Paper number EU-SP0049

A structured approach to assess the success factors of urban zone management

Dietrich LEIHS[1*], Uğur NAZ[2]

1. University of Žilina, Univerzitná 1, 010 26 Žilina, Slovakia, leihs@uniza.sk

2. University of Applied Science, Höchstädtplatz 6, 1200 Vienna, Austria, ugurn@poas.com.tr

Abstract

Urban access regulation turns out to be a strong instrument in shaping the fleet in urban zones and change user mobility behaviour. A number of successful deployments prove it to be an effective tool in urban politics. The most important applications are Low Emission Zones, Urban Road User Charging and Park Pricing. However, a success is not guaranteed as many factors have to coincide that a zone regulation does not only achieve the desired aspect but is also accepted by the citizens. A structured approach with performance indicators is described in this paper, in which certain categories of the application are systematically questioned and turned into countable and measurable parameters. As a use case, the recently introduced Istanbul Smart Parking underwent an assessment "from outside" in order to demonstrate working with the performance indicators.

Keywords:

Sustainable Urban Mobility Plans, Carbon Emissions, Urban Indicators

Introduction

Urban transport plays a major role in carbon emissions. Since 2007, more people do live in cities than in rural areas – and by 2050 most people will live in cities – and consequentially most travels will take place within agglomerations, but also the successful efforts of carbon reduction within industry, dwelling and agriculture are almost completely eaten up by the growing fuel demand of transportation. The way urban mobility is de-carbonized is decisive in any greenhouse gas initiative. In its White Paper on Transportation, namely the Commission Staff Working Document, the European Commission set the goal of reducing conventional carbon mobility by 50% until 2030, a goal that is both, not exaggerated and seemingly out of reach.

Looking closer to de-carbonize urban mobility, one has to admit that any change goes hand in hand with behavioural changes of those who use private cars (more than 500 of 1000 inhabitants in the western world). While urban procurement already starts to change to alternative fuels for their fleets, private car users mostly remain unaltered in their way to use cars. Even if a 1-to-1 change to electric cars would be imaginable, let us ignore the range limitations of most present e-cars and the significant higher price, fuelling up is different and creates mobility patterns that are different from a gasoline car driven by the same person. And still, this 1-to-1 change does not solve the scarcity of parking space in urban areas, which turns a major burden in urban development.

So, urban decision takers who aim turning their cities more liveable, more sustainable and more prosperous, look for solutions to change the mobility behaviour of citizens. Due to the given possibilities of ICT, the last 15 years brought a number of reference cases where urban zones successfully changed regarding car usage, and they brought examples where this failed. Nevertheless, urban zone management, urban access regulation respectively, proved to have a very high potential as a game changer. The reasons for introducing zone management measures are manifold, such as cleaning the air, reducing congestion, improving accessibility or simply reduce the parking pressure. The most common measures for urban zone management are Low Emission Zones (LEZ), Congestion Charges and Park Pricing.

Urban Zone Management

There is no simple answer on how to manage mobility in urban zones; this depends on the goals, the size of the zone, the topology and many more factors. The listing below gives a short comparison of the three most common urban zone management methods regarding their most important properties.

	LEZ	**Congestion Charge**	**Park Pricing**
Mechanism to control traffic	Drive Ban, Charge	Charge	Charge
Specific to certain vehicle types	Yes	Yes	No
Large zones possible	No (Charge: Yes)	Yes	Yes
Reduce flow traffic	No (Charge: Yes)	Yes	Scheme specific
Reduce Pollutants	Yes	Yes	Scheme specific
Reduce Carbon Emissions	No	Yes	Scheme specific

Table 1 – Comparison of the most common urban zone management methods regarding their most important properties

One of the successful examples for urban road user charging is Milan, Italy. In its first version, the charge depended on the emission category of the vehicle. In the second and still operating version, the access charge is flat. In both versions, all vehicles are subject to the charge. The reason for the success is that it is accepted by its car loving citizens, who understand it as a vital instrument to improve the (catastrophic) air quality in the city. Nevertheless, this indication falls short as the measure was accompanied by information campaigns, improved public transport, bike rental and many more. Indeed, the results are convincing, as shown in the table below.

