15-Minute City: Future Urban and Transportation Development Mode

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Abstract: With the rapid expansion of cities today, more and more environmental, traffic, human settlement and safety issues have emerged. To better solve the problems and reorganize the urban layout, the 15-minute city development model came into being. This paper deeply analyzes and summarizes the application and impact of the 15-minute city concept in environmentally sustainable development, intelligent traffic control and human settlement environment. Through case analysis, this paper interprets the development and application of the 15-minute city model in cities such as Paris and Shanghai and compares the similarities and differences in different countries and policy backgrounds. After research, the 15-minute city model is becoming a blueprint and guiding strategy for the future development of more and more large cities. Under the current situation of highly concentrated and expanded urban scale, the 15-minute city concept reshapes the urban pattern from a new perspective. The development of the transportation field is crucial in the 15-minute model, so the research results of this paper will re-examine and define the future development direction of cities at multiple levels.

1 INTRODUCTION

With the acceleration of urbanization, many cities are going through a phase of rapid expansion and development, which has led to the distribution of living facilities such as schools, hospitals and supermarkets becoming irrational and unable to meet the needs of citizens. To reach these facilities, citizens often need to spend a lot of transportation time and cost, which not only aggravates traffic congestion but also causes frequent environmental pollution and geological disasters, seriously hindering the development of cities. In addition, in the context of the current epidemic, especially during the COVID-19 epidemic, people are more likely to choose walking or cycling to reach as many living infrastructures as possible within 15 minutes to reduce the risk of virus exposure. To address this issue, urban planners need to reassess the layout of amenities to ensure that they are reasonably distributed near residential areas.

Therefore, the concept of a 15-minute city is gradually being adopted and practised in more and more areas. The concept of a 15-minute city can be used to alleviate the growing problem of urban development by rationally planning transportation facilities so that citizens can reach places within 15 minutes by slow transportation. The concept of a 15-minute city can be analyzed more efficiently, comprehensively and systematically from the perspective of transportation.

The concept of a 15-minute city was first proposed by French urbanist Carlos Moreno. With the acceleration of global urbanization and the improvement of residents' quality of life in recent years, the transportation systems of more and more cities are facing unprecedented challenges. In this context, a 15-minute city is gradually becoming the focus of academic attention and a hot topic of discussion. Carlos Moreno and others emphasized the vital role and potential of 15mc in promoting urban sustainable development, enhancing urban resilience and shaping local characteristics (Moreno, 2021). Kostas Mouratidis analyzed several major problems and hidden dangers in the implementation of this concept: including sustainability, fairness, livability

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and spatial analysis (Mouratidis, 2024). The analysis of these issues provides a more diverse perspective in the process of practicing this concept. Zaheer Allam and others further explored the theoretical basis and technical support of various models in a 15-minute city and emphasized the various benefits of this concept in terms of environment, society and economy (Allam, 2022). This study reveals that intelligent transportation systems achieve 15mc and sustainable urban development by optimizing traffic flow, improving traffic efficiency and reducing traffic congestion. Thomas Papasa and his team explored the relationship between the 15-minute city model and the evolution of the urban transportation system from a broader perspective, and how urban planners can use the model to improve urban resilience (Papas, 2023). Both studies emphasize that the urban transportation system, as an important part of urban infrastructure, plays a key role in promoting the realization of the 15-minute city (Bocca, 2021).

In summary, 15-minute cities, smart transportation and sustainable transportation are inseparable topics. As an important means to achieve community accessibility, transportation is an important means to achieve 15mc. By regulating and optimizing various parameters in the transportation process, people can effectively increase transportation efficiency and reduce environmental pollution, which plays a vital role in the physical and mental health of citizens and urban development (Abdelfattah, 2022).

This paper will analyze the concept of a 15-minute city and its application scenarios. This paper mainly takes Paris, France and Shanghai, China as examples to discuss the concrete practice and application of 15-minute city. It compares and summarizes the similarities and differences in the application of 15mc in different countries under different development statuses, and the characteristics of its implementation in China. Therefore, this paper will take a 15-minute city as the background to study the application of sustainable transportation development and intelligent traffic control and analyze the concept of a 15-minute city and its practical cases from the perspective of transportation.

