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Section: Sustainable Urban Development

Possibilities for the Implementation of Park and ride Scheme in Vilnius City

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Abstract

The annually growing number of vehicles headed to the centre of large cities of Lithuania makes a negative impact on the operation of transport system, and on the quality of life of local inhabitants causing traffic congestions, air pollution and traffic-generated noise. In order to eliminate those negative effects essential measures are necessary to decrease the need of inhabitants for using private cars to travel to the city centre. Currently, in large Lithuanian cities, namely in the capital city Vilnius, park and ride scheme is still in a planning stage. A transport network of Vilnius City (540 000 inhabitants) has no park and ride scheme yet which would help to avoid traffic congestions and to increase the number of passengers in public transport. The level of car ownership in Vilnius is 570 cars/1000 inhabitants. The existing bus and trolleybus routes account for 40 percent of urban journeys, the private cars - for 60 percent. The Vilnius Gediminas Technical University has developed a databank of public transport passenger flows, traffic loads on streets and intersections and road accidents. Comprehensive researches and analysis of Vilnius City transport system have showed that it is advisable to implement nine park and ride lots at the main suburban entrance roads to Vilnius City.

Keywords: Park and ride system; parking; public transport.

1. Parking Policy in the Centre of Foreign Cities

The first ideas of urban transport system development were raised in the first half of the 20th century. They were originated from a protégé policy of private car, the result of which – a saturated urban transport system which disorganized the efficiency of public transport operation, inconvenienced transport possibilities for people and caused economic losses in various fields of activity, etc. To solve urban problems the solutions of sustainable transport development policy were introduced. One of such solutions is park and ride scheme the principle of which is to leave a car in a peripheral part of the city and to continue journey by public transport [20]. The first examples of this parking infrastructure were implemented in the twenties of the 20th century in USA [22], in the fifties – in United Kingdom. Development of the scheme was also encouraged by the local authorities aiming to reduce air pollution and vehicle flows [0]. Park and ride scheme and its bike and ride and park and go systems are popular and successfully functioning in the Western Europe, South and East Asian countries, as well as USA. Park and ride scheme has been successfully functioning for already several decades in metropolitan cities of foreign countries: Madrid [0], Zagreb [0], New York [0], Beijing [0], Madison [0], Portsmouth [0], Southampton [0], Ljubljana [0], Hamburg [0], Warsaw [0], Krakow [0], Wroclaw [0].

In 1984, Luxemburg started to develop park and ride system. One of the first parking lots was designed for 400 cars, later it was expanded to up to 1300 parking spaces. Today, Luxemburg is surrounded by five park and ride lots with the total number of 4166 parking spaces.

The overview of foreign studies shows that the cities all over the world lack parking spaces. The problems of parking cannot be solved merely by the traffic engineering measures and appropriate financing. When designing park and ride schemes, the individual transport needs of each city shall be assessed, also geographical conditions, the habits and thinking of local people and drivers. It is of special importance to determine the optimum layout of park and ride lots and the indices on which the journey costs depend when using combined journeys. In the publications of foreign scientists a lot of attention is paid to the analysis of efficiency and pay-back.

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2. The Problems of the Car Ownership in Vilnius Centre

The level of car ownership in Vilnius – 570 cars per 1000 inhabitants – compared to other European countries is rather large and creates all possibilities for using private car and to ignoring the existing public transport vehicles. The level of car ownership in Vilnius is the largest in Lithuania, it exceeds all the other large cities and is 1.06 times higher than the average in the country.

The length, density and technical parameters of streets form a basis of Vilnius City transport system which creates appropriate conditions for a territorial development of the city and for pedestrian traffic. They are accountable for traffic and pedestrian flows, real traffic conditions, capacity of streets and intersections. The existing street network in the territory of Vilnius City amounts to 992 km and has only slightly changed over last years. Vilnius is not a compact city and this finally results in a direct impact on the structure of journeys: the number of journeys on foot, by bicycle and public transport decreases, the travel time increases, environmental impact grows.

In a survey of public opinion in Vilnius City more than 50 percent of respondents indicated that the most topical problem of the city is traffic congestions [0].

