

On-street Parking Management Measures in Developing Cities: A Case of Phnom Penh

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In recent years, on-street parking management has not yet been properly addressed in most developing cities. Likewise, Phnom Penh is also facing the phenomena, which ends up with road interruption due to some practices of on-street parking in urban areas. Without proper parking management measures, parking would cause more troubles for local authorities to manage traffic in the city center in Phnom Penh. Therefore, this study identifies current behaviors related to on-street parking in Phnom Penh city center and propose effective sets of on-street parking management measures in Phnom Penh city center. The current study used on-street parking observation at 3 intersections and 3 road sections in Khan Daun Penh, interviews (10 personal interviews, 5 group interviews and 6 interviews with different shop owners) and carried out questionnaire survey with 247 respondents (including motorcycle drivers and car drivers). The results of observation show that the major travel mode choice to the city center was motorcycle, representing 73% of all observed vehicles. Availability of parking space at intersection accommodates on-street parking for motorcycle and car in the city center of Phnom Penh and motorcycle parking stays for around 20 minutes at intersection and 5 minutes at road section. The results of questionnaire survey indicate that trip purpose would determine their parking choice in the city center by motorcycle and car, respectively. 25% of all respondents used motorcycle to the city center parked on roadside or sidewalk for eating purpose and 76% of them parked less than one hour. This study found that the parking duration was less than one hour, especially business areas in the city center of Phnom Penh. Therefore, this study proposes implementation of on-street parking pricing and regulating on-street parking by limit parking duration in business areas in the city center.

Key words: *on-street parking, parking management measures, on-street parking management framework*

1. INTRODUCTION

1.1 Research background and problem

In the last decades, on-street parking management in urban areas has become a hot topic among many researchers not only in developing countries but also developed one. Along with rapid growth of population, motorization, and urban sprawl, urban areas have been a great concern for developing countries when it comes to parking management. Not all the countries in developing ones have implemented or managed proper parking management policies or strategies.

On-street parking affects capacity of roads and deteriorates traffic flow in urban areas. Availability of parking spaces close to destination of parkers can encourage using curb-side parking, and parking search also contributes to traffic generation and congestion (Parmar, et al, 2020). Demand on on-street parking is also influenced by automobile

ownership. The more the number of automobiles is, the more parking spaces are needed for both on- and off-street parking. If it is difficult to find a space for parking or paying for a parking is costly, then owning a car would be less attractive (Albalate, et al, 2020).

Biswas et al. (2017) raise a concern on on-street parking problems in developing countries. Research on on-street parking problems in developing countries is limited in their context due to the absence of road design guideline, including the influence of parking. In their study, there are mainly two ways of on-street parking that affects the road capacity – narrowing down the width of carriageway, resulting in a lower speed, and parking frequency and unparking maneuvers produce congestion on urban roads.

Integration of land use for on-street parking management and inclusion in transport planning to

promote public transport is critical in the context of developing cities. On-street parking management depends on previous and existing land use, mainly for commercial and residential purposes. Mingardo et al. (2015) mentioned in their article “Urban parking policy in Europe: Conceptualization of past and possible future trends” that in the last two decades, car ownership kept growing and urban space become smaller, which led to how important parking is in urban planning.

Franziska and Martin (2019) concluded that physical separation of residence and parking space discourage car use and the distance from residence areas to residential parking place should be the same as the distance to the nearest public transport station.

Therefore, on-street parking management in urban areas is needed to address parking issues in developing cities. Without proper (on-street) parking management, it would lead to a chaos on roads, and frequently, discourage urban activities. Regarding on-street parking management, some measures were found in the literature. Those measures were considered as proper means to address on-street parking management in urban areas in developed cities like Tokyo, Amsterdam, etc. Parking pricing and regulating on-street parking were key tools to address on-street parking problems in developing cities. In this study will look at some practical measures of on-street parking management applicable to small-size cities like Phnom Penh.

1.2 Goal and objectives

The study aims to propose an on-street parking management framework in urban areas, mainly business areas in developing cities. The goal can be divided into the following objectives:

- To identify current behaviors related to on-street parking in Phnom Penh city center;
- To propose effective sets of on-street parking management measures in Phnom Penh city center.

1.3 Research Hypothesis

This study on on-street parking management in developing cities: a case of Phnom Penh consists of three hypotheses as follows:

- a. Trip purpose will affect parking behaviors (including parking locations) in the city center.
- b. Parking preference are more likely to affect travel mode choice into the city center.

- c. Parking management measures are more likely to change parking behaviors and travel mode choice.

1.4 Research Conceptual Framework

The study outlines the research framework of how on-street parking management that could be done to address on-street parking problems in the city center.

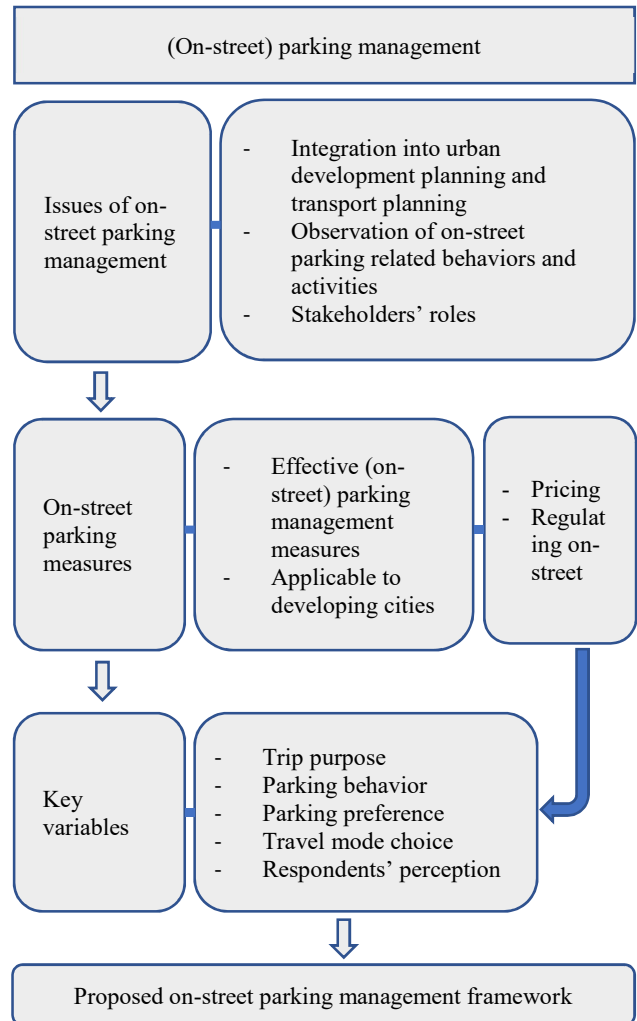


Fig.1 Research Conceptual Framework.

