



## **The role of public transport to populous cities – the case of Athens**

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### **Abstract**

The transport management, the distribution of time, the sequences to the environment and the urban regeneration affect the existing quality of life to the big cities. The role of public transport (metro lines – trams – busses) to upgrade lifestyle in big cities is extremely important because public transportation systems are friendly to the environment and they have the capability to transfer a huge number of passengers. In this paper we will examine the principles both to the transport planning and to the transport policy that should be applied to cities with saturate roads, such as Athens. In the city of Athens (about 4 millions habitants) it is noticed huge upsurge in traffic and a lot of problems of traffic and parking management. It will be determined the role of public transport to big cities and measurements should be applied for the best transport service of citizens. We will examine policies to make the alternatives to the car more attractive in terms of both infrastructure and services, taking into account difficulties that exist in an urban area like Athens where a lot of circumscriptions are imposed by the existing urban planning. We will examine capabilities of the existing public transportation system in Athens and ways for efficient use of them. Focusing to the contribution of public transport to the desirable growth of an urban area we will mention good practices to ensure a high quality of urban transport services aimed at making better use of public transport and existing infrastructure. Finally we will mention the approach to the urban transport by local public authorities that will reconcile the modernization of public services with rationalization of private car use.

## 1 Introduction

The expanding urban fabric, lifestyle changes and the flexibility of the private car combined with not always adequate public transport provision have caused a huge upsurge in traffic in towns. Though decentralization of activities (especially those of tertiary sector) or housing may occasionally have been flanked by the development of appropriate public transport infrastructure or services, the lack of an integrated policy approach to town planning and transport is allowing the private car an almost total monopoly. More than four-fifths of the population of the European Union lives in urban areas and one-fifth of all EU kilometers traveled are urban trips of under 15 km. Between 1995 and 2030, total kilometers traveled in EU urban areas are expected to increase by 40%. [1]

The ongoing need for locomotion in urban areas can't be confronted without the effective improvement of public transportation systems and implementation of measures about traffic control. Public transport (means of constant orbit – busses) facilitates citizens' movements, fulfils the demand for accessibility for people and good, while the same time minimizing the impacts on environment. Public transportation systems reduce the air and noise emissions to the environment especially when they use alternative (to oil) energies, friendly to the environment (like natural gas, liquid gas, solar energy etc.). In order to be achieved that; public transport needs to achieve levels of comfort, quality and speed that come up to people's expectations, so that attracts passengers and constitutes a credible and ecological transportation solution.

The European Union works toward to this direction by financial programs, financing researches for new technologies aiming at public transportation improvement and promoting the use of alternative energies by transportation systems. [1]

## 2 Urban transport and public transportation systems

An urban transportation system should be promoted combined movements by changing the mean of transport to selected hub of the transport net. An integrated transport system should be consisted by a cardinal metro system, which will serve the center, a secondary tram system that will serve the circumference, and a bus system with frequent stages that will serve local needs.

Public transport reveals operational problems, which effect the attraction of public transport. With regard to the passenger the main problem is the sparseness of the scheduled routes joint to the irresponsibility in terms of the accurate beginning of scheduled routes, the overfilling during the peak hour and low quality services. So a feeling of insecurity puts people off using public transport in certain areas and at certain times of day (especially during peak hours).

Public transport contribute directly to improvement of urban area traffic conditions, because of using them we reduce the use of private car that is the main reason of generation traffic problems. The intention of public transport is to provide urban accessibility to users. Main components that affect the urban accessibility of transport systems are represented to Table 1.

PASSENGER TRANSPORT				
Type of transport	Infrastructure		Traffic operation	
	Type of infrastructure	Level of privatization	Means of transport	Level of privatization
Private motorised	-Inner-urban main roads -Inner-urban other roads -Urban/ inter-urban motorways	-Public -Semi-private -Private	-Passengers cars -Motorcycles -Waterways	-Private (commercial, private households)
Private non motorised	-Walking and cycling areas and facilities	-Public	-Bicycles -Pedestrians	-Private
Urban public transport	-Road/ Bus Lanes -Rail	-Public -Semi-private	-Busses -Light Rail -Underground	-Public -Privatised
Regional rail and bus transport	--Road/ Bus Lanes -Rail	-Public -Semi-private	- Busses -Underground -Railway	-Public (upper state level) -Privatised

Table 1: The most important dimensions of urban passenger transport systems [2]

Important factors that represent the service level are the total time and the credibility of travel. The total time of travel depends on traffic conditions of roads. So, some roads with traffic congestion the priority to public transport (busses) or the bus lines with exclusive use from buses contribute to reduce travel time.