2 15-MINUTE CITY CONCEPT, PRINCIPLES AND MEANS OF TRANSPORTATION

The concept of a 15-minute city was first proposed by Carlos Moreno, a professor at Sorbonne University in

2016. The 15-minute city aims to improve the quality of life by enabling residents to easily reach the required public places within 15 minutes through a reasonable layout of urban facilities. This model can promote sustainable urban development, reduce urban traffic congestion and pollution index, and increase citizens' happiness and convenience of life. The scope of the community under this concept is defined as 15 minutes based on the walking speed of people and the moving speed of bicycles in the city. Within 15 minutes, the average walking speed of citizens can reach a radius of one kilometer, while the average cycling speed can reach a radius of three kilometers. In this area, the community achieves comprehensive coverage of living facilities through a compact layout, which not only saves citizens' commuting time but also improves land utilization efficiency (Allam, 2022).

Figure 1: The 15-minute city framework. Adapted from (Moreno, 2021).

Since the mid-18th century, cities have gone through several stages of development, which provide historical background and theoretical support for the subsequent 15-minute city theory. The mainstream urban theories that have emerged include compact cities, new urbanism, and other formal theoretical foundations of 15mc. Compact urbanism emphasizes sustainable urban forms and reducing dependence on motor vehicle travel, and the 15mc theory is the practice of this concept in a specific microcosm. After experiencing the large-scale outbreak and blockade of Covid-19, more and more citizens and urban planners have discovered the irrationality of the current urban planning layout and the fragility of the structure. Due to government blockades and health concerns, people did not want to reach where they wanted to go through long distances or closed and intensive commuting during that time, so walking or cycling to safely and

quickly reach living facilities near their residences became mainstream during the epidemic. This also re-exposed the concept of the 15-minute city (Van Der Waals, 2000). Today, more and more cities are beginning to embark on the path of practicing the 15mc concept. The first to start was Paris, France, which launched the world's first shared bicycle system as early as 2001. American urban planning is also abandoning the previous development model of car-first and returning to the city concept of people-oriented. There is a common topic in China: the 15-minute convenient living circle, which is the Chinese community development concept before 15mc was formally proposed. Now, after integrating with the 15mc theory, it has also begun to be systematically implemented in major cities in China. For example, Shanghai, Shenzhen, Lanzhou and other cities have successively launched their own 15-minute living circle experimental communities (Wu, 2021).

The 15-minute city is a conceptualization of the principles of accessibility and sustainable development through the 15-minute city approach, in which the four principles of proximity, diversity, digitization, and reasonable building density should be followed in conjunction with the development of the new digital age (Cui, 2023). Proximity refers to the short spatial distance between places at the architectural level, which is measured in terms of the travel time of residents, meaning that pedestrians can reach the public facilities or places they need in their lives within 15 minutes by walking or cycling. This is a core and one of the objectives of the 15-minute city concept. In realizing the 15-minute city concept, the need to select appropriately scoped and well-laid-out neighborhoods are the foundation of the concept. Overemphasis on density is not a permanent solution; even if the density is too high for residents to reach at a certain time, it is still empty talk. Therefore, rational transportation and urban layout that enables travellers to reach their destinations within 15 minutes is the core. Diversity refers to both spatial and temporal diversity (Manakina, 2020). Spatially, residents can reach different functional facilities and places within 15 minutes, and this diversity meets the differentiated needs of citizens, making community life more convenient and community ties closer. The differentiation of workplaces is also a form of spatial diversity, especially the online office that became popular during the epidemic is one of the most important ways to realize the 15-minute city because most of the necessary commuting is for work purposes. Home-based or free-space offices can effectively reduce long-distance commuting while reducing the various costs and environmental

pollution generated by transportation. Spatial diversity also includes a variety of transportation options: within a 15-minute neighbourhood, residents can choose to walk, bike, etc.; within a larger 30-minute or even 45-minute living area, they can choose to use public transportation such as buses, subways, and other modes of transportation.

