



Capacity and Delay Produced by Parking Operating System

Rania A. Al-mrumudhia ^a, Jalal T. Al-Obaedia ^a

^a Roads and Transport Dept, Eng College, University of Al-Qadisiyah, Iraq

*Corresponding author E-mail: rainaali.eng.road@qu.edu.iq

Abstract

One of the justifications for planning integrated activities is the particular area of the land and its efficiency. Every journey concludes with a look for a parking lot. Therefore, it is important provide adequate parking spaces for vehicles. This is a complicated issue as it cost land spaces at significant areas like city centers. The standard parking provides normal spaces so as no other vehicles can prevent or delay the drivers to leave when finish their duty. At Al-Diwaniyah city center, most private parking manage their work by forcing drivers to leave the vehicle's key inside vehicles so as the parking workers can reduce the stopping spaces and increase the capacity of the parking. This will cause a delay to drivers when they want to leave the parking later due to informal stopping inside the park. This work examines the effect of leaving the key inside vehicles when stopping on the capacity of parking and delay that causes for drivers. The results of analyzing data from nine parking reveals that the capacity will significantly increase with a range from 19 to 89% while causing average delay ranged from 81 to 114 sec with a maximum delay of 240 sec. In order to balance capacity and delay, the study emphasizes the significance of using smart parking solutions.

Keywords: Capacity , Delay , Leave a key , Operating system , Parking

1. Introduction

Parking is essential to providing a service to people since it enables them to park their cars before starting any kind of activity. Parking is one of the procedures a person must follow when traveling to a certain place because every trip involves parking at its destination. In addition, it is important to take into account cost and suitability, as these factors could aggravate consumers and lead to unintended problems in different domains [1]. According to [2], parking problems in metropolitan areas have grown in significance due to recent rapid economic growth and an excessive increase in the number of automobiles. As a result, rising living standards and population expansion are responsible for the increase in the number of city cars. People would rather drive their own cars than take public transportation because of the lower rates and subsidized parking fees. Many studies carried out in Europe have found that the hunt for parking takes between 25 and 40 percent of travel time. European surveys indicate that it takes an average of eight minutes to find a parking spot [3]. One component of the transportation system that is inextricably linked to other subsystems is parking. The last action or transit that a vehicle takes when searching for a spot to halt is parking. Some halt or park the kind of vehicle at the designated spot for a predetermined amount of time. Processing and managing parking lots successfully shows successful transportation planning. Parking is generally understood to be the act of a vehicle stopping at designated locations as directed by signs [4]. According to [5], vehicles may spend about one day during a week for parking outside the houses. The parking may cause



This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited. © 2025 The Authors

<https://www.muthuni-ojs.org/index.php/mjet/index>

incidents for roads access and provide resinous traffic congestion. Parking is a difficult issue for most cities, educational institutions and other facilities [6]. The growing number of cars in urban areas has made it essential to find a suitable vehicle parking solution. The use of traditional parking techniques is no longer possible since they call for a large amount of space, which is necessary to meet parking requirements [7]. Plans for parking management that take sustainability into account are now required. This includes creating effective parking spaces that support and promote environmentally friendly modes of transportation. Parking have been planned with predetermined auto-oriented and functional classes since the 1990s [9]. In Delhi's commercial center, examinations of parking spots were conducted in nine sectors. The results showed that there was a considerable indirect condition, with parking peaking at 3.25 and bicycles peaking at 6.21. Geographic information systems were utilized in a research conducted in the Sanandaj city. Iran, to map out car parking spaces. The results indicated that 14.16%, of the study area would be appropriate for parking facility construction [10]. In Iraq, a study was carried out in Hilla's city to focus on the high demand for both on- and off-street parking. The work proved that the on-street parking increased the risk and reduced the safety [11]. A research was conducted in Ramadi city center revealed that there are more parking spots on the street than there are off-street; hence, it was suggested that there be more off-street parking. (Mahmoud, 2011). The standard parking provides normal and safe spaces so as no other vehicles can prevent or delay the drivers to leave when finish their duty. At Al-Diwaniyah city center, most parking manage their work by forcing drivers to "leave the key" inside vehicles so as the parking workers can reduce the stopping spaces and increase the capacity of the parking. This will cause a delay to drivers when they want to leave the parking later due to informal stopping inside the park. This work examines the effect of leaving the key inside vehicles when stopping on the capacity of parking and delay that causes for drivers. This study examines the operational impact of the "leave the key" practice on capacity and delay, in contrast to the majority of earlier research that mainly looked at geometric design or demand estimation. Recent research has also explored smart parking and machine learning applications in parking management, showing potential to reduce delay and improve efficiency. The study also highlights how crucial it is to integrate intelligent parking management technologies with traditional traffic engineering techniques.

