

Research on Sustainable Countermeasures for Shared Parking Development

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Abstract: Utilizing "shared parking" can effectively enhance the utilization of private parking spaces, thereby increasing the overall supply of parking spots and contributing to alleviating the urban "parking challenges." Based on the current research status of shared parking both domestically and internationally, this article focuses on analyzing the existing issues and proposes corresponding strategies and recommendations to address these challenges.

Keywords: Shared Parking, Current Status, Proposed Measures.

1. Introduction

In the face of the increasingly prominent parking challenges in urban transportation, the development of parking resources has been constrained by factors such as urban space, auxiliary facilities, land development levels, and additional socioeconomic value. As a result, the disparity between parking demand and supply has been growing, driven by the increasing number of motor vehicles and the uneven development of parking resources. Enhancing the utilization of parking spaces to alleviate urban parking conflicts has become an urgent issue that requires immediate attention and resolution from local governments and city administrators at all levels.

In recent years, propelled by the rise of the sharing economy, the concept of shared parking has gradually become a consensus. By breaking through the constraints of private parking spaces through sharing, it effectively enhances the utilization of parking spaces and presents a new approach to tackling the problem of parking difficulties. While setting up road parking spaces and constructing public parking lots have been the main methods to alleviate parking challenges, the availability of road and land resources is ultimately limited. In many cities, the annual growth rate of motor vehicles far exceeds the rate at which parking facilities are being added. This objective reality necessitates a breakthrough from the perspective of efficiently utilizing parking spaces.

Shared parking encourages individuals and businesses to open up their idle parking resources for others to use, promoting resource sharing and optimizing utilization. An analysis of the parking supply-demand dilemma reveals that various functional areas within cities often exhibit complementary patterns in terms of parking needs concerning time. For example, commercial districts, corporate offices, hospitals, and similar regions encounter significant parking difficulties during the day while experiencing higher vacancy rates at night. Conversely, residential areas demonstrate the opposite trend, with higher vacancy rates during the day and a need to diligently search for parking spaces at night.

Shared parking, as an innovative parking model, leverages the sharing and utilization of existing resources to effectively mobilize parking resources from various functional areas within a region. By increasing parking supply and balancing the parking demand and supply relationship, this approach

significantly improves the turnover and utilization of parking spaces. It helps alleviate urban parking difficulties, reduce traffic congestion and environmental pollution, promotes resource sharing and sustainable development, and propels the advancement of intelligent urban transportation.

2. The Current State of Shared Parking Development

The continued development of shared parking is seen as a positive step towards creating a more sustainable and efficient urban transportation system. As technology advances and public awareness grows, it is expected that shared parking will continue to expand and play a significant role in addressing parking challenges and enhancing urban mobility.

2.1. Research dynamics

Presently, research on shared parking primarily focuses on issues related to parking space allocation, parking fees, and parking space reservation.

For instance, in the research of parking space allocation models, Zhang et al.[1] proposed a shared parking space allocation model with the optimization objectives of platform revenue and parking walking distance. Zhang et al.[2] from a user-centric perspective, introduced a model for allocating multiple shared parking spaces in residential areas, aiming to provide optimal decisions for user parking requests. Tan et al.[3] combined market design mechanisms with auction mechanisms to analyze the allocation and pricing of shared parking spaces. Their research demonstrated that a shared mechanism with cash incentives can attract more private parking space owners to participate in the sharing platform. Sun et al.[4] comprehensively considered costs such as parking space rental, service provision, and user loss. They aimed to maximize the revenue of the parking sharing platform and constructed a decision model for allocating shared parking spaces based on parking demand. In order to alleviate parking conflicts and achieve a more equitable utilization of parking resources, Zhang et al.[5] proposed a neighborhood shared parking space allocation model. This model aimed to improve the utilization rate of parking spaces in residential areas and reduce walking distances, taking into account both usage rates and walking distances. Li et al.[6] aimed to maximize total revenue and established a shared

mixed parking space rental and allocation (MPRA) model, which considered matching priorities.

In the practical application of reserved parking, it is essential to consider the issue of parking punctuality, wherein parking users may arrive earlier or depart later than the scheduled reservation time, resulting in uncertainty. Jiang et al.[7] conducted research on the issue of parking punctuality in the context of shared parking space allocation. They established probability functions for parking arrival and departure times for consumers and parking space owners during different time periods and devised a mixed-integer programming model to determine the optimal solution. Huang et al.[8], based on the stochastic distribution of vehicle arrivals and parking durations, constructed a shared parking allocation model with the objective of maximizing parking efficiency. Following the principle of maximizing parking benefits, they determined the optimal proportion of reserved parking spaces and the quantity of shared parking spaces to be purchased from residents. Wang et al.[9] proposed an opportunity-constrained optimization model to address the reservation and allocation issues in shared parking platforms. Xue et al.[10], to cope with uncertainties such as early arrivals and delayed departures during parking, enhanced the robustness of parking space allocation schemes by reserving appropriate buffer times. Subsequently, they developed a dual-objective optimization model aiming to maximize platform revenue and robustness in parking space allocation.

