

Interrogating Best Practices of School Accessibility in Neighbourhood Planning

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Abstract- It is well understood that, in major Greek urban centers, the number of vehicles in circulation is disproportionately high regarding the available road network, while at the same time the inadequate public transport system forces the citizens to be highly car-dependent. Walking and cycling do not receive the due attention neither by inhabitants nor by administration bodies, increasing the risks for vulnerable road users while also decreasing any equal opportunities to safe, affordable and convenient transportation. According to the principle 12 of the Charter of the New Urbanism [1], '...activities of daily living should occur within walking distance, allowing independence to those who do not drive, especially the elderly and the young. Interconnected networks of streets should be designed to encourage walking, reduce the number and length of automobile trips, and conserve energy'.

This paper discusses the critical issue of school mobility management as a core aspect of neighbourhood planning, aiming at ceasing the so called 'addiction' in motorized transport as generated in young ages. Transportation to school is largely depended on private cars, dissociating children from the school surroundings, the street environment and the sense of place and community in their home-zone. Planning and traffic characteristics in school zones are explored for 10 cases in Attica Prefecture, in order to identify deficiencies in the street and public transport network as well as demonstrate accessibility attributes. Based on the analysis of the current state, comprehensive proposals include policies and measures aiming at the downgrade of the car-centric model of urban neighbourhoods by upgrading critical infrastructure, such as traffic calming arrangements, pedestrian friendly intersection development et cetera, with a bold approach in bicycle potential.

Lastly, the paper presents tangible ways of enhancing awareness (educators' seminars, Kids Mobility Week, teaser cards and books etc.) and promoting alternatives regarding students' mobility through a number of best practices around European and American cities.

Keywords — accessibility, school commuting, traffic calming, Athens, mobility management.

I. INTRODUCTION

The Greek planning environment and its traffic conditions are generally considered to be perplexing and tough, as the street networks remain overburdened and little has been done to mitigate the impacts (road accidents, air and noise pollution, delays, car-dependency etc.) in transportation terms. Issues occur due to the inadequate street network, the lack of a concise parking management system as well as the overall absence of robust and sustainable mobility planning. Hence, dense urban areas which could be transit oriented, remain highly car-dependent and vulnerable road users, such as pedestrians, cyclists, disabled people, children and the elderly are constantly at risk. In general terms, it is observed that the -already limited- public space is mostly hostile, excluding the user from the everyday activities in urban neighborhoods. However, due to the narrowness of the street network, a redevelopment of it with the needed widenings and re-arrangements seems inept, leading the planners to propose ways for reducing car mobility and increasing space for the above described users. This paper addresses those areas in the neighborhood, that are mostly in need for strategic intervention; the school zones. School zones are priority places for planning and traffic interventions as they demand a safe and friendly environment for everyday activities especially during the peak hours. School mobility is a supplementary notion to the common term of 'mobility' and refers to the movement and travels of students to and from all educational facilities, in all educational levels (nursery, elementary, primary, high school, colleges, universities etc.). In general, it contributes an important share in the everyday transportation conditions of a city in various ways, as students cover considerable distances with or without their parents to reach their destination. The number of school travels, according to Tsipra [2] and the particular modes of transportation vary significantly according to the type of school facility, the age of the students, and the general planning environment of the area (i.e. densely built up areas in comparison to sprawling suburbs).

This paper focuses on the particular areas that serve schools for younger students, namely nursery school, elementary, primary and high school, as these facilities are mostly approached by car as parents accompany their children to and from their schools.