1.5 Research Methodology

A mixed-method was utilized in this study to identify the current behaviors and activities related to on-street parking in the city center, preference of on-street parking and acceptance of on-street parking management measures and use of public transport (bus). Creswell (2014) defines mixed methods integrate both qualitative and quantitative research and data in a research study with a more complete understanding of a phenomena.

Therefore, in the study, on-street parking observation and interview on parking behaviors and preferences were conducted for a qualitative research method. On-street parking observation was used to

understand how the people using roads (both roadside and sidewalk) for parking, including motorcycle drivers, tricycle drivers and car drivers at 3 intersections and 3 road sections in Khan Daun Penh, Phnom Penh. For other method of qualitative research, interview on parking behaviors and preferences was made with 10 different persons from different work areas (transport, insurance, lecture, student, business, car driver, security guard, logistic driver, and street vender), 5 group interviews (public urban transport officials, including car user group, motorcycle user group, tricycle group, and motor taxi group), and 6 interviews with the shop owners.

Moreover, a questionnaire survey was used for a quantitative research method with the 247 respondents, mainly from public servants, private employees, teachers, students and others. Microsoft Excel was used for data analysis for parking counting on roadside and sidewalk, and questionnaire survey.

1.6 Scope of the Study

This study mainly focuses on addressing on-street parking management issues and propose an on-street parking management framework in urban areas, especially in business areas in the city center.

1.7 Significance and Limitation of the Study

This study's findings will contribute to the development of planning on-street parking management in the urban areas for developing cities with small-size like Phnom Penh. Moreover, parking pricing and regulating on-street parking were mainly identified as effective tools for (on-street) parking management measures and generally implemented successfully in developed cities.

For academic contribution, this study would contribute to the literature review of on-street parking management in developing cities. More importantly, studies on on-street parking management in Phnom Penh are limited and there were little studies on parking behaviors and preferences. Therefore, the study would provide a concrete evidence for the local government of Phnom Penh city to manage parking in the business areas.

However, the study has two limitations. First, the study conducted one-hour observation on parking behaviors three times a day during peak hours in the morning, during lunch, and in the evening in weekdays. It would be beneficial to conduct study on peak hours and non-peak hours to compare parking behaviors between those hours in weekdays and weekends. Second, the standard parking price is not yet studied. Therefore, further research on acceptable

parking charge for motorcycles and cars (parking charge by time) in the city center and technical study of development of parking lots for motorcycles and cars in small size areas should be conducted to promote private parking lots within the city center.

2. LITERATURE REVIEWS

Literature on parking was not made clear for a long time until the end of the 1990s (Mingardo, et al., 2015). Similarly, Biswas, et al (2017) conducted a critical review on effects of on-street parking in urban context showed that there was limited research related on-street parking problems in developing cities as those cities needed more proper capacity guideline on parking.

On-street parking has been becoming a major concern for developing cities, and addressing on-street parking requires careful planning and management to improve traffic flow, reduce automobile dependency and promote walking. Due to the lack of rules, regulations, policies and enforcement, developing cities have been improperly addressing parking management problems. Likewise, there are also problems related to parking management for developing cities. In Thailand, parking management was also considered as problematic such as irregular enforcement of parking regulations and illegal occupancy of curb-side parking at night time by illegal parking users (Chalermpong and Ratanawaraha, 2020). In Veitnam, Phuc, et al. (2019) mentioned that there were problems of parking management in Ho Chi Minh City - synchronous in parking development planning and urban transport planning, inefficiency of pricing regulation, loose parking management facility and its services, and lack of control and enforcement from authorized institutions.

Even developed countries have been properly managed parking, some are still addressing parking management problems. Rye and Koglin (2014) highlighted some parking management problems in Europe cities. First, operational problems were about the financing of controlled parking zone, mainly in residential areas due to insufficient parking turnover and demand for paid parking. Second, externalities of parking included congestion and pollution, conflicts between different parking users, or accessibility problems of pedestrians and safety and problems for buses on narrow roads. Third, spatially concentrated demand focused about the perception of insufficient parking. Last, insufficient curb space was for parking vehicles of residents in some residential areas. Along with the problems of parking management, some other developed countries also redesign parking

policy or integrate into TDM to reduce automobile dependence.

Provision of parking space generate vehicle dependency. Franziska, and Martin (2019) conducted a study on parking management for promoting sustainable transport in urban neighborhoods: a review of existing policies and challenges from a German perspective and mentioned that preparation of parking was challenging to sustainable mobility in urban areas as parking pricing and availability of parking space could affect private car ownership and use. The results showed that municipalities need to understand parking as a tool of transportation demand management, by limiting public parking space and strengthening alternative means of transportation. As similar to other countries, in German, states and municipalities needed to redesign their legal frameworks not only to manage car parking supply, but also to integrate bicycle parking.

Vehicles are forced to move into a narrow road width due to a string of on-street parking as it reduce the capacity of the road (Biswas, et al, 2017). Vacant on-street parking spaces tends to provide accommodation for those who end their travel close to the destination. Parmar, et al, (2020) mentioned that parkers tend to park next to their destination, therefore, they end up using curbs-side parking because they don't need to spend time for cruising for parking.

Albalate & Gradera (2020) conducted a study on the impact of curbside parking regulations on car ownership and showed that if a parking spot was difficult to find or it was costly, then owning a car became less attractive due to high cost of usage and storage. In particularly, parking levy was imposed indirectly on commuters to reduce motorization dependency such as Congestion Levy in Melbourne (Taylor, 2020), Parking Space Levy in Sydney, and Working Parking Levy in Nottingham (Ison & Mulley, 2014).

Rye and Koglin (2014) conducted a review of prior research and literature on parking management and explores impacts of difficulties of parking management from study survey from southern, eastern, and southeastern European cities about parking problems and policies. The findings show that it is necessary to consider what types of parking solutions may work for cities. However, they stress whether very different solutions will suit cities of different sizes or not, but the level of implementation of the solutions must be related to the scale of the problem in each city, and its citizens' demands. In addition, each city must work within its respective

legislative context, which is why certain solutions might not work in some cities.

On-street parking management in developing cities does not address one single parking issue, but it requires many sectors including transport planning, travel demand management, street management, urban planning, land use management, building codes or zoning codes in addressing issues of on-street parking management.

Legal schemes on parking management depends on different legal frameworks specifying parking regulations in different countries in terms of social trend, economic development, technological advancement, and environmental issues. "Parking management should anticipate the future because economic, social, technological, and environmental conditions affect the types of strategies that should be used. Thinking about parking's use value is an important step in creating better land use and transportation policy" (Willson, 2018).

