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A CONTRINUTION OF PARKING POLICY TO SUSTAINABLE URBAN MOBILITY

Key Words

Sustainable
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Abstract

The increased awareness towards quality of life and environmental standards along with high costs and limited spatial possibilities for traffic infrastructure expansion, have led to the transport planning paradigm shift. Instead of construction, new concept insists on a better use of existing infrastructure through the management of transport demand, primarily through modal shift from a car to alternative transport options. In this sense, parking demand management policy is increasingly seen as a powerful tool which can largely contribute to the realization of new concept. Parking policy becomes an integrated part of transport policy and it is more integrated with the general aims of the city in terms of mobility, urban planning and environmental quality.

Nevertheless, even though the new concept of parking management has been adopted and parking is regulated in central areas of most Serbian cities and towns, the impression is that parking is poorly managed, hence above mentioned impacts are missing. According to our experience, the main reason lies in inadequate measures as well as in poor parking enforcement.

This paper aims to demonstrate, on the example of one Serbian city, how proper parking management can solve parking problems, but also contribute to the realisation of sustainable urban mobility goals. Likewise, this paper intend to encourage

transport policy makers in the region to implement parking policy within the sustainable urban mobility framework and to share their best practices in order to show tangible accomplishments, and to encourage researchers to engage in promoting this topic so as to gain its deserved place.

1. INTRODUCTION

Excessive reliance on passenger cars as a primary mean of people mobility and the infrastructure planning that primarily supports this mode of transport have led to numerous environmental, social and spatial problems. The inability to follow the increase in the number of cars by constructing areas where cars travel (roads and streets) and areas where they are parked (parking lots) has caused an imbalance between supply and demand which is reflected in traffic and parking congestion. The awareness of limited energy resources, environmental protection and aesthetic appearance of cities has influenced the abandonment of the traditional approach in planning and problem-solving strategies which meant adapting a city to traffic. At the same time, the idea of a sustainable transport system which would enable mobility in a way that would not impair the quality of life has risen. These changes have led to the development of sustainable urban mobility concept.

Unlike the traditional approach which relied on the traffic supply expansion, the sustainable urban mobility concept emphasizes the quality of life in a city, whereas its main objectives are to provide mobility and information services and better connectivity of the existing network [12]. Sustainable urban mobility is based on mobility management, which means the application of various measures aiming to use the existing transport resources as efficiently as possible. It sets priority on the movement of people and goods rather than just motor vehicles. This actually means limiting the car use, as it was identified as the root cause of the problem. This is achieved, on the one hand, through the improvement and promotion of alternative transport modes, and on the other, by discouraging the car use through the implementation of various measures among which parking measures play a significant role.

Sustainable planning implies comprehensiveness, therefore parking management has become an integral part of urban transport policy. In this way, parking policy should solve parking problems, while contributing, at the same time, to the achievement of a sustainable transport system.

Parking management in central and other areas of high attractiveness typically starts with the implementation of an adequate parking regime. The aim of this policy is to increase parking turnover through the discouragement of long-term parkers and thus to balance limited parking supply with qualified demand. Regulated parking duration regime is commonly in use, within which parking charge has stood out as a very effective measure due to the high price sensitivity of users [4, 11]. Possible driver responses to parking regimes (parking charge and time limitation) are complex and varied. These include a change in the parking type, parking location, transport mode,

car occupancy, destination, travel frequency, travel time (with possible consequences on the parking duration) and route (Feeney, 1989). This mechanism of influence allows the parking regime to be used to achieve objectives beyond this subsystem.

Even though most cities in Serbia (82%) have accepted the idea of a modern parking management concept and introduced some of the restrictive parking regimes in their central areas, the impression is that the desired management effects have not been sufficiently achieved. This is confirmed by the research which was conducted in 11 Serbian cities and towns in 2018. The results show that central areas of all surveyed cities experience illegal parking during peak periods (67% of them "to a large extent") while at the same time in 44% of the surveyed cities parking spaces are underused [9]. This may be due to the inadequate measures (in just 22% of cities the implemented measures are the result of the Parking study) and/or due to poor control of implemented measures, i.e. poor parking enforcement. One of the reasons for inadequate measures is often irrational attitude of public towards parking (users believe that parking should be unlimited and free) and towards parking measures that are restrictive by nature [7]. This prevents decision makers (politicians) from supporting the adoption of parking measures because they doubt the measures would be accepted by the general public (electorate).