At present, in the Vilnius city centre the need for parking is larger than it is possible in respect of territories designated for this purpose. There is no clear strategy so far how to solve parking problems. The result of uncontrolled growth in the number of car ownership is the increasing traffic congestions [0], the increasing noise [0], [0], [0], the increasing air pollution [0], etc. A policy of parking process control in Vilnius City is interpreted as the need to increase parking possibilities, to build in the city centre large underground and over ground parking lots.

Charging of parking in the city centre and its surrounding areas is a must, however, a system of fares shall be flexible and convenient for not only city inhabitants and guests but also for the people working in the taxed zones. The current Vilnius public transport system is still not attractive for passengers, therefore most of them uses private cars to reach their destination. An attractive public transport system, a new public transport mode could contribute to the decrease of vehicle flows in the city and also to solve parking problems.

3. Traffic Flows and their Elimination in Vilnius City

Before implementing park and ride scheme in Vilnius City a comprehensive analysis of combined journey systems was carried out. The need for implementing a combined journey system in Vilnius was assessed and its financial possibilities: the number of potential users (based on the survey of public opinion), research on passenger transfer from private cars to combined transport schemes was performed, traffic flows in Vilnius streets and city entrances were studied, passenger flows on Vilnius public transport routes were investigated and analyzed.

Modelling of the possible alternatives of combined journey systems in Vilnius was carried out. Locations were planned where park and ride lots could be constructed taking into consideration density of local inhabitants, possibilities for territorial development (the issues of land purpose and ownership), visibility and accessibility of parking lot (by car, bicycle and public transport), the need for the elements and modes of combined journey systems was determined in the selected parking lots (the number of parking spaces, bicycle storage facilities and capacity, information measures, etc.).

Through eleven main entrances 126 800 private cars come to Vilnius every day. Having constructed 10 000 – 15 000 park and ride spaces in a peripheral and middle zone, traffic volume in the Vilnius City centre would be reduced by 10 percent (Table 1).

Table 1. The main entrances to Vilnius City and traffic flows on them

No.	Name of Vilnius City entrance	Private cars/day	Number of inhabitants in suburban settlements	The total area of built-up territory, ha
1.	Road A14	9395	31 600	857
2.	Road A2	28055	2200	393
3.	Road A1	25410	10 700	258
4.	Road A4	17210	6 000	300
5.	Road A16	10150	6 200	371
6.	Road A3	10180	11 100	828
7.	Road 5212	3230	19 800	203
8.	Road 101	2815	27 000	422
9.	Road 103	4410	28 300	548
10.	Road 102	7220	6600	565
11.	Road A15	8760	4600	615

3.1. The model of park and ride scheme in Vilnius City

When implementing park and ride scheme in Vilnius, the city was divided into three zones [21]: peripheral, middle and central (Fig. 1).

It was calculated that park and ride scheme of combined journeys will comprise all the modes and forms of public transport in the territory of Vilnius City. Inhabitants before starting their journey by a private or public transport will have a possibility to choose the most acceptable way of travelling: the cheapest, the most convenient or the fastest. A combined journey ensures safe and convenient use and storage of vehicles.