Diversity in time can be understood as the same building or site serving different purposes under different time conditions. For example, the school playground can be used as a place for student activities and teaching during the school year. However, during vacation time, most students and teachers are not in the school for teaching activities, so the schoolyard can be used as a venue for large-scale activities or as a parking lot, which greatly increases the usability of buildings with tidal properties. A deeper practice of temporal diversity for urban participants is the variability of working hours. Unlike workplace diversity, time diversity means that people with different jobs travel to their workplaces at different times, a policy that is being implemented in many major cities such as Beijing and Los Angeles. This measure allows the transportation system to avoid peak traffic and increase operational efficiency, resulting in shorter commute times and reduced urban loads.

In the process of practicing the 15-minute city, digitalization and intelligent technology have also gradually become indispensable components. Combined with the traffic control realized by intelligent technology, digitalization can improve the efficiency and accuracy of urban management. Strengthening the construction of the information city and promoting the improvement of information technology infrastructure can significantly improve the accessibility of the city, and effectively improve the city's existing problems and pitfalls, such as traffic congestion, carbon emissions, and so on. Although the 15-minute city theory does not overly emphasize the concept of digitization, incorporating digitalization into the 15-minute city concept is certainly a more efficient and accurate way of practising it in this day and age.

As mentioned earlier, the pursuit of density in building layouts is not the best solution. Many large cities in developing countries, such as New Delhi in India and Cairo in Egypt, have large populations of more than 20 million people. However, due to uneven economic development and poor urban layout, the distribution of urban infrastructure is extremely uneven, resulting in significant differences between communities. This has led to increased fragmentation and uneven distribution of resources within cities,

leading to more pollution and waste of resources. Uneven regional development will ultimately undermine the development of the city as a whole, so it is more important to have a balanced distribution of amenities. It is also important to pay attention to not only the infrastructure and living space but also the population density to ensure the comfort of living in the community and the sustainability of the land.

Sustainable transportation is closely related to the topic of achieving a green, environmentally sustainable 15-minute city. Sustainable transportation can also be understood as green transportation, such as walking, cycling, using clean energy cars or public transportation. They all share the common feature of not polluting the environment as much as possible, and building a network of urban transportation systems by saving fossil energy, reducing air pollution and increasing the health index of the population. This coincides with the concept of a 15-minute city. Intelligent traffic control takes the intelligent transportation system as the carrier and realizes the diversified management of spatialized temporalization of traffic flow through informatization, and artificial intelligence technology, which provides a guarantee for fast, safe and efficient commuting. Highway unmanned toll collection systems, intelligent parking system, real-time signal light deployment systems are all part of this field. An intelligent transportation system is exactly part of the digital proposition in the concept of a 15-minute city, in the age of technology today, the use of the Internet and AI technology is undoubtedly an important means of realizing the 15-minute city, and from the perspective of intelligent transportation into can be more systematic and efficient to land the project to promote. The government and institutions can collect travel behaviour data, accurate analysis and through processing and analysis to get the most in line with the local situation of the traffic solution, is traffic control in the 15-minute city plays an important role. In Hangzhou, China, the government cited a city brain project in the field of transportation, which can detect the traffic flow of more than 2,000 intersections in Hangzhou, and through deep learning and other methods to predict the traffic flow of each time and real-time traffic light timing to slow down traffic congestion and tailpipe emissions.

To sum up, sustainable transportation and intelligent traffic control are important means of transportation to realize 15-minute cities, and the author will analyze concrete examples of 15-minute cities around the world in the following.

3 ANALYZING THE 15-MINUTE CITY DEVELOPMENT MODEL WITH EXAMPLES FROM PARIS AND SHANGHAI

The 15-minute city has been adopted and acted upon by an increasing number of city governments around the world, and this paper will analyze a few representative examples.

3.1 Paris, France

After World War II, Paris experienced rapid urbanization, accompanied by a dramatic increase in the number of motor vehicles, leading to serious traffic congestion and air pollution. Against this background, the concept of the 15-minute city gradually sprouted in Paris and was practiced through a series of policies.