2. Methodology

In order to address the effect of operating system on the parking capacity and delay, it is essential to collect data from selected parking areas, nine parking were selected for data collection process. The data collected represents the maximum number of stopped vehicles (i.e. parking capacity) and the delay caused for drivers when they want to leave the parking. The amount of time that passed between the driver's arrival at the parking lot and their ability to depart without any hindrance was known as the delay. Direct field observation was used to determine the measurement, which was in seconds. The standard system's capacity was estimated using design standards that are frequently used in traffic engineering (HCM 2010 and AASHTO guidelines).

Fig. 1 shows the map for Al-Diwaniyah city and **Fig. 2** shows the locations of the selected parkings. All of the selected parkings have private owners.

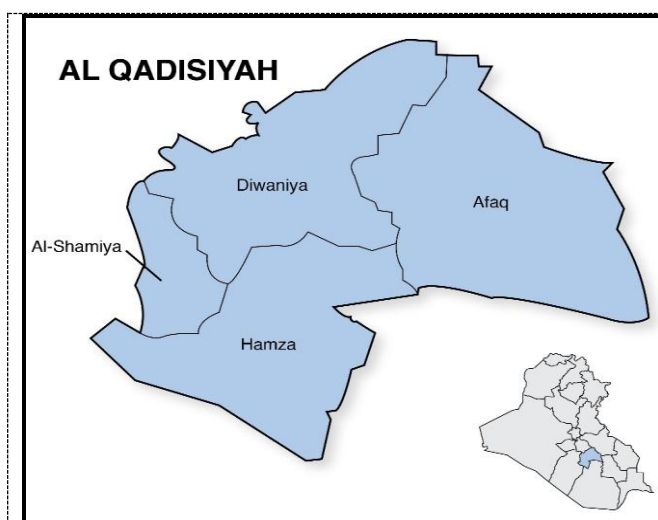


Fig. 1: A map for Al- Diwaniyah city.



Fig. 2: The locations of the selected parkings.

3. Results and Discussion

The effect on capacity

The results in **Table 1** shows the capacity of each parking when operated at both standard and “leave the key”. The capacity for standard operating was theoretically estimated based on design standards while the capacity for “leave the key” strategy was estimated as the maximum stopped vehicles at fully condition for a park. **Fig. 3** shows the results and suggested that there was significant increase in parking capacity based on “leave the key” ranged from 19 to 89%. This finding indicates why the private parking owners prefer this system as it increase the capacity and increase their incomes.

Table 1: Capacity difference by operating system

Park Name	Capacity (veh)		% of increased
	Standard system	“Leave the key” system	
P1	28	35	25
P2	84	100	19
P3	36	50	39
P4	25	40	60
P5	9	17	89
P6	15	25	67

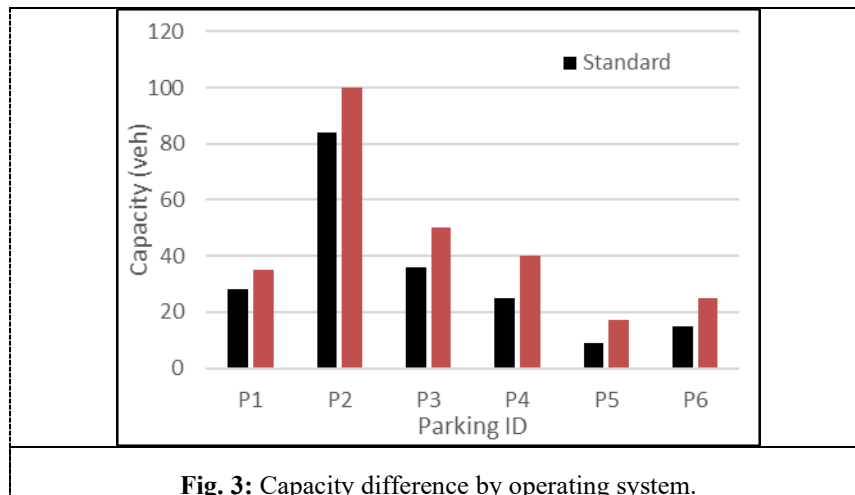


Fig. 3: Capacity difference by operating system.

4. The effect on delay

Table 2 shows the delay caused by “Leave the key” method for three selected parking. The delay here is estimated as the difference in time between the arrival of a driver until he/she can drive car without being delayed by other stopped vehicles. The results in the table showed significant delay produced for drivers reached to 240 sec as a maximum with average delay ranging from 81 to 114 seconds for the selected three parking. These results support earlier findings that parking operating systems have a significant impact on user experience and efficiency.