	ADTw[1]	CO_2	NO_X	PM_{10}
Ecopass 2008-2011	-14,4%	-9%	-11%	-19%
Area C 2012 – present	-31,1%	-35%	-18%	-18%

Table 2 – Effects of the Urban Road User Charging in the first year of operation of the two schemes respectively

One of the interesting aspects, the ability of a zone management to reduce cars in the city, is shown in the figure below. In Milan, charged vehicles (i.e. polluter cars) were faster replaced by uncharged vehicles (i.e. less polluting cars) than the natural renewal would do. In general, the charge achieved a sustainable reduction of the traffic volume.

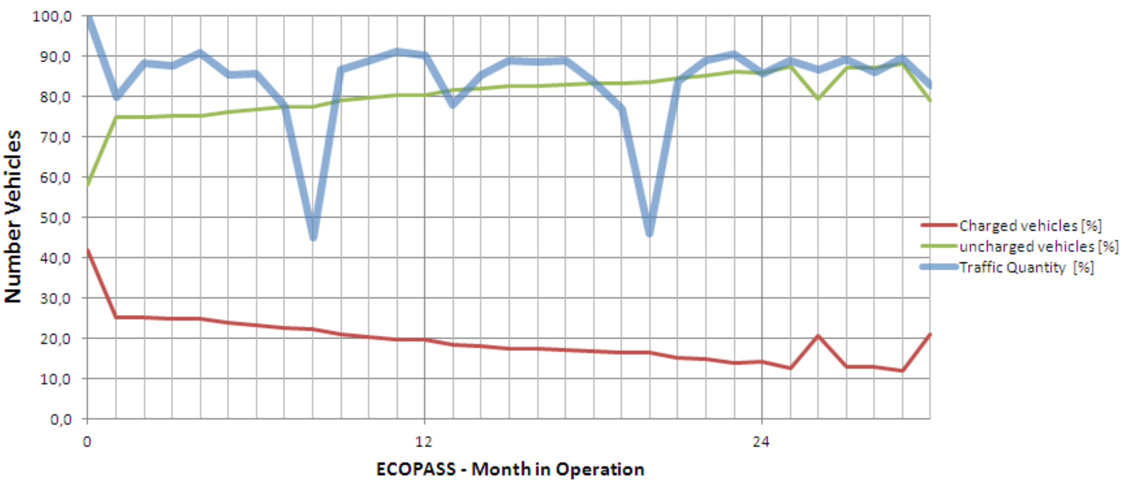

Figure 1 – Fleet renewal and traffic volume reduction during the Ecopass phase of the Milan urban road user charging

A successful example for Low Emission Zones (LEZ) is the Netherlands, where the most polluting trucks exceeding 3,5t gross weight are banned from more than a dozen of cities. The scheme was introduced in 2006, the regulations were tightened two times in order to accelerate the process. The options for owners of not compliant trucks was to renew the fleet, under certain circumstances to retrofit the exhaust system with a particle filter, or to violate. Regional and national exempts

1 Average Daily Traffic on Weekdays

smoothened the situation. The effects were partly significant; in Amsterdam, for instance with its rigid enforcement of non-compliant vehicles, PM_{10} emissions could be reduced by 21%. Also here, introducing the scheme is highly accepted, partly because it affects only a small number of car owners (the commercial segment only), and partly because a high consciousness of sustainable mobility. And also here, this indication falls short, as many more factors contribute to this success.

An example for successful park pricing is the zone enlargement in Vienna. The existing zone with the size of more than 52 km² in the densest populated areas was almost doubled in 2013 in order to overcome the parking pressure from commuter traffic. Parking a car is not only priced but also limited in time (3 hours max). The figure below shows the effects of this measure.