A. Towards Sustainable Mobility in Congested Urban Neighbourhoods

Given the overall will for a better quality of life and urban environment, cities- especially in Northern Europe and some in the U.S.- are shifting to sustainable means of transportation and adjust their mobility habits with the imposition of slower speeds, transforming congested neighbourhoods into vibrant places that invest to their public space and develop pedestrian and cycling networks in the planning environment. Historical city centres and neighbourhoods are priority areas for traffic calming interventions, which impede 'through traffic' and protect inhabitants from the so called 'traffic anarchy'. Especially in the focal places of neighbourhoods, namely the central nodes of activities, which concentrate educational and recreational facilities as well as in their immediate vicinity, alternative approaches, policies and measures should be implemented. It is a fact that, in the last decades, due to the increased concerns of parents in developed countries of the world, for road accidents and the rising crime rates, travels to and from schools are mostly conducted by car, even in the cases that schools are within walking distances. More specifically, as Fotel and Thomsen describe, "The number of children driven by car on school journeys has doubled from 1993-2000. Of the total journeys, the 6-10 year-olds have doubled their car trips and reduced their walking trips by 40% from 1978-2000, while the 11-15 year-olds have tripled their car trips during the same period" [3].

In order to resolve such issues in these vulnerable areas, traffic alongside planning interventions are necessary.

The determination of the proper space to locate educational and recreational activities in the wider territory of a neighbourhood should be an integral part of community and regional development and land use planning, which though is not the case for most of the Greek urban neighbourhoods which many times occurs as an isolated endeavour.

The location of schools is determined by a number of criteria (population, young population, urban density etc.), but the one that seems to be the most crucial is the availability of the land parcel, where places with centroidal benefits around the wider area are usually selected. The traffic conditions and the overall QOL indicators are rarely been considered, leading to scattered interventions in retrospect.

Moreover, the attraction of further traffic flows due to the location of a new activity, in an already congested artery, demands special policies and intervention attributes regarding the absorption of extra traffic or the reorganization of the whole mobility system around the degraded area.

Common practices include the development of traffic calmed neighbourhoods, apart from interventions incorporated in the upper level strategic planning, as well as specific localized acts. '30 kilometres zones' or traffic calmed zones is a common and mostly successful policy implemented in urban neighbourhoods all over Europe and in the USA, that defines the maximum speed for car circulation in a specified area. The aforementioned policy, along with case specific placemaking interventions, allows the redeveloped areas to become more human friendly. Streets are becoming again the public spaces they used to be, attracting more people to socialize, play, interact and participate in their city's life. Other public spaces, such as parks and plazas, reconnect to encourage the creation of the future compact and sustainable city. The regeneration of the street environment in the neighbourhood scale improves the mobility of vulnerable users and turns transportation habits in order to serve the people's needs while at the same time confront traffic issues.

Starting with places around schools and other educational and recreational facilities can be an asset in terms of both increasing safety and accessibility for priority areas as well as for convincing the public to accept and participate in the city's transformation. School mobility management includes various elements of comprehensive urban planning and the sitting of the various facilities can have a significant impact on transportation patterns, road service demands, residential choices, and housing development, real estate as well as water and utility demands. Moreover, proper school mobility management presents notable health benefits for students, according to Davison [4], who has concluded through his research that 'Children who walk or bicycle to school have higher daily levels of physical activity and better cardiovascular fitness than do children who do not actively commute to school'.

B. Planning and Traffic Characteristics around School Zones

As stated above, school mobility management constitutes a crucial matter in city planning that has received little attention by the Greek planning authorities and local administration bodies. This section aims to explore the overall planning and traffic characteristics of school zones in urban neighbourhoods and emphasize in factors that impact on school mobility.

In order to analyse the complex and precarious aspects in the planning and transportation reality in the studied field, we should firstly identify the specific aspects of school mobility compared to the common notion of 'mobility' as a scientific field in transportation studies and consider afterwards the factors that have a major effect on the way children move to and from the particular educational units.

First of all, school mobility and students, as identified by Athanasiou [5], present the below particularities:

- School commuting is conducted by specific ways, such as walking, cycling, public transport, school buses and by car accompanied by their parents.
- Travels to and from school is a act of transportation concentrated in particular time and space, as students move in definite streets around the school in particular time zones (school timetable). These disorganized concentrated movements result in greater likelihood of causing accidents involved with students during peak hours.
- Students, as users of the surrounding network, are characterized by insouciance, enthusiasm and carelessness, perceiving the daily commute as playing in streets. Although children have high reflexes, they can also act spasmodic, making abrupt movements that pose immediate risks to their safety.

