

Effects of PLUS-ONE Promotion for Parking Permit Identification Policy

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1. Introduction

In Japan and Korea, elderly adult population is rapidly increasing while younger is decreasing, tending to Matured Aging Society. Mobility for handicapped persons like elderly adult, disable persons, pregnant ladies, temporarily injured persons and so on have to ensure by both local government and community power.

Saga Prefecture Government (SPG) in Japan launched Parking Permit Policy (PPP) for wheel-chair using persons, disable persons, pregnant ladies and so on since 2006 and PPP is broadening in nation-wide, 30 prefectures, in 2013. SPG issues the parking permission identification (PPID) card (see Fig.1(a) and 1(b)) to handicapped persons and facilitates designated park lots (see Fig.1(c) and 1(d)) at near entrance of city hall, shopping mall, and so on. Increasing the total number of Parking Permit Identifications issued to handicapped persons from 3,449 in 2007 to 25,798 in 2013 as shown in Fig. 2: the number of parking Permit Identifications issued in 2007 was for physically disabled persons 2,768, incurable disease persons 88, intellectual disabilities 27, injured persons 96, pregnant ladies 330, and elderly adults 140. The guideline to facilitate parking space recommends three parking-lots of 3.5m width (thereafter we call this space PP-WL: Parking Permit Wider-Lots) per 200 regular parking-lots with 2.5~2.7m width. Until 2006, only PP-WLs are dedicated to handicapped wheel-chair using persons. Since 2007, vehicles with PPID of various categories rush to those PP-WLs, resulting sever congestion in PP-WL space.

To improve congestion, one additional parking-lot has to settle, i.e., promotion for setting PLUS-ONE parking lot. But handicapped persons think that this PLUS-ONE strategy is less effective to improve the blocking probability because of 'a drop in the bucket'.



(a)Valid for 5 years (Green card) (b)Valid for 1 year (Orange card) (c)Notification seal for Dedicated PP-RL excluding wheel-chair user (d)Signboard for PP-WL

Fig. 1 Parking Permit Identification cards (courtesy of SPG).

Then, in 2007, SPG showed the idea to owner of parking space called 'PLUS-ONE promotion,' offering some areas of regular parking-lots for non-wheel-chair using handicapped persons (thereafter we call this space as PP-RL: Parking Permit for Regular Lots), intending to alleviate sever congestion of PP-WL (see Fig.1(c) [1]).

In this paper, we analyze the performances of blocking probability and utilization of PP-WL and PP-RL in the following sections.

2. Simulation model for usage of PP-WL and PP-RL

Analyzing the performances, we set following assumptions. Arrival process of vehicles is Negative exponential distribution: average arrival times are 50 minutes, 20 minutes, and 3 minutes for wheel-chair user, non-wheel-chair user, and regular user, respectively. Parking time process of vehicles is Erlang distribution: average arrival times are 80 minutes with phase 3, 60 minutes with phase 2, and 50 minutes with phase 2 for wheel-chair user, non-wheel-chair user, and regular user, respectively. We consider the parking space as follows: three PP-WLs (3.5-meter width), 40

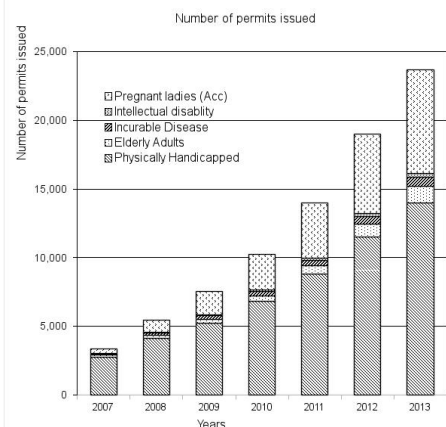


Fig. 2 Increasing Number of PP registered users. (courtesy of SPG)

regular lots (2.5~2.7 meter width) including variable number of PP-RL (from zero through 6). The network simulator -ns2- [2] is used.

3. Effect of number of PP-RL on Performance of blocking probability of wheelchair user and utilization of PP-WL

3.1. Blocking Probability of wheel-chair user (BP-WU)

The blocking probability of wheel-chair user is defined as the probability that those users cannot park her/his vehicles at PP-WL. Fig. 3 shows the performance of BP-WU varying with the number of PP-RL. When PP-WL was only dedicated for using wheel-chair users, BP-WU was 0.15. Allowing PPID holders with various categories to use PP-WL, BP-WU is drastically increasing to 0.5, meaning the severe performance degradation, 3.3 times worst, for wheel-chair user. To improve BP-WU by introducing PLUS-ONE promotion, i.e., at least one PP-RL facilities at the entrance of city hall, for example, BP-WU is only decreasing to 0.42, meaning 'drop in the bucket' effect for wheel-chair users. If we could increase the number of PP-RL from one to 6, wheel-chair user get back almost same performance for exclusive use of PP-WL.

3.2. Utilization rate of PP-WL

Fig.4 shows the utilization efficiency (β) of PP-WL. Firstly, β of wheelchair user is about 0.45 for the case of not allowing non-wheelchair user to use PP-WL. Next, sharing with wheelchair and non-wheelchair user, i.e., PPID holders, β of wheelchair user is drastically dropped to about 0.27, while β of non-wheelchair users is about 0.5, meaning that wheelchair users are pushed out from PP-WL by non-wheelchair users. But, it is interesting that the total β becomes higher than original wider-width (3.5m) lots using policy. As increasing number of PP-RLs from one to six, β of wheel-chair user is gradually recovered.

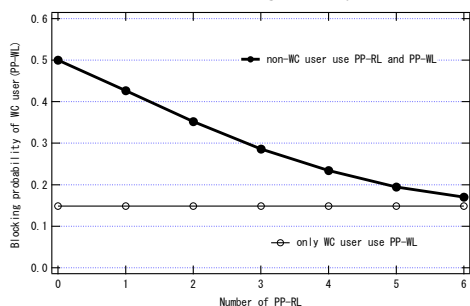


Fig. 3 Blocking probability of wheel-chair user

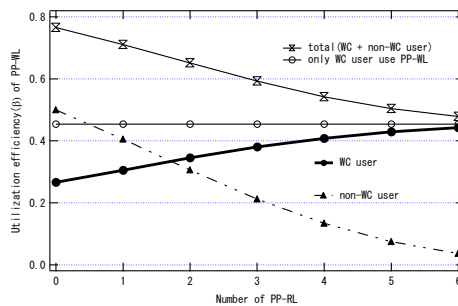


Fig. 4 Utilization efficiency of PP-WL for wheel-chair users

4. Conclusion

In this paper, we consider the effect of PLUS-ONE promotion on Parking Permit Identification Policy. Lessons from the simulation results are: 1) it is better to be set the PP-WL as exclusive-use for wheelchair users, and 2) sufficient number of PP-RLs should be offered to non-wheelchair handicapped users. We are now considering the performances of parking lots shared with handicapped and non-handicapped users.

5. Acknowledgement

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6. References

[1] Saga Prefecture Government: 'Plus-one promotion in Parking Permit Identification Policy' (in Japanese), available at <http://saga-ud.jp/keikaku/machi/parkingplusone.htm>
 [2] 'The Network Simulator - ns-2', version 2.35', available at <http://www.isi.edu/nsnam/ns/>
 [3] Masaharu KIYOTA, Yukuo HAYASHIDA, Akiko MAEDA, 'Issues on Parking Permit Identification System without Penalty and Toward Its Improvements', (in Japanese), Journal of Traffic Engineering, Vol. 46, No. 1, pp. 66-76, 2011.