

Integration of Parking Information Systems into Traffic Management

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Introduction

Demand management of road transport networks includes also tasks regarding parking facilities. During traffic management, parking problems can be avoided or managed efficiently with the operation of parking facility information systems and with the interconnection of them with other management systems. In this paper, features and functions regarding “base” and information processes of the certain parking methods have been summarized. Assignment of parking demands (which are originated from the mobility demands) to free parking capacity is a cardinal operational task, taking the personal preferences of travellers and hauliers also into consideration.

1. Characteristics of parking methods

The road traffic management covers:

1. management of moving traffic and,
2. management of “standing” traffic (including searching for parking places movements as well).

Parking methods can be grouped according to the ownership, location and layout (connecting infrastructure) of the facility. Parking methods are summarised in Figure1 [1], [2].

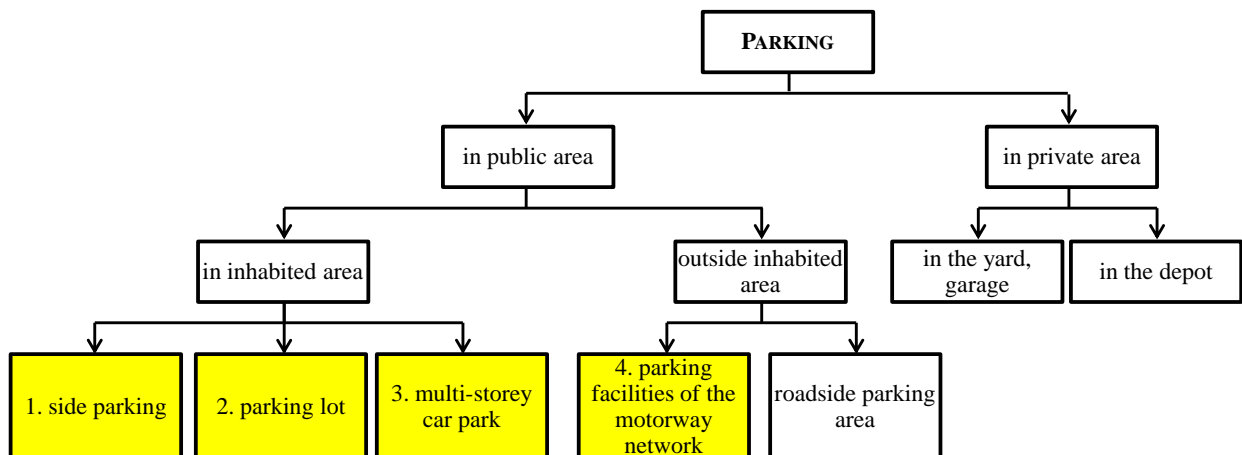


Figure 1: Parking methods

In the viewpoint of parking and its information management, only the highlighted parking methods have been analysed, because parking demands exceed capacity mainly on these sites [3]. Table 1. presents main characteristics of parking methods (advantages, disadvantages, preferred duration) and the speciality of the information system.

Table 1. Characteristics of the examined parking methods

Parking method	Advantages	Disadvantages	Preferred duration	Informatics specialities	Operators
1. side parking	easy parking manoeuvres, short walking distances, simple layout	limited capacity, dangerous parking manoeuvres	short term 0-4 hours	informatics management of parking places requires considerable investments	local government, commissioned parking inspectors
2. parking lot	higher capacity, simple layout, actual occupancy can be easily measured	difficulties at management of vehicle queues entering and egressing simultaneously	medium term 4-24 hours	information management is related to the entering and egressing movements	on public places – see above, on private property – the operators
3. multi-storey car park	vehicles are protected against environmental effects and vandalism	requires substantial investments, in-door navigation and information dissemination should be solved	medium and long term over 4 hours	requires considerable informatics investments, especially in the case of automated (mechanized) vehicle movements	private companies
4. parking facilities of the motorway network	rest period of the transport becomes more predictable	occupancy of parking places fluctuates significantly (depending on the time of day, season, etc.)	short and long term (compulsory rest period)	it should be integrated with other transport information systems	motorway operator company

Two main types of parking houses with the typical differences are [4]:

- conventional parking houses,
 - pedestrians on the road surface in the parking house,
 - air ventilation is to be solved,
 - security measures are expensive,
- automated (mechanized) parking houses,
 - vehicles are moved by conveyors between entrance/exit cabins and storage,
 - there is no bump or crash risk caused by inadvertence of drivers,
 - there is no need for wide transport roads and ramps (surface and volume utilization is advantageous),
 - well-developed informatics background because of automation of conveyance system.