As early as 2001, the world's first bike-sharing system landed in Paris, and the Paris city government began to gradually shift from developing urban transportation centered on motor vehicles to one led by public transportation. Since the 1990s, with the French government strengthened the travel restrictions on private cars and environmental standards have been issued Loi sur l'Air et l'Utilisation Rationnelle de l'Energie, LoiAURE and the Loi Solidarité et Renouvellement Urbain. The city government of Paris actively corresponds to the policy and vigorously develops public transportation. As of 2017, Paris has built a total mileage of 206 kilometers, bus routes of up to 1,511, and bike lanes of up to more than 1,100 kilometers of Europe's most extensive and complex public transport system. This has effectively reduced motor vehicle ownership and travel in the Paris region. In the highly economically developed French society, motor vehicle ownership in the Paris region made a rare downward inflection point in 2018. 2016 Paris Mayor Anne Hidalgo's re-election continued to increase the 15-minute city landing in Paris. Public transportation, as well as slow-moving traffic, has gained a large amount of public support in Paris, with the number of people travelling via self-propelled trips in the city rising by 54% in 2019 alone. Paris is in the process of transforming more of its streets into low-speed streets with a focus on walking, and cycling. The 2024 Olympics Paris has added almost another 400 kilometers of new cycling lanes. The center of gravity of car ownership in Paris is shifting from the city center to the outskirts, and the city's traffic congestion index is decreasing and the pollution index is under

control. From the example of Paris, people can see that the traffic management of large cities is not without solutions, try to return the heart of the city to the people themselves, abandon the car as the center of development, the city will be divided into their centers but closely linked 15-minute neighbourhoods, it seems to be an effective way to solve the problem of urban development.

3.2 Shanghai, China

Shanghai is the city with the highest GDP output value, the largest population size and structural volume in mainland China. As of 2020, Shanghai's population has reached more than 24 million, and the number of motor vehicles has reached about 5.37 million, making it a veritable supercity. Along with this are the various common problems brought about by the large size of the city, including traffic congestion, pollution relief, and urban land shortage. In the process of rapid urbanization, Shanghai has gradually developed a huge transportation infrastructure. However, as the city size expands, traffic congestion and pollution problems have become more serious.

In response to these challenges, Shanghai took the lead in proposing the concept of a 15-minute living community in 2014 and actively promoted it through a series of measures. Shanghai has laid out 1,600 15-minute urban communities throughout the city, and each community adopts a 1+N service point layout model. A core name is Bailefang, which is a comprehensive place covering government affairs, entertainment, mother and baby, food, and other services to provide convenience for residents within the 15-minute community circle. There are many independent facilities scattered in the community called Liuyi Pavilion, which provide citizens with rest, drinking water, toilets and other convenient facilities. Shanghai is more inclined to provide diversified infrastructure in the block to meet the differentiated needs of the community. As a major country in science and technology development, China also needs to combine smart technology in the field of transportation. The evolution of Shanghai's smart city in the past 11 years can be divided into three stages, namely exploratory advancement, continuous deepening and efficiency improvement. Shanghai uses technologies such as the Internet of Things, cloud computing, and big data collection to predict traffic flow and optimize the behaviour of traffic flow on urban arterial roads through real-time regulation of lanes and traffic lights. Optimize the density of subway and bus schedules. Intervention and timely

handling of driving and pedestrian accidents, etc. Based on algorithm prediction, virtual simulation and other technologies, various traffic data can be collected, model analysis of concentrated problems can be carried out, and intervention factors such as policies, measures, and regulations can be added to find the most suitable development and improvement model for the local 15-minute community, and this will support the realization of the 15-minute city step by step, providing a solid foundation for building a green and sustainable development city concept.