The enforcing of public transport use for movements to job is determinative for the city's operation during peak hours. Urban movements using public transport that are connected with job, decline in European Union, while the movement from/ to job using private car increases. The average proportion in Europe from/ to job using public transportation systems (train, metro, tram, bus) was 25.9% in 1996 in cities and only 18.8% on outskirts.

The adopting supplemental and supportive measures, like parking and riding to specific points of transportation net, proving facility to services like shops in metro's stations or near to them, is essential.

The authorities should be adopted by-laws to keep to the strict minimum the number of parking spaces to be provided with each new office building, making car use less practical. Parallel the largest employers (firms and administrations) could be encouraged to organize their employees' journeys or even to pay for public transport (In Vienna, for example the metro is partly funded by the city's companies).

In order to be reduced the contraction against public transport; the services should have the desired level of comfort, quality and safety so public transportation system will become competitive to the private car. The total travel time is affected by traffic conditions that exist to the road net. So in roads with heavy traffic the priority to bus lines promotes to reduction of total travel time.



Recent survey that became in Athens in point of the purpose of movement shows that the 18,30% concerns the movements to job, 1,5% to business, 4,9% for educational reasons, 0,80% for attendance, 4,9% for shopping, 7,4% for personal reasons, 9,20% for social recreation. From the total 7.000.000 movements that take place daily in Athens area, it is estimated that the 52,5% becomes using private car and the rest 47,5% using public transportation systems, taxi, motorcycles and bicycles. The public using daily private car is mainly men and employees from 25 to 54 years old. [3]

The 68% of Athens citizens don't use public transport against 40% of others European citizens. The most frequent daily used public transport is the thermal bus (41,4%) following by underground metro (19,9%), the sub ground metro (13,4%), electrical trolleybus (9,6%) and the municipal busses (1,2%). Percentage 13,4% uses taxi and 8,7% motorcycles and bicycles. The differences between the preferences to means of transport of Athens citizens are noticed in proportion to sex with women prefer public transport more than men. [4]

Today, a program of transportation readjustment takes park in Athens, aiming at providing transportation services during the Olympic games in Athens, in 2004 and at the completion important infrastructures until 2006. This program includes the construction of major infrastructure such as a new airport, a new underground metro system and a series of new highways while a new tram system and a region railway will be materialized soon.

#### **4 Traffic and parking problem in Athens**

In the area of Athens, there is heavy traffic problem, mainly during morning and afternoon peak hours. The average speed of cars in the center doesn't get 8 km/h. Suggestively is referred that a route 10 km of the road net in the center of Athens, may be take more than 1,5 hr travel time.

Except traffic, the parking is main problem in Athens, and it is expected to remain because of a serious increase of private cars is expected (Table 2). Drivers need 30 min to find parking in Athens during peak hours. In the center of Athens there are parking for 68.000 cars, while are needed 30.000 more in order to serve all drivers. The 68% of parking are on the roads and no to parking lots. 100.000 cars park in the small circle of the center between 10:00 to 13:00, 45.000 of them illegitimately. About 1 to 2 cars parks illegitimately in the small circle of the center and only 2/3 of parking in parking lots are used in the same time. The illegal parking causes falloff of urban context by occupation of pavements and annoyance to movement of pedestrians and people with reduced mobility, while it has contribution to urban accidents. [3]

Recent researches estimate that the illegal parking is 80% of total parking in the center of Athens. Also in the area in the circle of city center the percentage of roads with one lane will be reduced from 56%, that is today, to 11% if there isn't parking in roads, while the corresponding number of roads with 3 or more lanes, will be increased to 40% from 16% today. [3]

As to synthesis of traffic, in 2001 the percentage of passenger cars was 77,3% of total number of vehicles in the city of Athens, 12% motorcycles and only 3%

busses. The percentage of busses was only 0,3% and trucks and taxi were 9,7% and 0,7% respectively.

Type of vehicle	Number of vehicles in 2000	Number of vehicles in 2001	Change between 2000-2001 (%)
Passenger cars	1.616.832	1.822.147	1.13%
Taxi	16.324	16.324	0.00%
Trucks	211.633	227.958	1.08%
Busses	12.116	6.944	-0.43%
Motorcycles	344.803	282.109	-0.18%
Total	2.201.708	2.355.482	1.07 %

Table 2: Vehicles in December 2000 and 2001, in Athens area. [5]

The pricing of services that are provided from public transportation systems is based to the united ticket independently of the route (except the zone system of sub ground metro). This system lends to an indirect support of long ways movements and probably it causes warp to the demand. That's why, options for adopting a zone pricing system, according that a pricing policy that the travel takes part to the price. Today, the ticket for a single way using public transportation systems vary between 0,45€ (bus ticket) to 0,70€ (metro ticket).