This paper aims to demonstrate how proper parking management can solve parking problems using an example of one Serbian city, and how it can contribute to the realisation of sustainable urban mobility goals. Also, this paper intends to encourage transport policy makers in the region to implement a parking policy within the sustainable urban mobility framework and to share their best practices in order to show tangible accomplishments, and to encourage researchers to engage in the promotion of this topic so that it can gain its deserved place.

2. PARKING STATE IN PIROT

This paper uses data collected within the Parking system improvement study for Pirot, which was done by the Faculty of Transport and Traffic Engineering, Belgrade, for the need of Standing Conference of Towns and Municipalities in the period of 2019-2020 [10]. The study is realized within the project "Sustainable Urban Mobility in Towns and Municipalities of Serbia", which is a part of wider initiative – regional project "Sustainable Urban Mobility in Southeast European Cities - Phase II" (SUMSEEC 2) funded by the German Technical Cooperation within the Open Regional Energy Efficiency Fund (GIZ ORF EE). The motive for this parking study was the assessment of SUMP work group that parking is the main traffic problem in the city. The assessment was done on the basis of transport subsystems indicator values and data collected by the survey of citizens.

According to Census 2011, the Municipality of Pirot has population of 57,928, whereby 65% of them is urban population³. Despite the fact that number of

³Source: https://www.piot.rs/images/foto-galerija/demografski_podaci.pdf. Access: 16.07.2021

population constantly decreases (by 17% in the last 40 years); the number of motor vehicles increased by 35% in the last 15 years⁴. Accordingly, trips are mainly realised by private car: users make 34% of trips as a driver or as a passenger, so private car is the second place in modal split, right behind the walking (42% of trips).

Parking problem is the most notable in the inner central area, which is therefore chosen to be the subject area of this study. In this area a restrictive parking regime has been implemented in 2008. Parking regime is valid every workday in the period from 7 a.m. to 9 p.m. and at Saturdays from 7 a.m. to 2 p.m.

In this area there are 1,002 on-street parking spaces and only 103 parking spaces at off-street parking lots. The area is split into 3 parking zones which vary in regime attributes. In Extra and Red zones, parking duration is limited to 2 hours and parking price is 45.00 and 35.00 RSD/h, respectively. Green zone doesn't have time limitation and parking price is 30.00 RSD/h. In addition, parking in Red and Green zones can be paid per day, whereby the price is equal to the cost of 4 hours of parking when paying per hour.

Beside "visitor" category to which all above-mentioned measures relate, tariff system also defines "priority users". In the Extra zone, this category includes only residents while in other zones it includes other private and business users too. In other words, in Red and Green zones anyone can buy monthly parking permit at a very reasonable price (from 1,100.00 to 1,700.00 RSD). Parking space can also be reserved. The compliance with the prescribed regime on regulated parking places is controlled by PC "Komunalac" staff while parking control on the places where parking is prohibited is done by Traffic Police.

The study presents the current state analysis based on the data collected from official documentation provided by institutions which are in charge of parking management or operation, as well as the data collected by field survey. In the survey area all parking spaces were recorded as well as minimal (morning) and maximal (noon) parking accumulation, while other relevant parameters were recorded based on representative sample of on-street and off-street parking spaces using methods of independent and dependent survey (i.e. counting and interviewing).