3.3 Case Comparison Between Shanghai and Paris

Based on the 15mc cases of Shanghai and Paris, people can get some similarities and differences between the two: In terms of developing slow traffic, Paris is more inclined to prioritize the development of slow travel, including walking and cycling, when developing 15mc communities. Since 2001, Paris has vigorously built more than 1,000 kilometers of bicycle lanes and pedestrian paths. Shanghai, on the other hand, focuses more on building public facilities that meet community requirements and the development of public transportation, so there is still room for improvement in the field of slow traffic development. In terms of housing and social integration, Western cities, led by Paris, tend to pay more attention to the impact of housing prices on projects. Paris has introduced many policies to promote affordable housing and try to eliminate the barriers and differences between so-called wealthy and poor communities, to promote urban integration. However, it can be concluded from the above cases that local governments have actively adopted the advanced urban concept of 15-minute communities to cope with the various problems brought about by the growing expansion of cities. Therefore, more and more cities and regions are gradually recommending the application of 15-minute cities.

4 CHALLENGES TO THE IMPLEMENTATION OF 15-MINUTE CITIES IN CHINA

The 15-minute city was first proposed by Western countries. When this development concept was introduced to China, it needed to be developed following the special conditions of the local country. First of all, as a country with a large population, China has been most concerned about the ageing of its

population in recent years. When developing the concept of community construction in Europe and the United States, more attention was paid to issues such as racial segregation and community housing prices, while China should pay more attention to the obvious age differences. The infrastructure in the community, including service points, and transportation facilities should fully consider the age distribution when they are built. Secondly, many Chinese cities have been built too fast in the early stage and lack reasonable planning, which makes many later engineering reconstructions particularly difficult. For example, many communities built in the 1980s have very narrow passages, but they gather a large number of residents. The construction of green travel passages in 15-minute communities cannot be transformed here, and a large number of old communities do not have the conditions to add community service points, which requires local planners to spend more energy to find a 15mc model suitable for local development. Third, China's unique household registration system and a large number of newborns have resulted in the government forcing the schooling of children within designated residential areas. This suggests that when implementing 15mc in China, schools can be used as an entry point. However, at the same time, the reasonable construction of schools and ensuring the safe passage of students in the community is one of the major challenges.

5 CHALLENGES

At present, the challenges faced by 15-minute cities mainly include uneven development situations, solidified travel habits, and uncoordinated multi-sectoral work.

First of all, in the process of promoting 15mc in Shanghai, it is obvious to see the unbalanced development situation. In Jing'an, Huangpu, Changning and other city centers, hospitals, convenience stores, schools and other facilities are well equipped, but not in Fengxian, Jinshan and other remote areas. A large number of communities do not have comprehensive facilities in or around their neighborhoods, making it difficult to promote 15-minute communities.

Secondly, many areas are very densely populated, but due to the lack of good urban planning and a developed economy, the urban infrastructure is relatively poor. This makes retrofitting very difficult, and municipal officials often need to make extensive changes or add new facilities to meet the 15-minute city standard. But the need for new neighborhoods

and transportation is often urgent in these areas, where neighborhood segregation, development inequities, and safety hazards abound. So getting policy off the ground in these areas will be a major challenge for that government.

In addition, the core of the 15-minute concept is to get to the infrastructure needed to live quickly in a greener way. This will require citizens to change their travel habits to adapt to the new policy, but for reasons that are notoriously difficult and time-consuming to change, it will be a challenge for the 15-minute city to get more residents to change and respond to the 15-minute concept.

Finally, in the process of transforming a community into a 15-minute city, a large number of facilities and buildings need to be renovated and laid out. This involves both multi-sectoral coordination and huge financial support. Multi-sectoral means more interests, so cooperation becomes a huge task with many variables to mediate. If the government is not so open-minded, it will be even more difficult to move the project forward.