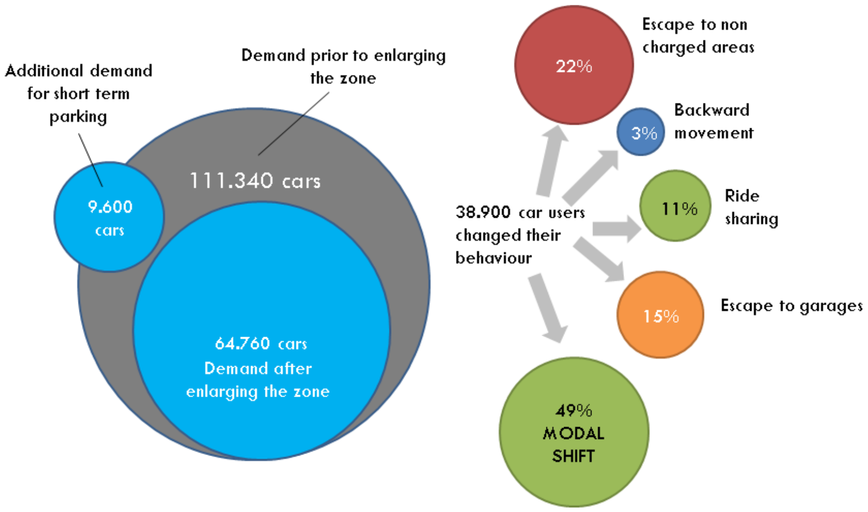

Figure 2 – Effects of the park pricing zone enlargement in Vienna

Parking pressure was indeed reduced significantly, showing that car users adopted their behaviour. More than half changed to sustainable mobility (modal shift, ride sharing). This measure was confirmed within the regional elections in 2015, proving it to be a success.

What made the success of these examples? Why did other deployments fail? The common observations in these and other deployment examples are that there existed a strong political will to change the situation in a changing environment, the high public acceptance, the positive and measurable effects regarding pollution, reduced congestion that created a better accessibility and reduced travel time. These empiric observations are easy to explain for the respective cases but hard to transfer to other deployments. However, an analytical and structured approach that counts on measurable indicators would increase the success probability and ease that one city could learn from another. Such a structured approach is explained below.

Urban Indicators

The properties and parameters model

The approach deployed to assess critical urban mobility factors uses a generic model to identify performance indicators systematically. The approach is outlined as follows:

1. In the first step, any mobility related measure is considered to influence mobility behaviour and consequentially the usage of transport modes and thus supports or foils sustainability ambitions, such as reducing carbon emissions. Measures can be technical measures as well as organisational measures. The measure considered in this paper is "Raise fees for on-street parking".

2. Every measure can be characterised regarding its properties within the mobility system. The generic model assumes, that - regardless the specific measure - these properties can be assigned to the same five categories. The five categories are:
    a. Availability of the general infrastructure which is necessary for the measure;
    b. Availability of specific infrastructure for the respective measure;
    c. Organisational practice;
    d. Influence from other measures;
    e. Shift Elasticity.

    By questioning the five categories for every identified measure, a vast number of mobility related properties are collated that are unique for the respective application. Every property can be described by its technical parameters. This can be shown by developing the example "Raise fees for on-street parking" in the table below (Table 3).

3. The example in Table 3 shows that the model allows a comprehensive assessment of a measure, which is far beyond the standard urban indicators. While in the table, the example for (a) "General infrastructure regarding parking" shows that a standard mobility indicator can be directly addressed ("Number of commuters using private cars and demanding on-street parking"), the example for (b) "Infrastructure for park pricing" shows a parameter that is not determined in the standard indicators ("Average time to obtain a parking ticket"), but it might significantly influence the acceptance of the measure and thus counts as a critical performance indicator.

4. During the assessment procedure, the local planner's expertise contributes to elaborate the properties and parameters columns in order to obtain measurable and countable performance indicators that allow putting urban policies' attention on the most important issues, trace the success and re-adjust if necessary.

Category	Properties	Parameters
(a) General infrastructure regarding parking	Availability of on-street parking lots	Number of commuters using private cars and demanding on-street parking
		Etc.
	Etc.	Etc.
(b) Infrastructure for park pricing	Availability of vending machines	Average time to obtain a parking ticket
	Etc.	Etc.
(c) Organisational practice for selling tickets and enforcing violators	Etc.	Etc.
(d) Influence from other measures	Etc.	Etc.
(e) Shift Elasticity	Etc.	Etc.