Kato and Kobayakawa (2020) report that in Japan, on-street parking lots are defined as road spaces, which allow parking vehicles and in parking lot development districts, introduced by road administrators like local municipalities, under the 1968 City Planning Act. A policy agency under the Road Traffic Act determines where a parking meter/parking ticket device is installed to allow vehicles to stop for a given period if a fee is paid. Generally, a maximum duration for on-street parking is 60, 40 or 20 minutes. Off-street parking is used for private use and shared off-street parking spaces for public use. A garage can be a form of off-street parking space for private use, especially for car owners, which is regulated by the Garage Act.

However, (on-street) parking management policies, measures or strategies have implemented and considered successful in developed cities. Japan can be considered a successful example of parking management in terms of providing parking supply, which parking emerges as market-based oriented (ADB, 2011). Axhausen et al. (2015) highlighted some reasons of growing parking business in Japan. First, a revision of the Road Traffic Act of 1960 in 2006 addressed illegal parking. Second, a decrease of the cost of equipment (such as ticket machines) encouraged property owners and parking companies to invest more in parking business. Third, parking spaces previously provided by restaurants, banks, hospitals, and shops were converted to cooperated car parks. Fourth, the severe economic depression since 2008 resulted in idle lands, which led to an increase of temporary use for car parks.

One of the most success measures is pricing on-street parking. In Los Angeles and San Francisco, the first cities set parking prices by time of day and location by adjusting the price in response to the observed occupancy (Manville, 2020). In Auckland, progressive parking prices is applied by increasing the duration of parking stay from NZ4.50 an hour for the first 2 hours and NZ9.00\$ an hour thereafter in the city center (Nunns et al., 2020). In Tokyo, during the day and on all streets at night, parking is banned and residents are required to own or rent an off-street parking space before they buy a car (Hironori & Kobayakawa, 2020). In Amsterdam, to reduce the number of curb parking space in the city centers, the city will not allow any residential parking permits when the drivers dispose of their cars, leave the city or die.

In this study, two main on-street parking management measures have been identified as effective tools to improve on-street parking management in developing cities – parking pricing and regulating on-street.

3. On-Street Parking Situation in Phnom Penh

Cambodia has just experienced its requirement of parking demand for the last 10 years with an increase of motorization. While, in Phnom Penh, with a rapid growth of urban sprawl and automobile dependency, increase of service, and change of lifestyle, parking has been becoming worse in the city due to a lack of proper on-street parking management. Parking has been ignored in transport planning and urban development in Cambodia. There has not been a comprehensive parking policy at the national and local levels yet. Parking regulations has been stipulated by some related ministries, and managed and enforced by local authorities in Phnom Penh and in other major provinces, mostly in the city centers or urban areas across the country.

On-street parking management is correlated to rules, regulations and policies because in developing cities like Phnom Penh, roadsides and sidewalks are used for multipurpose, mainly for business, office and residence. Sometimes, a long line of car, tricycles and motor-taxis occupies roadsides. Sidewalk is not mainly used by pedestrians but for those residents, and/or business operators who run a small business and occupy sidewalks for customers' parking. Setback is determined by local authorities and it can be various from one to another location in city centers. Furthermore, it can be occupied by business owners or residents and the authorities could determine the demarcation between private and public property,

reserved land for pedestrians, possibly for allowed on-street parking and some urban activities. Overall, it can be called a share of space for multipurpose. However, city activities are not encouraged with such practices or activities. In particular, curbside parking near city centers has been common in Phnom Penh as it is convenient and takes less time for parking search by drivers.

Therefore, to improve walkability in the city centers, some potential areas should be identified along with some parking measures and strategies to address the current situation of parking problems around the CBDs in Phnom Penh.

Generally, parking pricing was not fully set by national level yet. Parking pricing was set and implemented by local authorities. Mostly, parking pricing was set at public and private markets. However, the price set by public markets was lower than that of private markets. In practice, parking charge was similar for both public and private markets. Figure 2 indicates the parking charge at a public market, Central market. The stance lists the price for bicycle parking, motorcycle parking and car parking. Parking charge per time was 200 riels (USD 0,05) for bicycle, 300 riels (USD 0,07) for motorcycle, 500 riels (USD 0.125) for car.



Fig.2 Photo of parking pricing at Central market (public market), by author (2021)

However, most of private markets or shopping malls set parking pricing similarly for motorcycles around 1,000 riels but for car, parking charge was based on duration. Figure 6 shows parking charge for an hour in one shopping mall in Phnom Penh, was free for 5 minutes. Meanwhile, from 6 minutes to three hours, parking charge was 2,000 riels (USD 0,50), and for more than 3 hours, one hour added 4,000 riels (USD 1). To conclude, this price was not consistent for

other private markets or shopping malls and usually was set by shopping mall managers or owners, especially for car.

4. FINDINGS

4.1 Results of on-street parking observation

Data analysis from observation was conducted to know the number of vehicle types, identify whether vehicle parked or not during the parking observation and if they parked, road side or sidewalk was chosen in the city center, and how long they parked between intersections and road sections in the morning (7:00-8:00/9:30-10:30), during lunch (11:00-12:00/11:30-12:30) and in the evening (4:30-5:30).

4.1.1 The number of vehicle count

Table 1 below shows the number of motorcycles, cars and tricycles counted at 3 intersection and 3 road sections. The number of motorcycles accounted for the highest percentage for both intersections and road sections, representing 73%, followed by car 15% and tricycle 12%. As a result, the major travel mode choice to the city center was motorcycle (73%) of all observed vehicles at all observed areas.

Table 1 The total number of vehicle count at all observed areas

	Motorcycle (M)	Car (C)	Tricycle (T)	Total
3 Intersections	464 77%	78 13%	57 10%	599 100%
3 Road Sections	200 65%	55 18%	52 17%	307 100%
Total:	664 73%	133 15%	109 12%	906 100%

4.1.2 Parking on roadside or sidewalk

Figure 3 below illustrates the number of parking on roadside or sidewalk at 3 intersections in the morning, during lunch, and in the evening. The motorcycle parking had the highest share on roadside in the morning (138) and during lunch (101); and on sidewalk during lunch (80). In the evening, there were not many numbers of motorcycle parking both on roadside and sidewalk but roadside still provide more space for parking.