Secondly, the factors that are considered to have an important effect on school mobility vary widely among planning and traffic parameters, which contribute with their respective share on the configuration of the cityscape and transportation environment. These parameters, as described below, act in combination and can ease or incommode school commuting and other aspects of city life.

Street network geometric characteristics:

The street characteristics that shape and drive school mobility according to Tzouvardakis [6] and Athanasiou [5] are;

Driving behaviours, traffic regulations and their level of implementation and obedience, the width of sidewalks and delineation of intersections, the infrastructure for cyclists and the potential urban furniture, the presence of proper signalling and traffic lights, the observed traffic load and any possible delays et cetera.

The narrowness of the Greek streets along with the impertinent driving behaviour and the lack of proper infrastructure around school zones are the key issues that discommode safe school commuting.

Proper allocation and concentration of school facilities:

The location and distribution of school units in the territory of a city defines the service level of the neighbouring students and promotes or discourages active school commuting, while impacts crucially on the traffic environment. Children mobility is mostly characterized by the travels they conduct to and from educational facilities throughout most of the day in a daily repetitive basis. Hence, school facilities appear as critical infrastructure in the urban environment and as such their location should be the result of an inclusive strategic planning in accordance to the housing, transportation and working needs of the family, the teachers and in general the community they serve. Proper allocation in the centre of neighbourhoods increases walking and cycling to and from schools while also pursues for traffic calming solutions and walking friendly environments. Indeed, the deficiencies in Greek planning policies and the limited level of development plans implementation leads to numerous inconsistencies impacting on the proper sitting of education units and the generated degradation of urban space.

Lifestyle and mobility habits of the contemporary family:

Modern lifestyle calls for parents to transport their children to school in combination to their work commute which is usually conducted by car. Hence, students get used to car transportation and it informally becomes the main mode for travelling around their city. Moreover, the fact that the Greek street network remains insufficient increases the risk for students, as vulnerable road users, to become involved in an accident. According to Tsipra [2] the four most common problems identified in and around school zones are; the traffic jam in the adjacent streets (1), the high speed developed by the private cars and motorcycles (2), the conflicts arising between cars, pedestrians and cyclists in the neighbourhoods' intersections (3) and lastly the drivers' delinquent behaviour (4). In general, all the above shape the current state of school mobility in Greek cities, urging the need for immediate low and medium cost interventions in terms of infrastructure as well as policy implementations.

The present image of school surroundings (figures 1-2) constitutes of narrow and damaged sidewalks which usually have various obstacles, such as garbage bins, trees, bus stops and many more.



Figure 1: Typical Sidewalk obstructions in Athens

Source: Personal Archive



Figure 4: Illegal Parking in Athenian downtown neighborhoods

Source: Personal Archive



Figure 2: Second Typical Sidewalk Obstructions in Athens

Source: Personal Archive



Figure 5: Street intersection in school zones, Kallithea area

Source: Google Street View © 2015 Google, Image Capture: Jul 2014
Achilleos, Kallithea, Attica
https://www.google.gr/maps/@37.945369,23.696963,3a,75y,307.78h,79.3t/data=!3m4!1e1!3m2!1s4Iehqtc_XbxcxqjachwZQ!2e0?hl=en

Illegal parking (figures 3-4) is a daily reality that allows almost every possible car movement, with little or no penalties which if added to the disorganized intersections (figure 5), downgrades further school zones, discourages walking and cycling activities in the periphery and most importantly increases the risk of students' safety.



Figure 3: Illegal Parking in Athenian neighborhoods

Source: Personal Archive

In addition to the deficiencies shown above, the phenomenon of school sprawl is becoming more apparent in the newly built suburbs or redeveloped districts in the Greek territory, affecting the planning attributes and consequently school commuting choices. As described by McKoy et al., many school sitting choices do not align with local land use and transportation plans, choosing sites far from existing housing, which helps promotes more rapid, and often low-density, development of land [7].