2.2. Analysis of Existing Issues

Currently, the development of shared parking is mainly achieved through collaborations between parking lot management companies, government agencies, and other relevant parties. Companies often contract or purchase fixed parking spaces for sharing. These shared spaces are usually equipped with parking locks, allowing users to unlock the parking spaces upon arrival through a simple click. However, this approach falls short of truly maximizing the existing parking resources; it merely converts regular short-term parking spaces into shared ones and offers reservation functionality without fully achieving the goal of mobilizing the available parking supply.

The actual operational situation of shared parking in various regions indicates that there is low participation from residents in sharing their parking spaces, and parking space owners show limited willingness to participate in the sharing scheme. Issues related to parking time limits, resource allocation, and revenue distribution are significant factors hindering the development of shared parking, a comprehensive analysis reveals that shared parking development typically faces the following challenges:

(1) Parking space supply-demand imbalance: Limited urban parking resources result in a significant challenge of supply-demand imbalance for shared parking. During peak hours, parking spaces are severely insufficient, making it difficult for users to find available parking spots. Conversely, during off-peak hours, some shared parking spaces may remain idle and underutilized.

(2) Insufficient scale guarantee: Shared parking requires a certain critical mass to enable the utilization of intelligent computing and dynamic allocation effectively. However, in urban renewal areas, individual parking garages typically have limited capacity and are often managed in a dispersed manner under traditional models. This results in congested parking information and low turnover efficiency, hindering

the realization of shared parking advantages and the full expression of its benefits. Consequently, it poses obstacles to the development of shared parking.

(3) Parking space management and regulations: The development of shared parking necessitates a robust and coordinated multi-departmental management mechanism with strong implementation. Effective management and regulations for parking spaces are essential, including ensuring the accuracy of parking space information, reasonable parking fees, and the maintenance of parking order. The lack of unified management standards and regulations may lead to inconsistent service quality, ultimately affecting the user experience.

(4) Unclear benefit protection: Shared parking involves unified management and dynamic reallocation of existing ownership rights to spaces. During this process, determining the allocation of costs, benefits, and losses within a reasonable framework becomes challenging. Furthermore, it remains uncertain whether the benefits can effectively motivate existing rights holders. Currently, there are no precise corresponding legal provisions or sufficiently mature practical experiences in place. In residential complexes, the parking garages are often owned by the residents who possess the priority rights for renting, purchasing, and using the spaces. The shared utilization of these spaces raises concerns among the owners about their exclusive rights. In the absence of clear benefit protection, coordinating the interests of the owners becomes exceedingly difficult.

(5) Data security and privacy protection: Shared parking platforms are required to collect and process users' personal information and payment data, making data security and privacy protection crucial issues. It is essential for the platform to implement effective security measures to safeguard the confidentiality and security of user data, ensuring the prevention of data breaches and misuse.

3. Recommendations for Countermeasures

3.1. Development of policies and legislation

Establishing Appropriate Policies and Regulations: Clearly defining the operating model and regulatory requirements for shared parking. Collaborating with relevant industry stakeholders, the government can develop unified operational entry standards, operational guidelines, and management mechanisms to provide clear guidance and supervision for shared parking. Strengthening the oversight of parking lots and parking spaces, enhancing law enforcement inspections, and imposing penalties to combat irregular charging, unauthorized occupation of parking spaces, and other violations. The government can also establish complaint and reporting channels, encouraging the public to actively participate in monitoring and reporting any violations.

3.2. Guiding reasonable pricing

Implementing Market Regulation Mechanisms: Guiding shared parking platforms and parking lots to set reasonable pricing through market mechanisms. Strengthening oversight of parking lots and parking spaces, and intensifying supervision of parking fees to prevent irregular and unjustified charges. The government can establish a price regulation mechanism, conducting regular monitoring and investigations of parking fees to ensure fairness and reasonableness. Moreover, enhancing parking space

management efficiency and convenience through smart parking systems and electronic payment technologies.