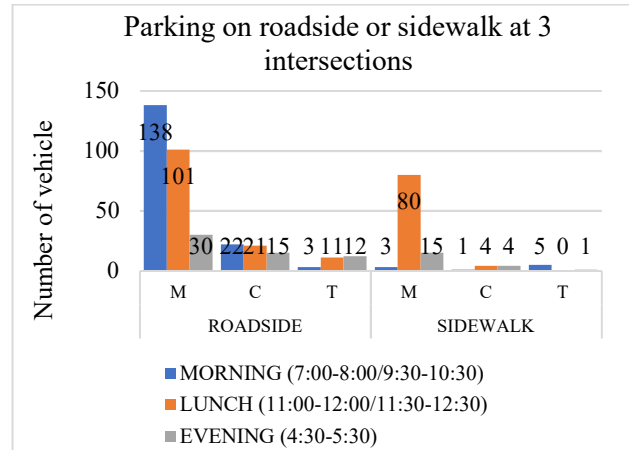


Fig.3 The total number of parking on roadside or sidewalk at 3 intersections

Figure 4 below illustrates the total number of parking on roadside or sidewalk at 3 road sections in the morning, during lunch, and in the evening. For 3 different times, motorcycle parking mostly stayed on sidewalk in the evening.

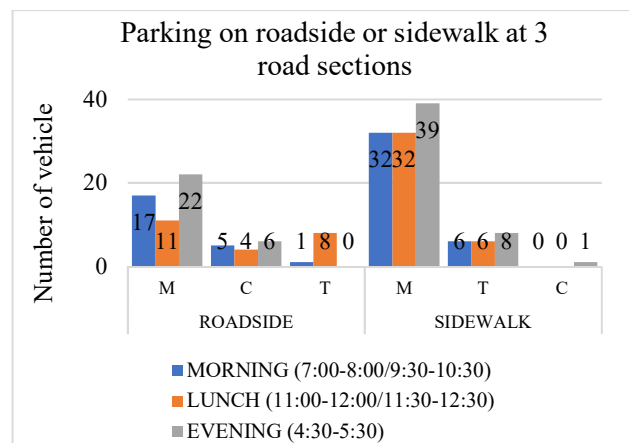


Fig.4 The total number of parking on roadside or sidewalk at 3 road sections

4.1.3 On-street parking duration

Counting parking duration was divided into three categories - parking 30 minutes or less, more than 30 minutes and unobservable. Unobservable could possibly mean that the vehicle may already arrived before observation time and stayed until the end of observation finished, or left during observation, or arrived during observation and stayed until observation finished. For this purpose, the analysis of parking duration was to identify which type of vehicle parked 30 minutes or less at all observed intersections and road sections.

Figure 5 shows that the total number of all observed vehicle for parking duration at 3 intersections. The

number of motorcycles parked 30 minutes or less represented 128, followed by 13 cars and 17 tricycles.

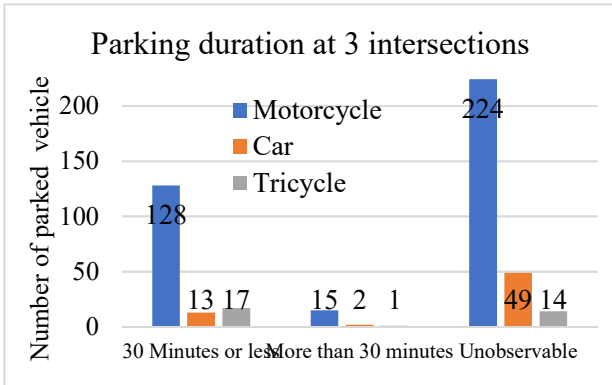


Fig.5 The number of vehicle parking duration at intersections

Figure 6 indicates that parking 30 minutes or less at 3 intersections. All observed motorcycles were generally less than 20 minutes. The number of motorcycles was more than 20 in every 5 minutes.

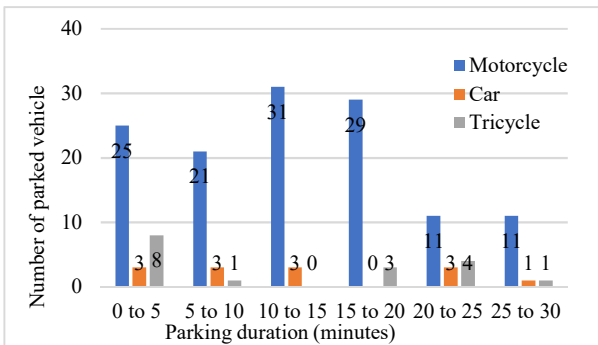


Fig.6 Parking duration 30 minutes or less at intersections

Figure 7 illustrates the total number of all observed vehicle for parking duration at 3 road sections. The number of motorcycles parked 30 minutes or less accounted for 49, followed by 5 cars and 4 tricycles.

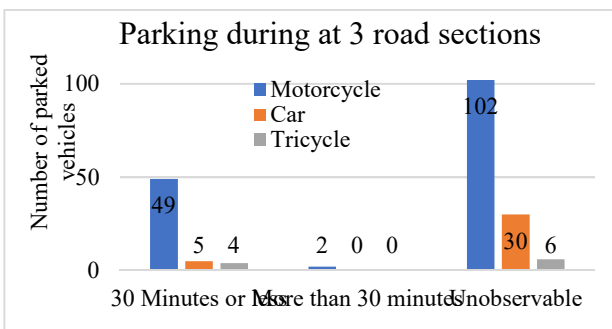


Fig.7 The number of vehicle parking duration at 3 intersections

Figure 8 shows that the parking duration at 3 road sections of all observed motorcycles was generally

within 5 minutes and a few motorcycles parked within 10 minutes and 15 minutes.

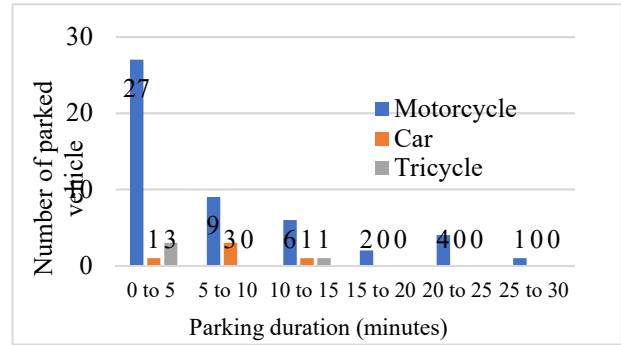


Fig.8 Parking duration 30 minutes or less at road sections

Generally speaking, the parking duration of motorcycle at intersection was within 20 minutes and a few motorcycles was within 20 minutes and 30 minutes. Whereas, the parking duration at road section was within 5 minutes and a few motorcycles was within 10 minutes and 15 minutes.

4.2 Results of questionnaire on parking behaviors and preferences

The results of questionnaire survey show that the percentage of respondents as male was 64%, and the respondents aged 20s accounted for 54%, followed by the respondents age 30s, 38%. The respondent lived in Phnom Penh from 10 to 30 years represented the highest percentage (47%), followed by 5 to 10 years (21%) and more than 30 years (14%). Regarding educational background, 48% of respondents were undergraduate, 39% were graduate. The respondents as public sector employee represented 38%, followed by student (28%) and private sector employee (22%). The respondents as motorcycle driver represented 75%, while car drivers accounted for 25%.