In the next sections of this paper case specific interventions in Attica region (the wider periphery of Athens) are presented in order to support active school commuting and overcome the above described hostile environments.

C. A short review on intervention attributes in 10 Greek cases

School mobility management as stated above calls for specific interventions and policy implementations, which can be categorized under three general classes;

- Local interventions in the street network and public spaces around school facilities, which are mostly low to medium cost projects such as the redevelopment of intersections, traffic calming infrastructure (i.e. traffic bumps), street lighting, special pedestrian traffic lights et cetera.
- Neighbourhood scale interventions in traffic regulations, such as the development of traffic loops, inner ring roads, one-way road conversions etc.
- Active school commuting awareness policy implementations, such as coordinated campaigns, classes, workshops and others in order to convince the children and their parents to use means alternative to cars for their daily travels.

The cases presented in this section focus on the first of the afore-mentioned categories as the latter two are subject to general sustainable mobility implementations, which are analysed later on the paper. All cases are in Attica Prefecture, the densest prefecture of Greece which includes the Municipality of Athens, and some have been developed by the authors' research group (cases C1 to C6) while others were precedents in our studies initially conducted by individual engineers and local authorities (C7 to C10).

C1. Moraiti School, Agiou Dimitriou Street, Municipality of Filothei- Psihiko

Moraiti School is a prime private school, attracting students from all over the city of Athens who mostly approach the school with a school bus or by private cars. For safety reasons, especially for the students living in the close vicinity of the school, the adjacent streets have been redeveloped to serve safe walking and cycling. Agiou Dimitriou Str., a two-lane one way secondary artery passing in front of the school (figures 6, 7 and 8) have been transformed into a more inclusive street after the removal of one traffic lane. The remaining space was devoted to a new bike lane and the rest was utilized for the expansion of the existing sidewalks. Road intersections were marked with different colours and materials, while also the pavement was elevated to align with the sidewalk and function also as speed bumps.

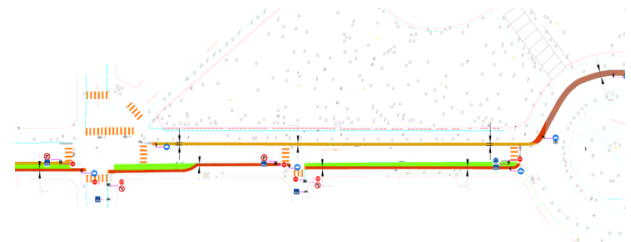


Figure 6: Street plan of Agiou Dimitriou Str. in front of Moraitis School

Source: Personal Archive

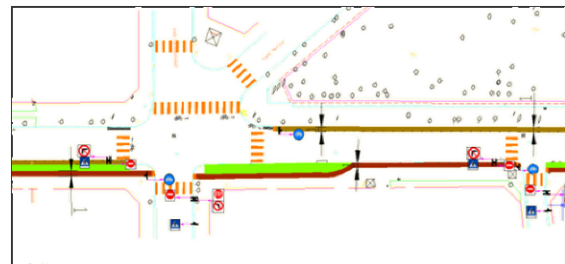


Figure 7: The redeveloped intersection in front of Moraitis school

Source: Personal Archive



Figure 8: Current street view of the regenerated intersection

Source: Google Street View © 2015 Google, Image Capture: Sep 2014, Ag. Dimitriou, Psychiko, Attica
<https://www.google.gr/maps/@38.010988,23.775225,3a,75y,70.72h,80.6t/data=!3m4!1e1!3m2!1sUBgbO2sQrV9bJS9IcnM6YQ!2e0?hl=en>

C2. 4th Primary School, Arakdiou Street, Municipality of Elefsina

The 4th primary school of Elefsina lies at a congested neighbourhood previously downgraded due to the extended presence of cars and motorcycles.