The main conclusion of the analysis was that parking state in the area was poor, i.e. that parking was poorly managed. This can be seen primarily through the large number of vehicles parked at places where parking is not allowed, although at the same time there are enough regulated spaces where all users could park. To illustrate this, at noon when the area is maximally occupied by parked vehicles, 30% of parking spaces are vacant, while 29% of vehicles are parked illegally. Even worse situation is early in the morning (at minimal accumulation) when only 58% of regulated spaces are used, while 23% of residents' vehicles are parked illegally. Users choose to park illegally because they know that the probability of being sanctioned for it is very small: a fine is issued only for every 500th violation.

⁴Source: <https://publikacije.stat.gov.rs/G2019/Pdf/G201913046.pdf>. Access: 16.07.2021

On the other hand, users who park at regulated parking spaces mainly do not pay for parking – in fact, 51% of residents and 58%⁵ of visitors do not pay for parking and/or do not comply with the prescribed time limitation. A penalty is issued only for every 150th violation of this kind.

In addition to the above documented poor parking enforcement, the implemented poorly-defined parking measures also contribute to the poor parking state. The applied tariff system is inadequate in the sense that it contains contradictory measures (in the Red Zone there is a time limitation but also the daily ticket that defeats it) and measures that are contrary to the parking management objectives (monthly tickets for individuals, which encourage parking of users with the "work" purpose). That is why it is not surprising that there is a significant share of visitors with the "work" purpose: 16% of all parking activities during the day and 55% at noon. Due to the long parking duration, the purpose "work" is the basic purpose that "should not" be realized in attractive zones where a restrictive parking regime applies. It can never be completely abolished, but we must not stimulate it by pricing scheme.

It is interesting to note that users are car dependent. This can be supported by the following data: the car is also used for short-distance travel. Namely, more than half of the users come from the urban part of the city, with 11% of them driving less than 400 m to the central area, and 34% driving between 400 m and 800 m. These are distances that could be easily travelled by walking or by bicycle. The average drive length of the citizens of Pirot is 1.2 km. The fact that the most important parameter for the quality of parking service is "vicinity of the final trip destination" speaks in favour of user car dependency. This is the reason why, although a vacant parking space can always be found, 27% of users drive additionally to find a parking space that is as close as possible to the destination.

3. PROPOSED MEASURES

In accordance with the parking state analysis and assessment, measures that should lead to its improvement have been defined. The measures proposed to solve/mitigate the parking problem are aimed indirectly at improving the quality of life of citizens, through their impact on urban mobility. Arranging parking in a way that will enable the parking demand management will affect the increase of parking service quality, but also the quality of other transport subsystems operation, especially the quality of pedestrian, bicycle and dynamic traffic.

The part of the measure set, which is important for the topic of this paper, includes:

Improvement of parking enforcement system, both the part in charge of the Traffic Police and the part in charge of PC Komunalac.

Redefining the tariff system: abolishing the daily ticket as well as the monthly ticket for private users, and keeping the number of monthly ticket for legal entities and

⁵ Of this number of visitors, 53% have a parking duration of less than 15 minutes, which is tolerated by the controller of PE Komunalac, although there has long been no legal obligation to do so.

users of reserved parking spaces under control. In addition, it is possible to increase parking prices if there is a need to (additionally) contribute to the realization of urban mobility management objectives.

It should be noted that the **communication with users**, citizens of Pirot, was envisaged as one of the so-called parallel activities - which is in line with the concept of sustainable mobility. Communication is necessary to create a positive image and raise public awareness that parking management is necessary as a concept of managing their quality of life through mobility management.

4. EXPECTED IMPACT OF PROPOSED MEASURES

In accordance with the defined measures, the effects are forecasted taking into account the following:

- All users park at regular parking spaces: those who currently park illegally will either move to regulated parking space or give up parking (depending on their price sensitivity).
- All users who park in the area pay for parking in one of the prescribed ways, with all residents possess resident parking permit.
- The number of reserved parking spaces and monthly tickets for legal entities remains unchanged.
- Users who currently pay for parking with a monthly ticket for private users or a daily ticket will either change the type of ticket or will give up parking in the zone (depending on their price sensitivity).