4.2.1 Parking place with trip purposes

Figure 9 shows where the respondents parked their motorcycle to the city center for different purposes. When the respondents commuted to the city center by motorcycle, 70% of the respondents parked their motorcycle at business, workplace or school parking areas. For eating purpose, 25% of the respondents parked roadside or sidewalk.

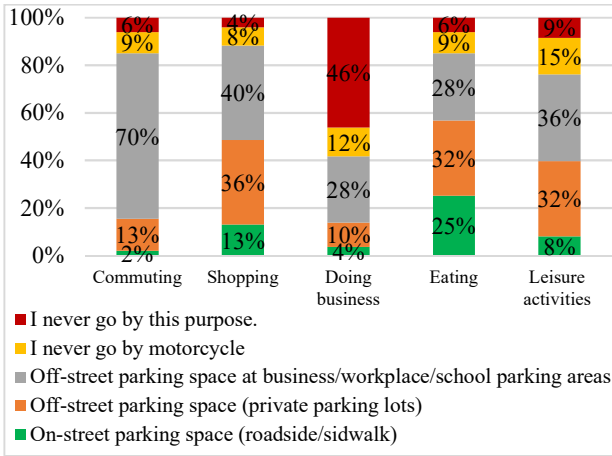


Fig.9 Trip purposes vs parking place by motorcycle

Figure 10 shows where the respondents parked their car to the city center for different purpose. When the respondents commuted to the city center by car, 51% of the respondents parked car at business, workplace or school parking areas and 21% never went by car. For eating purpose, they used both private parking lots (30%) and parking space at business, workplace or school parking areas.

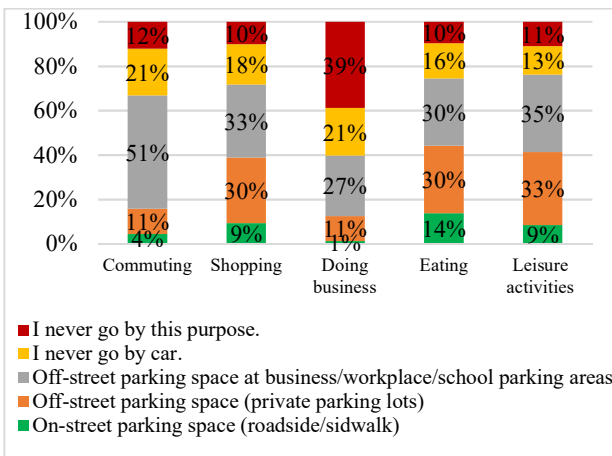


Fig.10 Trip purposes vs parking place by car

4.2.2 Parking duration and parking place

Figure 11 and Figure 12 indicate the parking duration when the respondents used motorcycle and car to the city center. The respondents travelling to the city center and parking on roadside or sidewalk less than one hour represented 76% by motorcycle and 59% by car.

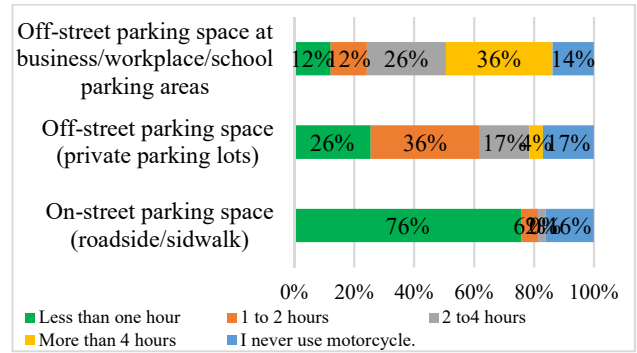


Fig.11 Parking duration by motorcycle in the city center

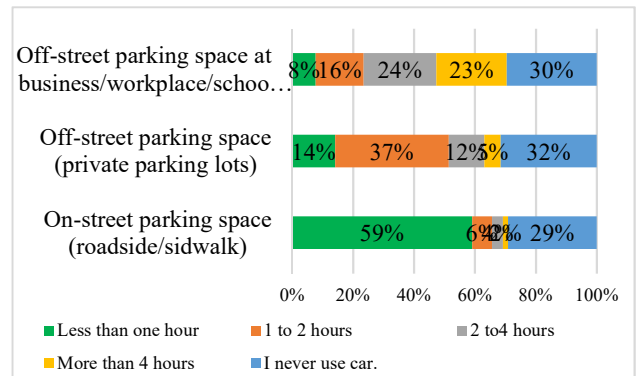


Fig.12 Parking duration by car in the city center

Generally, the respondents parked on roadside or sidewalk less than one hour when they travelled to the city center.

4.2.3 Acceptance of paying parking fee for shopping purpose

Figure 13 shows preference of paying parking fee by motorcycle users for shopping purpose. Motorcycle users would accept paying parking fee for shopping purpose if they parked more than 2 hours, representing 72%. If they parked more than 2 hours, they would pay 1,000 riels, representing 86%. However, when the parking charge increased double, 59% would not accept paying of 2,000 riels.

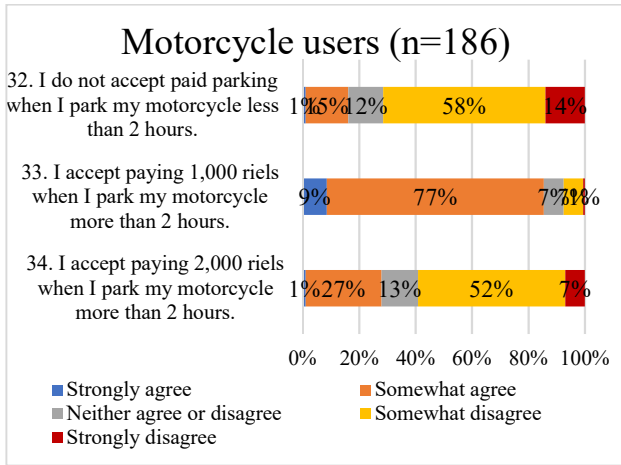


Fig.13 Preference of paying parking fee by motorcycle users

Figure 14 shows preference of paying parking fee by car users for shopping purpose. 58% of car users would pay parking fee for shopping purpose if they parked more than 2 hours. They would pay 2,000 riels, representing 86% when they parked car more than 2 hours. Even though parking charge increased double, 50% would accept paying double charge of 4,000 riels when they parked more than 2 hours.