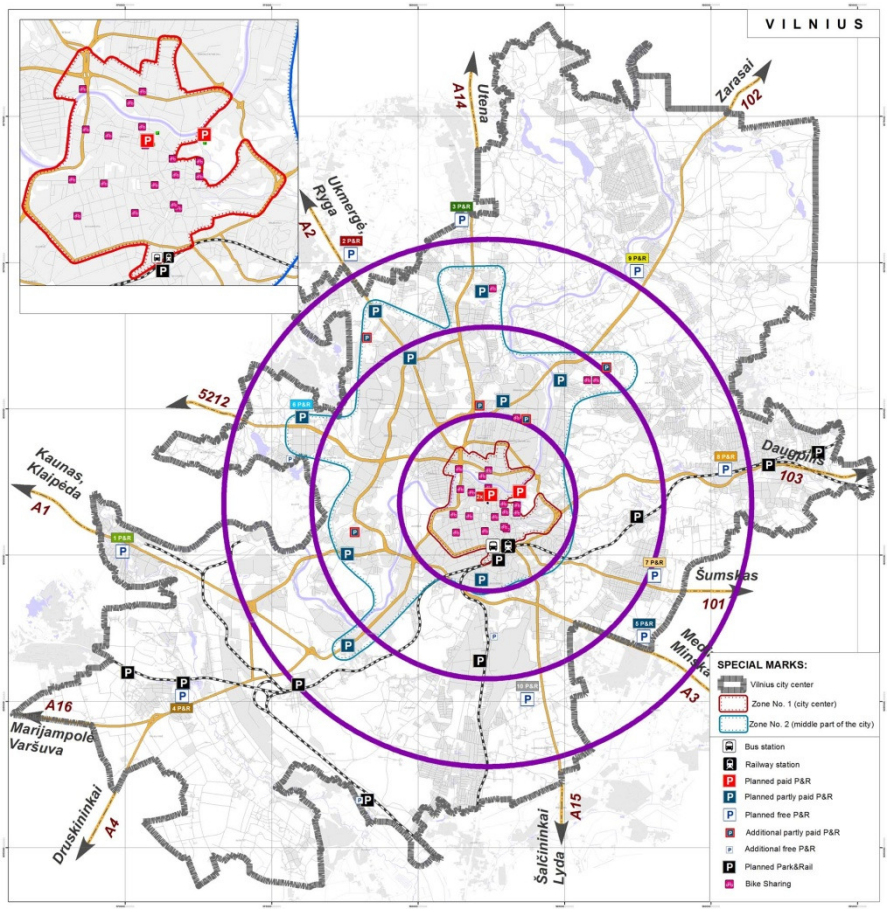

Fig. 1. The network of combined journeys in Vilnius City

The network of park and ride schemes in Vilnius is planned in the middle and peripheral city zones where the largest vehicle and passenger flows are formed headed to the city centre [7].

In the peripheral zone, at the major entrances to the city 7 park and ride lots are planned. In the middle zone – also 7 park and ride lots are planned.

In the central zone 8 existing parking lots situated adjacent to the Old Town are recommended to serve park and go scheme and to be used for visiting the Old Town on foot [9].

The first park and ride lot is recommended to be constructed on the road A14 (Utena, Molėtai) – city centre, with the capacity of 250 spaces. Further, it is recommended in a priority order to implement next links of combined journeys (Table 2).

After reorganization of public transport routes in Vilnius, six fast bus routes were opened which carry 22 percent of passenger flow (140 thousand passengers per day). The final stops of fast bus routes are located in a peripheral (4) and middle (7) city zone, therefore, it is advisable to build near them park and ride lots (Table 2).

Table 2. The planned park and ride lots at the final stops of fast bus routes in Vilnius

Route No.	The starting bus stop	The zone, capacity of a parking lot (veh.)	The final bus stop	The zone, capacity of a parking lot (veh.)	Public transport traffic interval during the peak hour	Number of passengers carried on the route per day
1 G	Station	Middle, 200	Santariškės	Middle, 300	4	24000
2 G	Station	Middle, 200	Santariškės	Middle, 300	4	26000
3 G	Fabijoniškės	Middle, 300	Airport	Middle, 500	5	27000
4 G	Pilaitė	Peripheral, 150	Saulėtekis	Peripheral, 200	4	34000
5 G	Pašilaičiai	Middle, 200	Saulėtekis	Peripheral, 200	5	27500
6 G	Naujoji Vilnia	Peripheral, 100	Centre	Central, 0	5	7500

4. The Principles of park and ride Implementation in Vilnius

4.1. Transport network of composite travelling

In Vilnius and other largest Lithuanian cities one of the major problems is traffic congestions. The integrated multimodal public transport and combined passenger journeys by using promotion systems have been implemented in European cities for already several decades. Experience of foreign countries shows that private car is not the only vehicle used for transport and is integrated into the total transport system. In city centres public transport should carry 70–80 percent of passengers. To achieve this, public transport should be more convenient and faster than private car. A rational division of passenger transportation between the public and private transport is very common in the international urban transport practice [24].

The essence of park and ride scheme is that from a suburban or peripheral zone by using your private car you can reach the final public transport stop situated further from the city centre and to leave your car in the park and ride lot situated here (Fig. 2). The remainder of the journey to the city centre is continued by public transport, usually by park and ride bus. This type of journey: private car plus bus allows part of inhabitants driving private cars to transfer to a public transport running to the city centre. Park and ride bus routes are often independent from the existing scheduled public transport, the bus stops are oriented to the main public attraction objects. A system of fares for the services of this scheme is simple and easily accessible for each passenger.