Table 2: Delay caused by operating system

Parking ID	Sample size	Delay (sec)			
		Min	Max	Avg.	STD
P7	25	0	210 sec	105.52	63.1771
P8	25	0	240 sec	114.24	65.6641
P9	25	0	150 sec	81.76	57.3616

5. Conclusions and Recommendations

At the city center of Al-Diwaniyah, most parking areas manage their operations by requiring drivers to leave their keys inside the vehicles. This allows parking attendants to rearrange cars and reduce the space between them, thereby increasing the overall parking capacity. However, this practice causes delays for drivers when they wish to leave, due to the informal and dense arrangement of vehicles.

This study examined the effect of the “leave the key” system on parking capacity and the delay it causes for drivers. The results showed a significant increase in parking capacity, ranging from 19% to 89%, depending on the site. However, the method also resulted in a notable delay for drivers, reaching up to 240 seconds at maximum, with an average delay ranging from 81 to 114 seconds across the three selected parking areas.

To achieve effective parking management in modern cities, several strategies can be implemented:

1. Implementing intelligent parking management systems to balance increased capacity with reduced waiting time.
2. Improving internal circulation and the width of entrances and exits to minimize delays.
3. Supporting legislative initiatives to standardize and regulate parking operations.

References

- [1] AHMED, L. A. (2009) “A STUDY OF PARKING CHARACTERISTICS IN A CENTRAL PART OF BASRAH CITY”. JOURNAL OF ENGINEERING AND SUSTAINABLE DEVELOPMENT (JEASD)13(1), 143-165.
- [2] PARMAR, J., DAS, P. AND DAVE S. M (2020) “STUDY ON DEMAND AND CHARACTERISTICS OF PARKING SYSTEM IN URBAN AREAS: A REVIEW”. JOURNAL OF TRAFFIC AND TRANSPORTATION ENGINEERING (ENGLISH EDITION), 7,(1), 111-124.
- [3] KAPLAN, S., & BEKHOR, S. (2011) “EXPLORING EN-ROUTE PARKING TYPE AND PARKING- SEARCH ROUTE CHOICE: DECISION MAKING FRAMEWORK AND SURVEY DESIGN”. IN 2ND INTERNATIONAL CHOICE MODELLING CONFERENCE, LEEDS.
- [4] RIFAI, A. I., DJAMAL, E. Z., & ROSADA, R. N. (2021) “EVALUATION OF PARKING CHARACTERISTIC ON INTERNATIONAL FERRY PORT AND SHOPPING MALL INTEGRATED AREA”. INTERNATIONAL JOURNAL OF ENGINEERING INVENTIONS, 10(7), 01-06.
- [5] LITMAN, T. (2016) “PARKING MANAGEMENT: STRATEGIES, EVALUATION AND PLANNING”. VICTORIA, BC, CANADA: VICTORIA TRANSPORT POLICY INSTITUTE.
- [6] ABBOOD, A. N., AHMED, A. R., & AJAM, H. K. (2021) “EVALUATION OF PARKING DEMAND AND FUTURE REQUIREMENT IN THE URBAN AREA”. CIVIL ENGINEERING JOURNAL, 7(11), 1898-1908.
- [7] MANVILLE, M., & SHOUP, D. (2005) “PARKING, PEOPLE, AND CITIES. JOURNAL OF URBAN PLANNING AND DEVELOPMENT”, 131(4), 233-245.
- [8] MOEINADDINI, M., ASADI-SHEKARI, Z., ISMAIL, C. R., & SHAH, M. Z. (2013) “A PRACTICAL METHOD FOR EVALUATING PARKING AREA LEVEL OF SERVICE.” LAND USE POLICY, 33, 1-10.
- [9] KARIMI, H., HERKI, B. M., GHARIBI, S., HAMIDITEHRANI, S., & KAKHANI, A. (2020) “IDENTIFYING PUBLIC PARKING SITES USING INTEGRATING GIS AND ORDERED WEIGHTED AVERAGING APPROACH IN SANANDAJ CITY”, IRAN. J CRIT REV, 7(4), 506-513.
- [10] AL-JAMEEL, H. A. E., & MUZHAR, R. R. (2020) “CHARACTERISTICS OF ON-STREET PARKING ON-STREET PARKING IN AL-NAJAF CITY URBAN STREETS”. TRANSPORTATION RESEARCH PROCEEDIA, 45, 612-620.