Parking locations and methods are mainly selected with consideration to several aspects. Among these features there are facility parameters, personal preferences and characteristics of the trip chain. Main factors influencing assessment of the parking places:

- Location:
 - location relative to the traffic generating establishments (e.g. shopping mall, post office) (in the city centre, near arterial roads, etc.),
 - network connections, accessibility (road, rail, public transport connections, etc.),
 - walking distances between transport modes ("resistance": stairs, ramps, aesthetics, etc.).
- Layout:
 - characteristics and simplicity of vehicle movements, (one-storey or multi-storey car parks, dimensions of lanes and parking places, curves, visibility at parking manoeuvres, etc.),
 - characteristics, simplicity and distances of pedestrian movements,
 - protection against environmental influences (rain, snow, ice, etc.).
- Terms of use:
 - accessibility, users' group (registered and/or occasional users),
 - structure and measure of fees,
 - method of payment (fee collection),
 - features of sanctions.
- Information management:

- method of registration,
- features of operations at entrance and exit,
- in-door information and navigation,
- scale of integration of local information system with other IT systems,
- information about connecting public transport services (static and/or real-time information about vehicle position, etc.).
- Safety and security solutions:
 - safeguard,
 - equipments for security surveillance,
 - equipments for enhancement of traffic safety,
 - passive safety solutions (safety leaves on pillars against bumping at door opening, etc.).

Users take several parameters with different "*weights*" into consideration during their decisions. For example: street parking is often preferred to parking in multi-storey car park. Its main reasons: lower fees, simplicity and quickness of parking manoeuvres as well as easy exploration of free parking places, etc.

2. Functions of the parking management information systems

Functions of the information systems are summarized in Table 2. (following the processes of trip chains). Their features:

1. **Information:** it can be realized in several ways; two-way communication and use of dynamic data (personalized information) can advance the higher level of service. Information dissemination is a part of each further function.
2. **Demand management (booking):** with pre-booking of parking lots the occupancy of facilities and user satisfaction can be enhanced. It can be realized through several communication channels (e.g.: voice- or data-based information exchange); it is related to route planning. Reservation can be executed manually or automatically (with route planning and route selection). Collection and procession of occupancy data can be used for forecast purposes.
3. **Navigation:** includes indoor and outdoor navigation. Static signs give collective and onboard equipments give individual (personalized) guidance. Inside of the facilities the immobile equipments that support individual navigation (e.g.: *LED displays* and *markers*, etc.) also can be applied.
4. **Payment and fee collection:** primary aims are elimination or significant reduction of cash payment and introduction of automated, free-flow payment systems. Payment can be executed in the following phases of the entire parking process:
 - (1) prior payment, prepaid solutions,
 - (2) payment during entering,
 - (3) payment after taken place,
 - (4) payment prior to get in the vehicle,
 - (5) payment during leaving the facility,
 - (6) post payment.
5. **Safety:** its aim is prevention of accidents when vehicles are moving. It is aided by intelligent vehicle functions as well as active and passive safety solution.
6. **Security:** its aim is prevention of theft and vandalism (with use of security staff as well as identification, surveillance and video recording systems).

Core informatics components of the parking management system can be divided into three main parts:

1. Users (included vehicles, haulier companies and drivers),
2. Management centre (with human and machine elements),

3. Parking facility (with IT peripheries aiding vehicle storage).

Listed elements are connected by telecommunication channels (*wired and wireless data networks*). Information terminals can be mobile - personal or vehicle based - and immobile - roadside - devices. In regions where mobility is well-developed, parking facility operators give facility based information through internet and they try to exploit the potential of smartphones by free downloadable applications [5].

The operations of an integrated parking management system can be divided into three groups (which is coherent with the structural architecture):

1. Users' operation,
2. Operations of parking management centre,
3. Operations of parking facility.

According to the time of the operation it can be:

1. Pre-trip,
2. On-trip, and
3. Post-trip.

Aim is to assign a time-dependent resistance factor for each facility that can be used for the parking management system. This value could influence users' decisions and is applicable at development of route planning and navigation software.

In the future it is predictable that vehicle-driving changes significantly. New technologies appear and they take over most of the driver-related activities. Users just have to input the destination and the car transports them automatically there and parking is also executed automatically without user intervention - even at a far location.

Summary

Parking problems often occur in congested areas with limited parking capacity. Its negative effects can be mitigated by parking management systems, that co-ordinate limited capacity and parking demands in real-time, taking actual traffic situation and personal preferences into consideration. User and vehicle based devices - smartphones and OBUs – can be used for information and also for data collection (e.g. location, user preferences, etc.).

References:

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