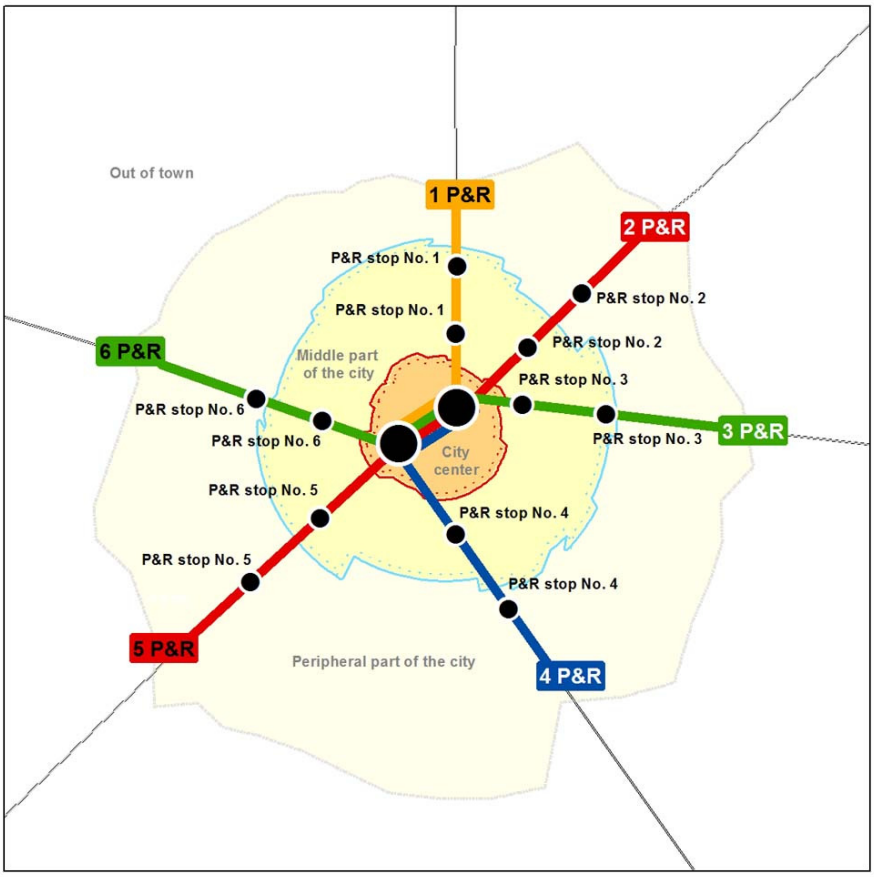

Fig. 2. Recommendatory scheme for the implementation of park and ride concept

4.2. Main implementation principles of Park and ride system in Vilnius city

The following main conditions are required for the implementation of park and ride scheme in Vilnius City:

- First point to erect parking lots for cars and bicycles at the approaches to the city or its centre which would guarantee a convenient travel continuation by public transport and eliminate the search for parking spaces in the city centre [25].
- To use complex economic promotion measures which having left a car in those parking lots would ensure discounts if the journey is continued by public transport. Besides, to impose high parking rates with the limited number of parking spaces in the city centre.

The following organizational principles are planned for park and ride scheme in Vilnius:

- People who leave their car or bicycle in the parking lot and continue their journey by public transport must feel its benefit.

- A supply of public transport shall be attractive in respect of traffic frequency, journey time and comfort.
- Parking – transfer lots shall not be established in intermediate route sites where public transport vehicles could be overcrowded and this would discourage passengers to use the suggested scheme.
- The site for changing vehicle shall be erected attractively to redeem transfer inconveniences.
- Park and ride lots shall be accessed sufficiently easy by a private car from the network of city streets or roads.
- The shortest possible walking distance shall be ensured between parking site and public transport station.
- The size of park and ride lot shall not exceed a 200–300 m walking distance acceptable to the user. Thus, instead of one large parking lot a better solution is to plan several smaller ones.

4.3. Tentative selection of parking-change parking lots in Vilnius city

Implementation of park and ride scheme is not an easy and quickly realized task since in the urban territory almost the whole land has been already privatized and only small territories are left in the municipal disposition where it is problematic to establish a parking lot, therefore, in separate locations construction of multi-storey parking garages is possible.

Locations for the parking – transfer lots in Vilnius City were selected near the main suburban roads running to the city before the very first traffic obstructions and congestions, also in the suburban train and bus stations and in the airport (Table 3). In the city centre parking lots are planned in the zones of large attraction with a possibility to transfer to bicycles.