To facilitate transfers from one transportation system to another, encouragement needs to be given to the introduction of ticketing systems that are integrated (and thus ensure transparency of fares) between rail companies or between modes of transport (metro - bus). Today ticket administration is become from every carrier separately, using different price and different coupon. So it is difficult to users to change transportation system. There is only a monthly card for unlimited routes using all transportation systems but it serves passengers who use public transportation systems a lot.

After starting the operation of underground metro, the sub ground metro and underground metro companies, offer an integrated service in a single ticket from those passengers who use underground metro and they continue their travel to the final destination using sub ground metro. This policy is proposed to apply to all public transportation systems in Athens. Corresponding to this model where integrating the services offered by different operators within a single tariff band and with a single ticket, is the policy that it has existed in Ile-de-France since 1976 and in Naples, offering users greater flexibility and so makes public transport more attractive.

Taxi acts competitively to public transport in Athens area. Mainly, taxi replaces lack of public transport. This is the reason that there are so many taxi and so low pricing of taxi's services. The pricing of a medium route by taxi is about 4 times lower than the most European capitals. The decline of taxi is expected to be double in 2020. A taxi moves about 19 hours daily, covering more than 350 km, while 28% of these km covering without passengers, searching for clients. [6]

It is required to recognize the role of taxi in order to upgrade their services, a role that goes far beyond merely carrying passengers, but also includes additional services (minor carriage of goods, express deliveries, etc.).

## 5 General characteristics for the existing public transportation systems in Athens

The total number of transport capacity for public transportation systems in Athens area is estimated from the sum of maximum capacity of transportation systems of busses, trolley busses, sub ground metro and underground metro. Also interurban busses should be added, but they will not change the total urban movements. Further:

The thermal busses are 1.848 with total transport capacity 195.257 passengers (standing and seating). The electrical trolley busses are 404, where 224 of them are new type and 180 old type busses with total capacity of electrical trolley busses 42.824 passengers. Usually the 90% of them circulates daily and the rest 10% are currently out of commission because of maintenance, damages etc.

### Thermal Busses

Type of bus	Number of busses	Number passenger per vehicle	Total capacity (Passengers)
Typical size	1.187	96	114.603
MIDI busses	194	58	11.252
MINI busses	32	36	1.152
Jointed busses	435	156	68.250
<b>Total</b>	<b>1.848</b>		<b>195.257</b>

### Electrical trolley busses

Type of bus	Number of busses	Number passenger per vehicle	Total capacity (Passengers)
New type	224	106	23.744
Old type	180	106	19.080
<b>Total</b>	<b>404</b>		<b>42.824</b>

Table 3: Transport capacities per type of busses and trolley busses [4]

In Athens there are two types of metro. The sub ground metro (line 1), with one line and the underground metro with two lines (lines 2 and 3). All metro lines serve the center of Athens, the connection with the port and main areas where there is high activity's centralization (big hospitals, music hall, athletic centers, etc).

The rolling stock of sub ground metro (Line 1) consists of 24 trains that are constituted by 5-wagon/ train and total transport capacity 1000-passengers/ train. The rolling stock off underground metro (Line 2 and 3), consists of 28 trains that are constituted by 6 wagon/ train and total transport capacity 1030

passengers/ train, where 224 of them seating and 806 standing (is calculated by 5 passengers/ m<sup>2</sup>).

	Number of trains	Number of wagons	Passengers per train	Total capacity (Passengers)
<b>Underground metro (Lines 2 and 3)</b>	28	6	1.030	28.840
<b>Sub ground metro (Line 1)</b>	24	5	1.000	24.000

Table 4: Transport capacities per type of thermal busses and electrical trolley busses [4]

The frequencies of routes during a typical day are between 5 (in peak hours) to 30 min for thermal busses and electrical trolley buses. The average daily frequency of underground metro and sub ground metro is 10 trains per hour (3 min in peak hours). Public transportation systems serve passengers between 06:00 to 12:00, that is 18 working hours.