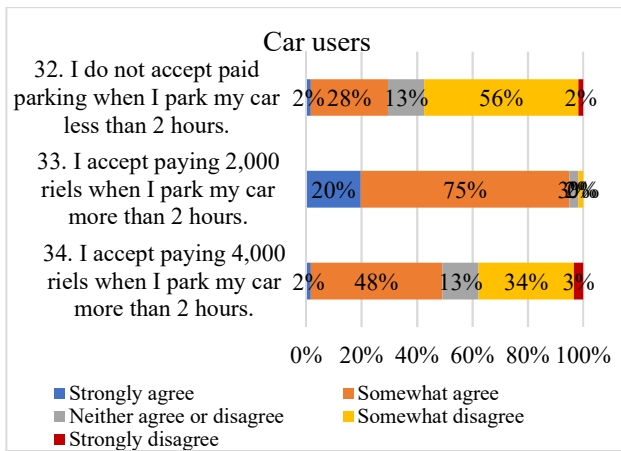


Fig.14 Preference of paying parking fee by car users

4.2.4 Acceptance of changing parking charge on specific times (peak and non-peak hours) for different locations

Figure 15 and Figure 16 shows the percentage of acceptance of changing parking fee on specific times (peak and non-peak hours) for different locations by the respondents of motorcycle users. 63% of the motorcycle respondents and 66% of car respondents accepted changing parking charge on peak and non-peak hours at different locations.

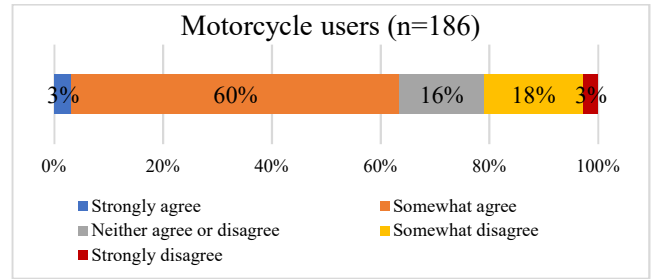


Fig.15 Acceptance of changing parking fee on specific times by motorcycle users

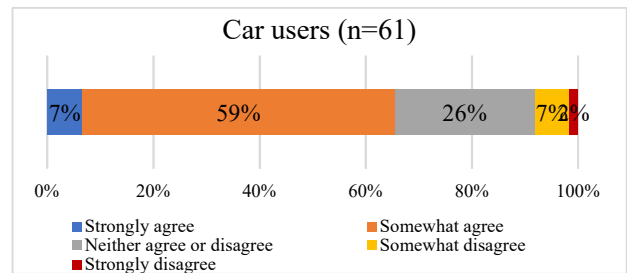


Fig.16 Acceptance of changing parking fee on specific times by car users

Both the motorcycle users and car users accepted changing parking charge on peak and non-peak hours at different locations.

4.2.5 Acceptance of limited on-street parking duration in the city center

Figure 17 indicates acceptance of limited on-street parking duration for motorcycle for one hour in the city center. 46% of the motorcycle user respondents accepted limited on-street parking duration of one hour. But 41% of them did not accept limited on-street parking duration for motorcycle for 2 hours. Surprisingly, 48% of the motorcycle respondents accepted paying parking charge per hour 1,000 riels after one-hour free parking in the city center.

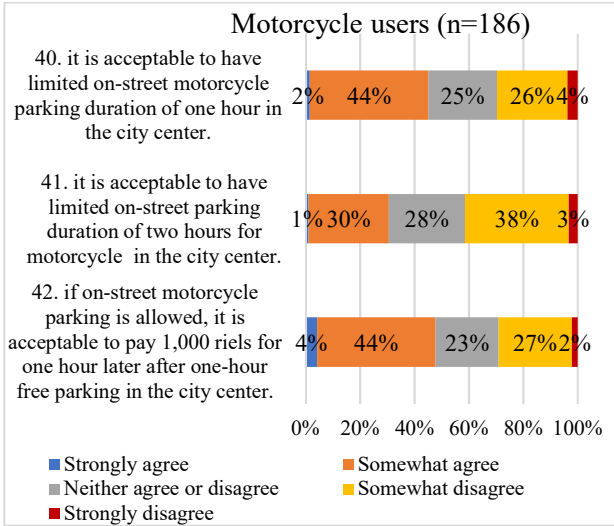


Fig.17 Acceptance of limited on-street parking duration for motorcycle.

Figure 18 shows acceptance of limited on-street parking duration for car for one hour in the city center. 56% of the car user respondents accepted limited on-street parking duration of one hour. But 41% of them did not accept limited on-street parking duration for car for 2 hours. Surprisingly, 54% of the car respondents accepted paying parking charge per hour 2,000 riels after one-hour free parking in the city center.

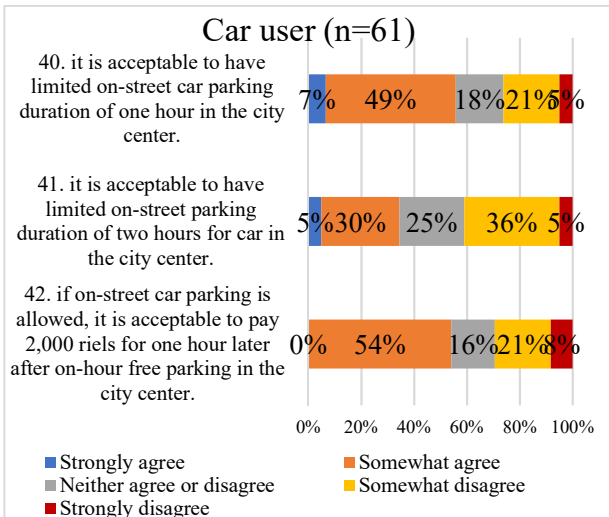


Fig.18 Acceptance of limited on-street parking duration for car.

4.2.6 Acceptance of prohibited on-street parking during peak hours in the city center

Figure 19 shows acceptance of prohibited on-street parking for motorcycle during peak hours in the city center. 76% of the motorcycle user respondents accepted prohibition of on-street motorcycle parking. Moreover, 81% of them supported regular

enforcement of parking on banned roadside for all day.

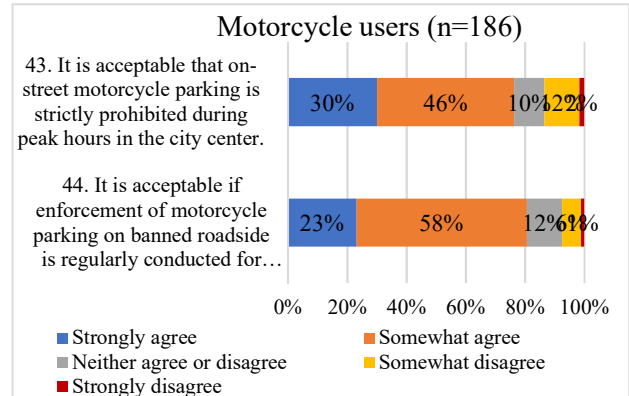


Fig.19 Acceptance of prohibited on-street parking for motorcycle.