Table 3. The recommended sites for vehicle parking – transfer lots and their capacity in Vilnius

No.	Preliminary site	The need / implementation	Number of parking spaces	Transfer to a scheduled public transport
A. The main P&R parkings				
1.	Airport	There are multi-storey parkings and lots suitable for P&R scheme	500	Buses, railway
2.	Railway station square	The final station of public transport and transfer point	200	Buses, trolleybuses
3.	The final public transport point in Saulėtekis	Additional territory is necessary for building a parking lot	200	Buses
4.	The hub of public transport in Antakalnis	Additional territory is necessary for building a parking lot	100	Trolleybuses, buses
5.	Santariškių hospitals	A parking lot is necessary in the final public transport point in Santariškės	300	Buses
6.	Siemens Arena	There is a network of parkings which should be adapted to P&R scheme	500	Buses
7.	The northern public transport passenger terminal in Fabijoniškės	A passenger terminal is planned to serve the suburban and urban public transport	300	Buses, trolleybuses
8.	Shopping and entertaiment centre Akropolis, City Stadium	There is a network of parkings which should be adapted to P&R scheme	500	Buses
9.	The Press House	Adaptation of the existing pay parking lot to P&R scheme	300	Buses, trolleybuses
10.	Pilaitės Av. – Papilėnų Str. intersection	Adaptation of the existing pay parking lot to P&R scheme	150	Buses
11.	Intersection of Pilaitės Av. and the old Pilaitės road	Underground parking is planned	150	Buses
12.	LITEXPO Exhibition Centre	There are large parking lots suitable to serve P&R scheme	500	Buses, trolleybuses
13.	The final public transport point in Vaduva	A territory is necessary for building a parking lot	200	Buses, trolleybuses
14.	Intersection zone between Laisvės Av. – Ozo Str.	A multi-storey parking can be used located at the shopping centre Mada	200	Buses, trolleybuses
15.	Opera-House	The existing parkings in Tilto and Vilniaus Streets can be used	300	Buses, trolleybuses
16.	Konstitucijos Av. – Lvovo Str. intersection	Part of the territory behind the Naujasis Vilnius hotel is planned to be used	300	Buses, trolleybuses
17.	Intersection zone between Žalgirio Str. – Kalvarijų Str.	Part of the parking in the territory of the existing market can be used	200	Buses, trolleybuses

Conclusions

1. The practice of planning transport schemes shows that the combined park and ride schemes is a background of a competitive and sustainable urban transport system involving the interests of local inhabitants and public transport operators.
2. Construction and maintenance costs of park and ride schemes are lower than those of multi-storey parking lots in the city centre.
3. The implemented park and ride scheme in Vilnius City will reduce the number of private cars in the centre due to a purposeful control of traffic flows in the middle and peripheral urban zones and will increase the number of passengers in public transport.
4. The network of combined journeys in Vilnius City will consist of park and ride, bike and ride, park and rail and park and go elements by using a complex solution of all transport modes and types in the central, middle and peripheral zone of the city [8]:
   a) at the major entrances to the city 7 park and ride lots are planned, as well as 7 park and ride lots in the middle zone.
   b) Park and rail lots are recommended to be built in the sections between Vilnius Central Train Station and Lentvaris (in Vokė or Paneriai Stations) – Pavilnys and Naujoji Vilnia Train Stations;
   c) in a peripheral zone of Vilnius City it is advisable to additionally equip the final public transport stops with bicycle parking lots.
5. When implementing park and ride scheme in Vilnius City, it is important to use the existing infrastructure of parking lots and structures, especially the parking spaces near the largest shopping centres. The largest shopping centres in Vilnius are often built in a densely populated city districts, at the main transport hubs and important arterial roads – city entrances from suburban areas, thus, they can successfully serve a function of parking lots for park and ride, bike and ride schemes, and to also use park and go and kiss and ride schemes. The schemes shall be provided with the public transport service. Park and ride lots shall be located at least at a 5 km distance from the Vilnius City centre.
6. In a combined journey system the total area and capacity of the planned parking lots depend on the traffic flow generated during the peak hour within the service radius of a parking lot. It is estimated that the scheme will be used by about 20 percent of vehicles participating in traffic.

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