In addition to the above, the number of visitors who are willing to pay for parking per hour at current prices was calculated based on the price sensitivity of visitors, which was obtained by a survey, using the stated preferences technique. The results show that visitors are very sensitive to parking price: only 19% stated that they would never give up parking regardless of the parking price. Users who would give up were asked how they would come to the zone in that case.

In this way, it was obtained that the parking volume in the area would be reduced by 1,256, i.e, 15%: 22% in the Extra Zone, 14% in the Red Zone and 13% in the Green Zone.

Visitors who would give up parking in the area would not give up coming to the area (which is a positive finding in terms of maintaining its attractiveness and economic vitality), but they would change the travel mode. Over 500 visitors would switch from a car to a non-motorized mode: they would come to the area on foot (316) or by bicycle (209), which is in line with short travel distances of most users, and is essential for the development of sustainable urban mobility. Others would switch to public transport, taxi and so on.

By increasing parking price, the number of visitors who would come to the area by alternative transport mode instead of a car would also increase, Figure 1. This means that if parking pricing was implemented and properly controlled, the parking price

could be an effective tool not only for managing parking demand but also urban mobility.

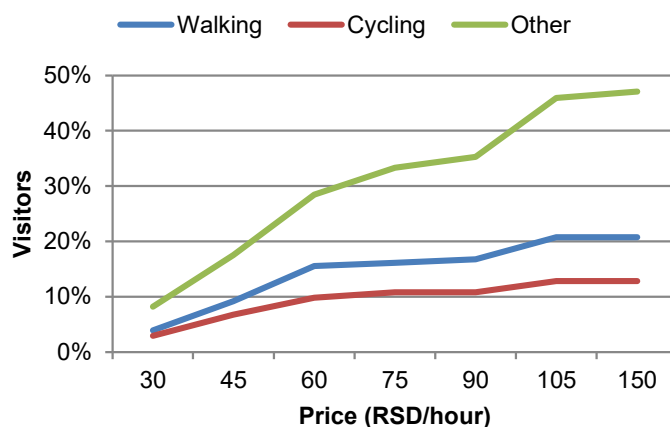


Figure 1. Distribution of visitors according to alternative modes of transport depending on the applied parking price

Similar to the parking volume forecast, the forecast of the maximum parking accumulation was made, Figure 2. In doing so, distribution of visitors parked at the maximum accumulation by parking purposes and price sensitivity of visitors of different purposes were taken into account.

The maximal accumulation in the area would be reduced by 11%, whereby illegal parking would be eliminated and already existing spaces would be used more efficiently. This is a positive finding not only for the parking subsystem, but also for other subsystems (dynamic, pedestrian, cycling...) due to the negative impact of on-street parking (especially illegal one) on their exploitation and safety. By reducing the parking accumulation, the parking adjustment factor also decreases (which is especially pronounced in Pirot as there is usually 1 lane per direction and parking turnover is high), i.e. the road capacity increases and thus their level of service too [1]. Based on the predicted maximal accumulation, the maximal parking occupancy was calculated, Figure 3.

By implementing the proposed measures, it is predicted that the maximal parking occupancy would be 87%, which is close to the 85% which is typically taken as a targeted value in the literature, because it is considered that then there is practically no parking search [8]. A slightly higher value of occupancy would be realized only in the Extra Zone, so the parking search within it would not be eliminated, but it would be reduced.