3.3. Enhancing Parking Space Utilization

Promote off-peak shared parking, where eligible enterprises and institutions can make full use of their vacant parking spaces during nighttime, weekends, and holidays. By voluntarily opening up these parking spaces for shared use, they can designate specific shared parking hours and implement paid parking arrangements. This initiative aims to alleviate the parking difficulties faced by neighboring residential areas and reduce the pressure of on-street parking.

Open up shared access for property owners, allowing them to participate in the shared parking program and generate income by sharing their parking spaces, thus leading to the appreciation of parking spaces. Shared parking users should undergo real-name authentication, and for vehicle owners who have not moved their vehicles beyond the designated parking time, backend staff will notify them by phone to relocate their vehicles. Vehicles that exceed the shared parking time limit will be treated as violating parking regulations.

Additionally, establish a shared parking credit system, where owners who do not adhere to the regulations will have their credit points deducted. Those with scores below a certain threshold will no longer be eligible for off-peak and shared parking services.

3.4. Secure Sharing.

Strengthen security measures and prioritize data security and privacy protection. Shared parking service platforms should establish comprehensive security measures, enhance the application of data encryption and privacy protection technologies, and implement robust data management and risk control mechanisms. Simultaneously, the platform must strictly adhere to relevant laws and regulations to safeguard users' data security and privacy rights.

Furthermore, the shared parking platform should enhance communication with vehicle owners and parking space owners while implementing effective data security measures to ensure the safety and confidentiality of users' personal information and payment data.

4. Conclusion

The shared parking model is still in its infancy and urgently requires relevant regulatory authorities to issue corresponding laws and regulations to guide the standardized development of shared parking enterprises or platforms. The government can provide support to the shared parking market through economic and policy measures. It is essential to strengthen promotion and publicity efforts to enhance public awareness and acceptance of shared parking.

Parking management entities should offer convenient parking space search and reservation services while continuously improving the social credit system and dishonesty punishment mechanisms. Conducting qualifications reviews of companies and users will ensure the safety

and reliability of shared parking. Implementing user feedback and evaluation mechanisms can provide assessments of parking space and service quality, thereby reducing usage risks and instilling greater trust among users in the shared parking system.

The development of the "shared parking" project has remained lukewarm. To move forward, we can start by focusing on increasing the supply of shared parking spaces. A key breakthrough can be achieved by considering shared parking space owners as both suppliers and consumers in the market. By incorporating their own parking needs into their supply decisions, we can encourage more space owners to participate in sharing their parking spaces. This will lead to an expansion in the supply of shared parking spaces and a boost in market activity, thereby driving the advancement of shared parking.

References

- [1] Zhang S C, Cai Y F, Huang R, et al. Shared Parking space allocation method considering reservation demand[J]. *Transportation Systems Engineering and Information Technology*, 2020, 20(03): 137-143.
- [2] Zhang W H, Su Y M, Dai J, et al. Distributing model for shared parking in the residential zones[J]. *Journal of Transportation Systems Engineering and Information Technology*, 2019, 19(01): 89-96.
- [3] Tan B Q, Xu S X, Zhong R, et al. Sequential auction based parking space sharing and pricing mechanism in the era of sharing economy[J]. *Industrial Management & Data Systems*, 2019, 119(08): 1734-1747.
- [4] Sun H J, Fu D H, Lü Y, et al. Parking spaces renting and allocation model for shared parking[J]. *Journal of Transportation Systems Engineering and Information Technology*, 2020, 20(03): 130-136.
- [5] Zhang W H, Gao F, Sun S R, et al. A distribution model for shared parking in residential zones that considers the utilization rate and the walking distance[J]. *Journal of Advanced Transportation*, 2020, 2020(04): 1-11.
- [6] Li C M, Wei W B, Zhang L. Rental and allocation of shared mixed parking spaces considering matching priority[J]. *Transportation Systems Engineering and Information*, 2022, 22(03): 190-197.
- [7] Jiang B, Fan Z P. Optimal allocation of shared parking slots considering parking unpunctuality under a platform-based management approach[J]. *Transportation Research Part E: Logistics and Transportation Review*, 2020, 142(10): 102-118.
- [8] Huang X, Long X Q, Wang J, et al. Research on parking sharing strategies considering user overtime parking [J]. *PLOS ONE*, 2020, 15(06): 23-37.
- [9] Wang S F, Li Z H, Xie N. A reservation and allocation model for shared-parking addressing the uncertainty in drivers' arrival/departure time[J]. *Transportation research part C: emerging technologies*, 2022, 135(02): 103-124.
- [10] Xue Z J, Yuan Q F, Ji K F. Robust method of shared parking allocation based on buffer time[J]. *Journal of Shenzhen University (Science and Technology Edition)*, 2022, 39(02): 216-222.