Figure 20 shows acceptance of prohibited on-street parking for car during peak hours in the city center. 78% of the car user respondents accepted prohibition of on-street motorcycle parking. Moreover, 84% of them supported regular enforcement of parking on banned roadside for all day.

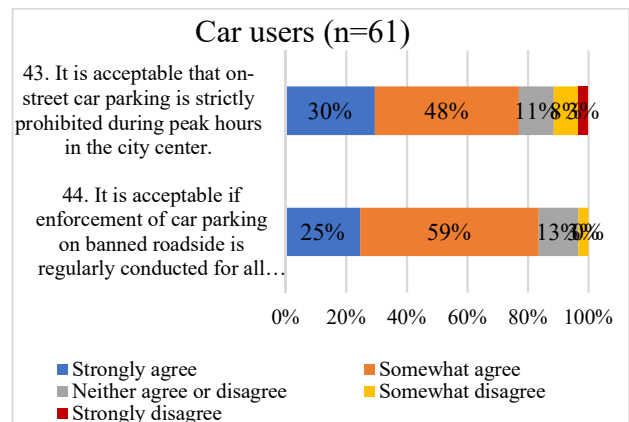


Fig.20 Acceptance of prohibited on-street parking for car.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

To tackle on-street parking management in the study area, there are many on-street parking management measures implemented in developed cities, considered successful in those cities. Therefore, this study explores two major on-street parking management measures – parking pricing and regulating on-street parking by looking at how trip purposes affect parking behaviors, parking preferences could change travel mode choice, and acceptance of parking management measures could affect parking behaviors and travel mode choice.

The results of the study are divided into 2 main parts, parking behaviors, where they parked on roadside or sidewalk, what type of mode when parking, how long parking lasted for motorcycle and car, trip purpose and travel mode choice. Part 2 describes on-street parking management measures, including acceptance of parking fee, acceptance of limited on-street parking duration, acceptance of prohibited on-street parking duration, and preference of using public transport for specific purposes. The summary of the results is presented in the followings.

5.1.1 On-street parking

Parking place (with trip purposes)

At intersection, the motorcycle parking was mostly on roadside but the peak parking time was in the morning on roadside, and during lunch on sidewalk. At road section, the motorcycle parking was mostly on sidewalk than on roadside and the peak parking time was in the evening on sidewalk.

Regarding the results of questionnaire survey, when going to the city center by motorcycle, the respondents preferred parking on on-street parking space for eating purpose, representing 25%. However, for other purposes, they mostly used off-street parking space at private parking lots and at business, workplace or school parking areas.

Parking duration (with trip purposes)

The results from road observation and questionnaire show that parking duration was less than 1 hour in the city center. Parking at intersection was generally less than 20 minutes and more than 20 motorcycle parked every 5 minutes. However, for parking duration at road section, the duration was within 5 minutes.

When the respondents used motorcycle to the city center, 76% of respondents parked motorcycle less than one hour on roadside or sidewalk. However, when the respondents used car to the city center, 59% of the respondents parked car on roadside or sidewalk less than one hour.

The respondents used motorcycle to the city center tends to parked on roadside or sidewalk less than one hour than by car.

5.1.2 On-street parking management measures

Acceptance of parking fee

Regarding acceptance of paying parking fee for shopping purpose, 72% of the motorcycle

respondents would accept pay parking fee if they parked more than 2 hours. They would pay 1,000 riels, representing 86% if they parked motorcycle more than 2 hours. However, when the parking charge increased double, 59% would not accept paying of 2,000 riels when they parked more than 2 hours.

58% of the car respondents would accept pay parking fee if they parked more than 2 hours. 30% would accept paying parking fee even they parked less than 2 hours. They would pay 2,000 riels, representing 86% when they parked car more than 2 hours. However, when the parking charge increased double, 50% would accept paying double charge of 4,000 riels when they parked more than 2 hours.

63% of the motorcycle respondents accepted changing parking charge on peak and non-peak hours at different locations. Likewise, 66% of the car respondents accepted paying parking charge on peak and non-peak hours at different locations.

Acceptance of limited on-street parking duration

46% of the motorcycle user respondents accepted limited on-street parking duration of one hour. But 41% of them did not accept limited on-street parking duration for motorcycle for 2 hours. Surprisingly, 48% of the motorcycle respondents accepted paying parking charge per hour 1,000 riels after one-hour free parking in the city center. 56% of the car user respondents accepted limited on-street parking duration of one hour. But 41% of them did not accept limited on-street parking duration for car for 2 hours. Surprisingly, 54% of the car respondents accepted paying parking charge per hour 2,000 riels after one-hour free parking in the city center.

Acceptance of prohibited on-street parking

76% of the motorcycle user respondents accepted prohibition of on-street motorcycle parking. Moreover, 81% of them supported regular enforcement of parking on banned roadside for all day. 78% of the car user respondents accepted prohibition of on-street motorcycle parking. Moreover, 84% of them supported regular enforcement of parking on banned roadside for all day.

6.2 Recommendations

Based on literatures public management should improve on-street parking management, mainly for motorcycle in the city center, especially business areas around markets. Therefore, there are a few methods to improve on-street parking management.

Some practical recommendations regarding on-street parking management are as follows:

Parking pricing – Paying haft for shorter time parking by motorcycle

Parking duration shows that parking at intersections was critical for on-street parking, especially motorcycles and motorcycle approximately stayed on roadside at intersections around 20 minutes but stayed on sidewalk at road sections around 5 minutes. If shorter time parking could move to use off-street parking with less than one hour for a half price of current parking fee. The current parking fee is 1,000 riels for motorcycle per time. Off-street parking facilities could be improved for shorter time parking and reducing using roadside or sidewalk for parking, mainly business areas at intersection.

By doing this, there will increase parking occupancy rate and earn more revenue. At the same time, the government should provide subsidy to small private business to provide off-street parking for shorter time parking. In this mean, revenue from parking tariff could be used upgrading public transport.

Addressing critical location of on-street parking at intersection

Intersection has become popular for business operation due to parking capacity with the practice using roadside or sidewalk for parking. The results of on-street parking observation show that more motorcycle stayed at intersection on roadside, and at road section on sidewalk. By providing shorter time parking at off-street parking facilities, demand of using parking space at intersection will become less, especially intersection with eating areas.

