fig. 1 Survey results of preference on travel mode before and during the COVID-19 pandemic

Resource: Reference [7].

2.2 Supplemental policies

When car-purchase restrictions are removed to boost the automobile industry, it is also necessary to implement specific transportation policies that can benefit the majority of residents. Old approaches that only focus on economy and ignore urban traffic are no longer feasible. Therefore, the following two policies are recommended when restrictions are relaxed on car purchases.

1) Prioritize families without passenger vehicles

In many cities, the quota of license plates is distributed to individual consumers through lottery. Such distribution is unbalanced and unfair because families with a car may repeatedly obtain license plates, while many families without a car have to wait for a long time to obtain a license plate. During a special period such as the pandemic, daily shopping and other trips are made by individual families. It is more reasonable to distribute the license plates to families instead of individuals as the basic unit.

2) Prioritize families with parking space

In recent years, parking problems in residential communities have become increasingly serious. Illegally parked vehicles interfere with road traffic outside of communities, occupy green space, and block emergency passages. It is quite common to see fire trucks being blocked by illegal parking vehicles in the event of a fire accident. Therefore, distribution of vehicle license plates should be based on a principle to ensure that using personal vehicles does not jeopardize the interests of community residents. Prioritizing families with parking space can help address the problems with community parking.

At the same time, it is important to accelerate the formulation of a regulation policy system with a full lifecycle for car ownership, usage, parking, and scrappage. In particular, it is important to focus on the vehicle usage to strengthen the role of economic regulation policies in managing travel demand. For example, in accordance with the principle of pay-for-use, users should pay for the negative external costs incurred by cars and fully utilize a market price mechanism in resource allocation. At present, car users mainly pay for their direct costs, such as vehicle purchase, fuel cost, and parking fees. External costs such as traffic congestion and air pollution caused by motor vehicles are shared by the entire society. Compared with developed countries, car users in China only cover vehicle operation cost and pay low fees overall, which contribute to faster growth of car ownership.

In 2019, the National Development and Reform Commission of China developed "Implementation Plan for Promoting Consumption of Automobiles, Home Appliances, and Consumer Electronics Products to Enhance the Development of Circular Economy 2019–2020 (Consultation Draft)" and proposed to accelerate the change from restricting vehicle purchase to guiding rational vehicle use. Therefore, it is necessary to form a closed-loop of policies for the ownership and use of cars and fully develop market-oriented approaches to guide rational use. Under the premise of respecting (or moderately restricting) car ownership, a healthy growth and sustainable usage of passenger cars can be supported by meeting basic parking demand through "prioritizing families with parking space" as well as differentiating insurance fees, vehicle purchase taxes, parking pricing, and congestion charges.

3 Depend on customized bus transit to promote diversification and marketization of public transportation

During the pandemic, to support the reopening and avoid excessive concentration of public transportation passengers that may cause large-scale cross-infection, Beijing, Jinan, Kunming, Fuzhou and other cities have successively launched, customized, or increased bus services. For example, the Beijing Public Transport Corporation launched an online survey on customized bus lines to meet passengers' commuting needs. Citizens can purchase tickets using WeChat online applications and scan a digital code to ride bus. In this special period, the upgraded customized bus service greatly improved the efficiency and safety of public commuting, which was thus widely appreciated. As of April 2020, the total registered users of Beijing's customized bus service have reached 50,000; 173 customized bus lines have been opened with a daily departure volume of 191 buses [8].

The pandemic has inevitably promoted customized public transportation, which has been gradually accepted by the public. However, customized shuttle buses are not just needed under an emergency situation. As a public transportation mode, the customized shuttle bus has an advantage of operating with precise schedule and offering comfortable and fast service, compared with traditional fixed-line buses. As long as the customized shuttle buses are comfortable, convenient for reservation, reasonably priced and on precise schedule, they will continue to attract more users through the powerful promotion and popularization during this pandemic.

The traditional understanding of public transportation is generally limited to mass transit services such as rail transit, bus rapid transit (BRT), and public buses. These services adopt a single operation mode with fixed stations, designated lines, and unified vehicle types. However, living standards continue to improve, and social values, consumption patterns and lifestyles are also undergoing substantial changes. Daily travel demand has changed from "accessibility" to "accessibility with efficiency" and further moved to "accessibility with high quality," while the bus transportation system has failed to keep up with these changes. With the expansion of urban scope and the increasing proportion of motorized travel over medium and long trip distance, the share ratio of bus transit yields little improvement, while passenger cars have rapid growth as a result. If vehicle purchase restrictions are simply adopted again, it will inevitably lead to inconvenient travel for residents and reduce social benefits. For medium- and long-distance motorized travel in cities, passenger cars and public transportation complement each other. A healthy urban transportation system should seek a balance between the two. Therefore, it is recommended to reform public transportation and take the opportunity of growing customized public transportation to promote the diversification and marketization of public transportation to better respond to the changes in travel demand.

First of all, future public transportation should include multiple levels with diversity. There are traditional large- and medium-sized transit systems such as metros, light rails, BRTs, and buses. Demand-responsive customized buses, connector lines around the rail transit stations, and small-sized public transportation system with a capacity of 7–10 passengers (or even 3–5) should also be developed, which will expand the types and service scope of paratransit.

Secondly, to better adapt to the changes in demand, public transportation should take market-oriented reform as an opportunity to promote diversified development, rather than relying on the monopoly of state-owned companies and government subsidies. On the one hand, in order that public transportation serves as the foundation of urban public services, two to three public transportation enterprises can be established in each city; rail transportation operators can also be allowed to operate buses within a radius of two to three kilometers around the station to connect passenger flows to

the rail station. Better travel services will be achieved through appropriate market competition. For example, DiDi and other social capital can be introduced to participate in investment and operation under the supervision of government. On the other hand, differentiated subsidies can be provided based on passenger flows in different routes of each enterprise. For instance, corridor lines serving large passenger flow may be exempted from subsidy or only slightly subsidized, while regional routes with small passenger flow and protection needs are offered with increased subsidy.

4 Conclusion

The COVID-19 pandemic has influenced many aspects of life and work. How to understand and control the travel changes during the pandemic is an evolving challenge that has to be addressed now and in the future. The solution needs to be integrated in the development of transportation systems, including congestion management, transportation policy development, and improvement of public transportation service quality, to promote a healthier and more sustainable urban transportation system.

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