Table 3 – matrix to assign properties and parameters of the five categories related to a respective measure (in this case: Raise fees for on-street parking)

The Istanbul Smart Parking Use Case

The Istanbul metropolitan area masterplan for transportation, which was published in 2011, point out that car traffic in the Historical Peninsular has to be reduced by using a variety of parking demand management policies. This encompasses the provision of parking space within but also outside the zone, supporting parking outside of the zone. Also the fact that cargo handling negatively effects road traffic has to be addressed, so specific locations for loading and unloading cargo has to be specified. Parking fees should discourage users from entering the zone, the charge due shall vary with the time of the day, the parking durance and the type of vehicle. Generally, the charges for long term parking within the zone shall be increased while the level outside the zone shall be kept low to make it attractive to park outside. The revenues shall be used for creating public parking.

The ambition generally was to pedestrianize Istanbul's Historical Peninsula, giving home to 434.000 inhabitants. The Historical Peninsula, sized 16 km², has four areas that bear an "outstanding universal value" and have entered UNESCO's World Heritage List in 1985; the *Archaeological Park* at the tip of the Historical Peninsula; the *Süleymaniye Quarter* with the Süleymaniye Mosque complex, bazaars and vernacular settlement around it; the *Zeyrek area* of settlement around the Zeyrek Mosque (the former church of the Pantocrator); and the *area along both sides of the Theodosian land walls* including remains of the former Blachernae Palace.

Figure 3 – Plan of Istanbul's Historical Peninsula with the zone boundaries (red dotted line) and the entry points.

Beneath other measures, the parking fees were indeed adopted, parking lots were regulated and violator enforcement – both, by street police forces and by video camera monitoring – was intensified. In addition, users were offered a real-time information on the availability of unoccupied parking space, on-street and off-street. Finally, efficient payment solutions and multiple payment methods ease traveller's daily routine.

Nevertheless, a large scale survey unveiled that local businesses considered the parking fees within the zone as one of their most significant problems, as the fees had increased two-and even three-fold although many respondents emphasized the benefits of the prohibition of storefront parking, increasing the visibility of their businesses.

The intelligent parking regime within the Historical Peninsular is just the beginning. By 2020, urban policy aims to minimize the number vehicles by simplifying zone entry-exit and the transit passing and by means of a dynamic fee for access. The pricing policy will be different for residents living within the zone, local shop owners, goods supplies with commercial vehicles to the zone, tourist buses etc., as well as for the duration within the zone and vehicle type. Furthermore, the zone's road network will be re-classified and the traffic flow will be re-regulated by creating pedestrian zones, transit roads for public transport, public service cars and emergency vehicles, and commercial vehicles serving to the zone in limited time slots.

The Municipality master plan's spirit for the next decade is being triggered by city planners & politicians in order to create a more liveable and sustainable city. However, one of the main driving factors is the economic prosperity of the Historical Peninsula as it is a highly commercial and touristic zone. The shop owners and residents evaluate the benefits of the zone management, their economic activity, the increase in the value of the property and land, as well as their perceived loss of comfort and flexibility.

So questioning the success is a vital issue for the zone management of the Historical Peninsula. Will the Istanbul Smart Parking be a success? It is maybe yet too early to evaluate the success, but by applying the properties and parameters model, critical performance indicators – or success factors - can be identified. The listing below is not comprehensive as this assessment was carried out from the expert observer's position. In fact, an assessment like this is supposed to be a measure accompanying the urban (mobility) planning procedures.

Category: (a) General infrastructure regarding parking	
Properties	**Parameters**
Parking capacity and parking performance at the boundaries of the Historical Peninsula	• Filling grade as a function of time • Share of residents • Share of commuters • Origin of parked vehicles

Category: (b) Infrastructure for park pricing "within" and "outside" the zone	
Properties	**Parameters**
Road Signage	• Number of vehicles entering the zone without parking
ICT (Booking / Payment)	• Rate of electronic payment users • Time to obtain a conventional paper ticket • Quantity of disruptions in the chain inform – book - pay
Performance of Police forces	• Frequency of a single parking lot to be monitored by police