Arrangement of fringe parking areas

People as customers are inevitable to use on-street parking next to the destination due to availability of parking space in front of business settings. However, this is not what the customers as motorcycle users or car users want, most of them prefer using off-street parking if it is available with a short walking distance less than 5 minutes for motorcycle users, and up to 10 minutes by car users. Surprisingly, car users could walk longer distance than motorcycle users.

When they accepted walking, it could mean they also could use fringe parking away from the city center and this could increase use of parking lots away from the city center by just walking around 5 to 10 minutes.

Considering parking duration in the business areas for motorcycle

On-street parking in the city center of Phnom Penh has been becoming worse due to some typical practice by some of business operation along the streets. Commuters also using on-street parking as it is considered as a common practice and many people do it. Not only business owners but also commuters follow the trend of on-street parking from previous practices. It becomes habit of using roadside or sidewalk for customers' parking and parking in front of business setting.

Reserving parking space for free for customers has been popular that business owners or shop owners may hire security guards to reserve parking for customers. However, customers may not stay long and they even pay for shorter time parking fee at business areas for their parking.

When they parked at business areas, parking duration should be set for less than one hour by using basic and traditional parking meters where on-street parking is allowed for motorcycle.

REFERENCES

- 1) Abbasian, A. (2016). Importance of urban squares as public space in social life: A new design of Fisktorget in Karlskrona City. Blekinge Institute of Technology.
- 2) ADB. (2011). *Final Consultant's Report Parking Policy in Asian Cities*.
- 3) Albalade, D., & Gragera, A. (2020). The impact of curbside parking regulations on car ownership. *Regional Science and Urban Economics*, 81. <https://doi.org/10.1016/j.regsciurbeco.2020.103518>
- 4) Axhausen, K. W., Chikaraishi, M., & Seya, H. (2015). *Parking – Learning from Japan. Arbeitsbericht Verkehrs- und Raumplanung: Vol. 1095*. Zürich: Eidgenössische Technische Hochschule Zürich.
- 5) Barter, P. A. (2011). *Parking Requirements in Some Major Asian Cities. Transportation Research Record: Journal of the Transportation Research Board*, 2245(1), pp. 79–86. <https://doi.org/10.3141/2245-10>
- 6) Biswas, S., Chandra, S., & Ghosh, I. (2017). Effects of on-street parking in urban context: A critical review. *Transportation in Developing Economies*, Vol. 3(1). <https://doi.org/10.1007/s40890-017-0040-2>
- 7) Fernandez, K., and Yoka, R. (2018). *A Guide to Parking*. Routledge.
- 8) Jones, C. (2018). Approaches to parking management. In K. Fernandez, & R. Yoka (Eds.), *A Guide to Parking*. (1st ed., pp. 25 – 35). Routledge.
- 9) Kirschner, F., & Lanzendorf, M. (2019). Parking management for promoting sustainable transport in urban neighborhoods. A review of existing policies and challenges from a German perspective. *Transport Reviews*. <https://doi.org/10.1080/01441647.2019.1666929>
- 10) Litman, T. (2020). *Parking Management: Comprehensive implementation guide*. Victoria Transport Policy Institute.
- 11) Liu, Y., Wang, W., Ding, C., Guo, H., Guo, W., Yao, L., Xiong, H., & Tan, H. (2012). Metropolis parking problems and management planning solutions for traffic operation effectiveness. *Mathematical Problems in Engineering*, 2012, pp. 1–6. <https://doi.org/10.1155/2012/678952>

- 12) Marsden, G. (2006). The evidence base for parking policies: a review. *Transport Policy*, 13(6), pp. 447–457. <https://doi.org/10.1016/j.tranpol.2006.05.009>
- 13) Milosavljevic, N., & Simicevic, J. (2019). *Sustainable parking management: Practices, policies, and metrics*. Elsevier. <https://doi.org/10.1016/B978-0-12-815800-5.00001-X>
- 14) Mingardo, G., Van Wee, B., & Rye, T. (2015). Urban parking policy in Europe: A conceptualization of past and possible future trends. *Transportation Research Part A: Policy and Practice*, 74, pp. 268–281. <https://doi.org/10.1016/j.tra.2015.02.005>
- 15) MLMUPC. (2006). *Decision on Inclusion of Criteria of Public Land Categories as an annex to Prakas on Identification of Public Land*. The Ministry of Land Management, Urban Planning and Construction.
- 16) Parmar, J., Das, P., & Dave, S. M. (2020). Study on demand and characteristics of parking system in urban areas: A review. *Journal of Traffic and Transportation Engineering, Vol.7(1)*, pp. 111–124. <https://doi.org/10.1016/j.jtte.2019.09.003>
- 17) Paul Barter (2016), On-Street Parking Management: An International Tool-kit, Sustainable Urban Transportation Technical Document #14, GIZ and SUTP (www.sutp.org); at <https://bit.ly/2JyHJt7>.
- 18) Pojani, D., Corcoran, J., Sipe, N. G., Mateo-Babiano, I., & Stead, D. (2020). *Parking: An international perspective*.
- 19) PPCH. (2017). *Instruction on Addressing traffic and order along the roads in Phnom Penh Capital Geography*. Phnom Penh Capital Hall.
- 20) Ray, T. (2010). *Parking management: A contribution towards liveable cities*. Eschborn: German Technical Cooperation.
- 21) Rosenblum, J., Hudson, A. W., & Ben-Joseph, E. (2020). Parking futures: An international review of trends and speculation. *Land Use Policy*, 91. <https://doi.org/10.1016/j.landusepol.2019.104054>
- 22) Rye, T., & Koglin, T. (2014). Parking Management. In S. Ison & C. Mulley (Eds.), *Parking Issues and Policies*. (1st ed., pp. 157–184). Emerald Publishing.
- 23) Rye, T., & Koglin, T. (2014). Parking management. In S. Ison, & C. Mulley (Eds.), *Parking: Issues and policies* (pp. 157–184). Emerald: Bingley.
- 24) Svedova, Z., Barta, D., & Bambusek, M. (2017). *Transnational review for smart parking solutions* (Version 1). Interreg Central Europe.
- 25) Thanh, T. T. M. (2018). Parking Management Strategies for Asian Developing Countries. *Institute of Transport Planning and Traffic Engineering*. <http://rgdoi.net/10.13140/RG.2.2.19634.35528>
- 26) Willson, Richard. W. (2015). *Parking management for smart growth*. Island Press, 2015
- 27) Yang, S., & Huang, L. (2017). Research on planning and management of urban parking lot: Taking Hangzhou as an example. *Current Urban Studies*, Vol.05(04), pp. 379–386. <https://doi.org/10.4236/cus.2017.54021>
- 28) Young, W., Thompson, R. G., & Taylor, M. A. P. (1991). A review of urban car parking models. *Transport Reviews*, 11(1), pp. 63–84. <https://doi.org/10.1080/01441649108716773>