6 CONCLUSION

Nowadays, more and more cities are suffering from uneven resource distribution, environmental pollution, traffic jams and other problems due to the rapid expansion of their scale, which seriously hinders the development of cities and even countries or regions. This study found that the concept of a 15-minute city seems to be able to solve many development problems within cities and is becoming the future development form of many cities. The 15-minute city has become the focus and emphasis of urban construction in many places in Europe, America and Asia. For example, Paris in France and Amsterdam in the Netherlands have benefited from their good urban construction foundation such as perfect bicycle lanes or reasonable community layout and high population quality, which makes the concept of a 15-minute city quickly and well responded to in the local area. Nowadays, many large cities in Europe are approaching green goals such as carbon neutrality. Due to its special national conditions, American cities are more inclined to live in suburban areas far away from the city center, so it is more popular to travel by car. The implementation of a 15-minute city is more difficult, and local urban and rural and transportation planners need to reconsider the application and layout of 15-minute city. Even so, Portland and Seattle have given us a relatively satisfactory result. Asian regions such as China, Japan, and Singapore are actively

implementing 15-minute city projects. The common characteristics of Asian cities are that their population density and population base are extremely large. Under high-density living conditions, the development of 15-minute cities is simpler but also more urgent. Many cities in the world that are developing 15-minute community projects are setting examples for more regions, such as reducing the waiting time of motor vehicles through intelligent traffic control to optimize traffic density to improve urban circulation and reduce pollutant emissions. The same situation can be applied to public transportation. Japan's Tokyo metropolitan area is the most populous metropolitan area in the world, but with its well-connected subway system, it has successfully made the city just orderly and rarely has traffic jams. The development of recyclable transportation will be implemented in the 15-minute city project. The purpose and implementation methods of the two are very similar. Both guide residents to commute by green transportation or slow transportation. This will not only achieve sustainable development of the city and help improve climate conditions but also promote residents' health and community integration. In summary, the 15-minute city is the future blueprint for urban development, and transportation development is the backbone and soul of the 15-minute city.

The scope of this article is relatively narrow. At present, it only compares and studies many regions that have implemented the 15-minute city project. However, this is only a minority of cities in the world. Many more cities are still in a period of confusion and chaos in their development. I hope that more and more governments can implement the 15-minute city project in specific cities in a more appropriate manner. Making cities more livable, accessible, and green rather than blindly pursuing economic development should be the key consideration and construction goal in the future.

REFERENCES

Abdelfattah, L.; Deponte, D.; Fossa, G. 2022. The 15-minute city: interpreting the model to bring out urban resiliencies. Transportation Research Procedia 60, 330-337.

Allam, Z.; Bibri, S.E.; Chabaud, D.; Moreno, C. 2022. The Theoretical, Practical, and Technological Foundations of the 15-Minute City Model: Proximity and Its Environmental, Social and Economic Benefits for Sustainability. Energies 15, 6042.

Allam, Z.; Bibri, S.E.; Chabaud, D. et al. 2022. The '15-Minute City' concept can shape a net-zero urban future. Humanit Soc Sci Commun 9, 126.

Bocca, A. 2021. Public space and 15-minutes city. A conceptual exploration for the functional reconfiguration of the proximity city. Tema. Journal of Land Use, Mobility and Environment 14 (3), 395-410.

Papas, T.; Basbas, S.; Campisi, T. 2023. Urban mobility evolution and the 15-minute city model: from holistic to bottom-up approach. Transportation Research Procedia 69, 544-551.

Moreno, C.; Allam, Z.; Chabaud, D.; Gall, C.; Pratlong, F. 2021. Introducing the 15-Minute City: Sustainability, Resilience and Place Identity in Future Post-Pandemic Cities. Smart Cities 4, 93-111.

Mouratidis, K. 2024. Time to challenge the 15-minute city: Seven pitfalls for sustainability, equity, livability, and spatial analysis. Cities 153, 105274.

Van Der Waals, J. 2000. The compact city and the environment: a review. Tijdschrift voor economische en sociale geografie 91, 111-121.

Wu, H.; Wang, L.; Zhang, Z.; Gao, J. 2021. Analysis and optimization of 15-minute community life circle based on supply and demand matching: A case study of Shanghai. PLoS ONE 16 (8), e0256904.

Cui, Q.; Chen, R.; Wei, R.; Hu, X.; Wang, G. 2023. Smart Mega-City Development in Practice: A Case of Shanghai, China. Sustainability 15, 1591.

Manakina, A.; Nikolaeva, V. 2020. IOP Conf. Ser.: Mater. Sci. Eng. 890, 012179.