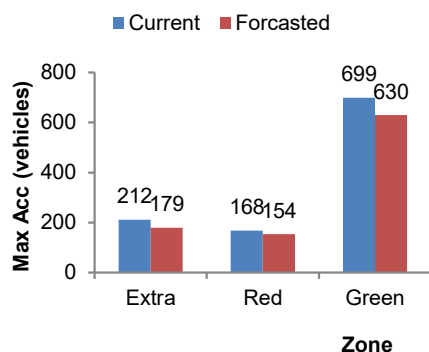


Figure 2. Forecasted maximal parking accumulation

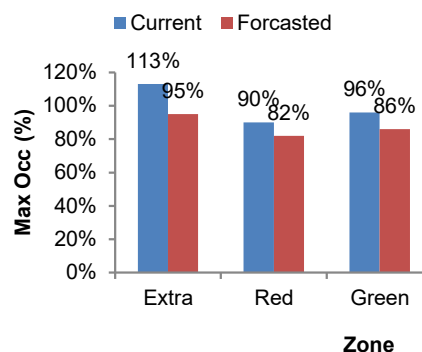


Figure 3. Forecasted maximal parking occupancy

If the average parking search times in Red and Green Zones are taken into account (0.59 and 1.67, respectively), as well as the number of entrances to these zones during the day (2,181 and 3,899, respectively), it can be concluded that in current state users spend 130 hours a day cruising for a vacant parking space. By bringing the parking occupancy to the desired level, this additional driving would be eliminated, which would, in addition to users' time and money savings, also contribute to significant energy and environmental effects. Using a model for the evaluation of energy and environmental effects of cruising for parking [2], it was calculated that cruising for parking in the area consumes 81 litres of fuel per day and emits 316 kg of CO₂⁶. In this analysis, only users looking for a parking space were included, while the impacts of this search on other users were not quantified. Additional driving due to parking search increases traffic volume [8], searching vehicles move at a lower speed and often stop, thus lowering the level of service on the street network and contributing to traffic congestion.

Finally, given that parking pricing generates revenue, the financial effects of the proposed measures were also forecasted. The analysis refers to the revenue from parking pricing, while the revenue from parking fines was not taken into account. Also, the revenue from reserved parking spaces was not taken into account, but due to the recommendation that the number of these parking spaces should be "frozen", it is expected that it will remain unchanged.

For the existing revenue, the accomplished revenue from parking charging on the day of the survey was taken. The forecast of revenue which could be realized if the proposed measures were implemented (Section 3) was made on the basis of the forecasted operational effects of these measures (volume and distribution of users by type of ticket), average parking duration of visitors who would pay for parking per hour (expressed in the average number of commenced hours) and the price by types

⁶ The distribution of the passenger car fleet in the Republic of Serbia according to the fuel (Manojlović et al., 2020) was taken into account, as well as the average consumption according to the fuel (Mellios et al., 2011).

of parking tickets. The analysis showed that in this way the parking revenue could increase by as much as 460%.

As it was pointed out, the precondition for achieving these effects is the good functioning of the parking enforcement, both the part which is in charge of PC “Komunalac” and the part in charge of the Traffic Police. However, in practice, for objective and subjective reasons, the projected regulatory measures are almost never fully implemented. However, further analysis showed that if 80% of users obeyed the parking regime, the parking revenue would increase by 357%.

Finally, it should be noted that the proposed measures would cause major changes in user behaviour, and that the effects are forecasted based on user statements about the change in their behaviour. Although this way of forecasting is considered valid, the predicted effects should not be taken as a precise value, but they indicate well enough the changes that can be expected.

5. CONCLUSION

This paper demonstrates how proper parking management solves not only parking problems but also improves the transport system in general, i.e., contributes to the realization of sustainable urban mobility goals. On the example of one Serbian city (Pirot), we showed that adequate parking measures and their implementation could lead to the realization of following effects:

- **They contribute to the realization of targeted car share in the modal split**, because some users switch from a car to alternative (primarily non-motorized) transport modes due to restrictive parking measures.
- **The attractiveness and economic efficiency of the central area is not impaired**, as the total number of trips to the area is not reduced, which is probably due to the fact that central area of “smaller-size” cities have no adequate alternative.
- **The negative impact of parking on other transport subsystems** (dynamic, pedestrian, cycling) **is reduced** through the reduction of illegal parking and the reduction of parking search time.
- **The negative environmental impact of traffic is reduced** through reduced fuel consumption due to fewer car trips as well as less cruising for parking.
- Finally, **the revenue is generated** that can be partly used for parking and transport system improvement programs, as well as to invest in local community development programs that contribute to the creation of more liveable cities.

These findings should be an incentive for policy makers to boldly use parking policy as a powerful tool within the sustainable urban mobility framework.

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