Category: (c) Organizational practice for selling tickets and enforcing violators	
Properties	**Parameters**
Information campaign beforehand	• Population reached • Population that understands the measure • Population that understands the rationale
Real-time information about available parking places	• Number of service providers • Validity of information • Number of users reached • User profile (commercial, private, frequent, …)
Payment control (dynamic rates),	• Number of users who cannot predict the rate due
Advance booking of parking lots	• Number of users who failed to obtain a booked parking lot • Number of users who failed to be charged correctly
Dealing with violators in the zone	• Absolute violator trend • Time to submit a penalty • Rate of violators that know the reason for being penalized

Category: (d) Influence from other measures	
Properties	**Parameters**
Public transport performance that feeds the zone	• Ratio of travel time by private car and by bus • Travel time outliers in the door-to-door OD matrix • Occupation outliers in the door-to-door OD matrix • Waiting time at the bus terminals in the periphery • Real time information about the bus performance
Availability of the Shuttle service (such as Minibus) within the zone	• Waiting time for the Shuttle Services at terminals • Travel time outliers in the door-to-door OD matrix

Category: (e) Shift Elasticity	
Properties	**Parameters**
Price sensitive control of flow	• Ratio of price and parking occupancy (of target groups)

Conclusion

Conclusion for the Istanbul Smart Parking Use Case

The collated parameters, respectively performance indicators or success factors, can be used to monitor the fulfilment of mobility goals. As such they are supposed to be a tool of urban planners and decision takers on their way to liveable, sustainable and less carbon consuming cities. Some of the parameters in the Istanbul Smart Parking Use Case turn out to be really critical:

1. General infrastructure regarding parking - filling grade of the parking facilities at the boundaries of the Historical Peninsula; this indicates that there is very limited room for improvement as it is hardly possible to create a significant parking capacity in the densely populated quarters close outside the zone boundaries. Together with the “share of commuters”, the outcomes would require a strong feeding public transport in order to get daily commuters out of their cars.
2. Real-time information about available parking places – Validity of information; this parameter is doubtless important in order to bring trust into the scheme, for those who cannot adopt. However, the quality of this parameter has to go hand in hand with that one from the bus operation in order to reward those who adopt.
3. Influence from other measures - Ratio of travel time by private car and by bus; this parameter is smaller than 1, indicating that bus commuters have not only to tackle the same congestion than car drivers but also are confronted with overcrowded bus stations and long waiting times.

General Conclusion

Urban decision takers who aim at turning their cities more liveable, more sustainable and more prosperous, have to look for solutions that change the mobility behaviour of citizens. Such solutions evoke controversial discussions and the pressure to succeed turns to be considerable. Many complex factors have to coincide in order to contribute to a success; an analytical and structured approach that counts on measurable indicators would increase the success probability as the factors can be tracked during the implementation and eventual adjustments get obvious.

The approach to assess critical urban mobility factors proposed in this paper uses a generic model to identify performance indicators in a systematic and holistic way. This makes complex influence factors visible and countable. The performance indicators can become part of the planning, the deployment and the quality assurance during the operational phase.

Further research is needed to ensure the general validity of this approach, and to identify a shortlist of indicators to make it a vital tool for local planners and urban decision takers.

References

1. Commune di Milano (2009). *Monitoraggio Ecopass – Gennaio-Diciembre 2008 – Indicatori sintetici*
2. Agenzia Mobilitá ambiente territorio (2012). *Monitoraggio Area C – Sintesi risultati al 31 Diciembre 2012 – Traffico e composizione del parco veicolare*
3. Agenzia Mobilitá ambiente territorio (2013). *Monitoraggio Area C – Emissioni atmosferiche da traffic stradale in 'Area C' nel period gennaio*-diciembre 2012.
4. Buck Consultants International, Goudappel Coffeng (2010). *Effectstudie milieuzones vrachtverkeer, stand van zaken 2009*
5. Sammer, G., Röschel, G., Gruber, C. Sammer, G. (2012). *Entscheidungsgrundlagen für die Ausweitung der Parkraumbewirtschaftung in Wien*
6. İstanbul Büyükşehir Belediyesi (2011). *İstanbul Metropoliten Alani Kentsel Ulaşım Ana Plani*
7. Çiğdem Ç., Merve A., (2014), *Istanbul historic peninsula pedestrianization project*