## 6 Capacity of the public transportation system in Athens

The total capacity of public transportation system is estimated by the mathematical formula, which associates the capacity (passengers) with the frequency of routes per type of system in time unit.

$$C = \sum_{i=1}^n \sum_{j=1}^n v_{i,j} * S_{i,j}, \text{ where:} \quad (1)$$

C = the capacity of the transportation system (passengers/ time unit),

v = the frequency of routes (vehicle/ time unit),

S = seats (standing and seating) of passengers (passengers/ vehicle),

i = transportation system (thermal busses, electrical trolley busses, underground metro, sub ground metro, municipality busses), and

j = the type of vehicle for the i transportation system

Applying the previous formula for every type of vehicle for every public transportation system in Athens area, we calculate the total transport capacity of public transportation system taking in consideration the following scenario that represent realistic the existing situation in Athens:

- The thermal busses that are in daily use consist 90% of total
- The average daily frequencies of thermal and electrical trolley busses, are 54 routes per day (3 routes per hour for 18 working hours per day)
- For underground metro three (3) trains of 28 are out of use because of technical problems and 3 train from 24 for sub ground respectively



- d. The average daily frequencies of sub ground and underground metro, are 180 routes per day (10 routes per hour for 18 working hours per day)

Based on previous acceptances and applying the equation (1), the average daily capacity of public transportation system in Athens is:

$$C = 9.489.490(\text{thermal busses}) + 2.312.496(\text{electrical trolley busses}) + 184.000(\text{sub ground metro}) + 185.400(\text{under ground metro})$$
$$C = 12.171.386 \text{ passengers/day}$$

Therefore, the total daily capacity is 12.171.386 passengers/day. If we include municipal busses and taxi then the maximum capacity for transportation system (except private cars and motorcycles) in Athens is up to 13 millions passengers.

We conclude that the total number of daily capacity of public system is almost double than the total number of movements (7.000.000 movements/typical day), and four times bigger than the number of habitants in Athens area (3.523.407).

It is obvious, that public transportation systems don't constitute attractive solution for urban movement. Their low quality and profitability, their operational problems constitute main reasons that lead to use of private cars and taxi.

## 7 Conclusions – Proposals

In Athens, but also and in others cities with similarities; the traffic is the main problem for the viable growth and the quality of habitants' life. The main reason is the increased growth of private car, and it has as result road infrastructures aren't enough for harmonic operation of city. So the solution may be the rational administration of incrustation and the pricing of their use. The state is obliged adopting arrangements that enforce the role of public transport, provided economic, safe and qualitative service to passengers.

Athens is a city with dense building with a lot of archaeological places dotted mainly in the center so a lot of circumscriptions are imposed by the existing urban context. So destructions and interpositions to infrastructures (like new roads, expansion of existing roads, new parking areas etc) are difficult to become. So the existing urban planning, the problems of traffic and environmental problems (like smog) constitute problems with one and only solution, the upgrade of public transport and pedestrian zones.

Measures that should be taken in this frame of policy are:

- Metropolitan administration of public transport about their pricing and financing
- Pricing of road infrastructure use for private cars, especially to the inner center of city
- Use of means of constant orbit (sub ground and underground metro). They can be used to serve the center "feeding" busses to circumference
- Revaluation of existing busses net so they serve present needs according the land use and the expansion of city's outskirts

- New bus lanes with exclusive use of public transport, aiming at reduce of travel time
- Use of telematics systems for information about the schedules of public transportation systems and about traffic conditions in roads with heavy traffic proposing alternative routes
- Signaling and mark-up providing priority to public transport and pedestrians
- Controlled parking in the center and provision for parking in building areas
- New park and rides areas near to stations for easy transfer from private cars to public transport, so the use of private car in the central road net avoid
- Upgrade of pedestrian zones and new pedestrians zones providing comfortable movement
- Promotion of advantages of public transport to citizens (by advertising, sensitization campaign etc)

The implementation measurements like the restriction of private cars' movements to specific department of the city and for specific time and days, it is not the solution for the regional roads, and in long term the use of private cars grows, like the case of Athens. The implementation of restrictional measures (inner center in the case of Athens), with parallel charge for entry (fare use of infrastructure for some hours), that includes all vehicles except public transportation system, will probably have results. It is estimated that the pricing of private cars' entry in the center of Athens, should be reevaluated. So it be coped with the low car-pooling and in long terms the car sharing will be declined. So the loaded road net in the center is expected to be comforted because of reduction of vehicles, while the levy for private cars leads to rational and economic use of private cars from habitants and visitors.

Finally, the rational and realistic urban transportation system planning comprises the basis on passengers' attraction to public transport and on averting of private car use. We prove that in the case of Athens, although public transportation systems are efficient to serve the demand, the effectiveness is not the desirable one. So, some times it is not necessary the budget expenditure for new transportation systems but the recast and the up date of transportation system following the developments and the changes to the urban context and the land use.

## References

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