As part of the wider area regeneration, Arkadiou str. and Ippokratous str. have been redeveloped to promote walking and cycling (figures 9, 10, 11). Projects included the connection of the school with the bicycle network, the upgrade of local intersections and a pedestrianization scheme at Ippokratous str.



Figure 9: Street plan of Arkadiou Street in Elefsina

Source: Personal Archive

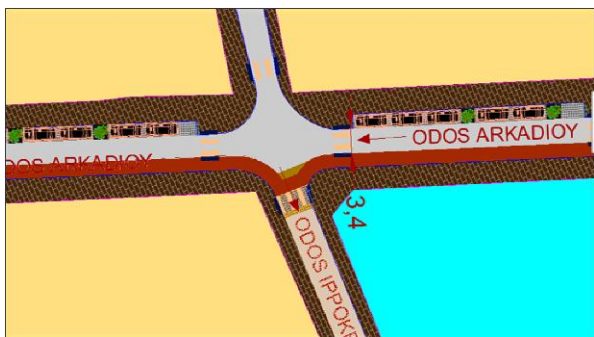


Figure 10: Arkadiou and Ippokratous str. intersection showing the crossroad application

Source: Personal Archive

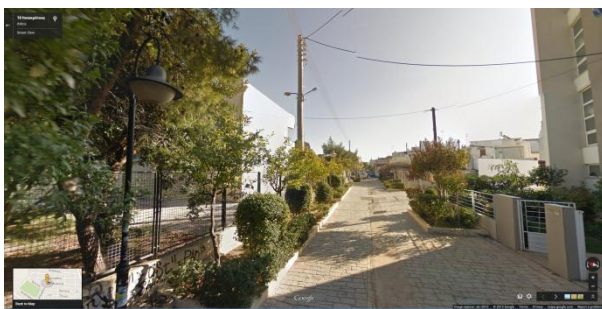


Figure 11: Street view of the pedestrianized Ippokratous str. (primary school on the right)

Source: Google Street View © 2015 Google, Google Street View © 2015 Google, Image Capture: Jan 2012, Ippokratous, Elefsina, Attica
<https://www.google.gr/maps/@38.052872,23.530625,3a,75y,75.3h,93.58t/data=!3m4!1e1!3m2!1s15LGokx-TMxoFLj1UvPGqw!2e0?hl=en>

C3.Day Care Nursery School, Papandreou Street, Municipality of Nea Erithrea

The Day Care Nursery is located at the intersection of Fleming and Papandreou Street in the suburb of Nea Erithrea, in Northern Attica.

The regeneration plan of Papandreou street (figures 12,13 and 14) included the complete transformation of the previous street form, as one traffic lane was dedicated to cyclists and pedestrians, intersections were upgraded, parking was completely rearranged and materials have completely altered the previous streetscape. The approach to school is conducted through Fleming Street and places of temporary parking are provided to assist the children's access.



Figure 12: Street plan of Papandreou Str. in Nea Erithrea

Source: Personal Archive

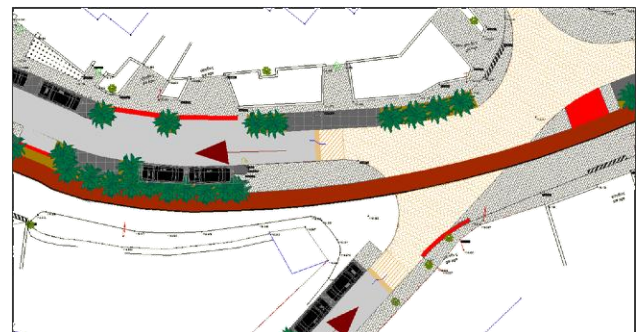


Figure 13: Papandreou and Fleming Str. regenerated intersection

Source: Personal Archive



Figure 14: Street view of Papandreou and Fleming Str. intersection (nursery school is on the left)

Source: Google Street View © 2015 Google, Image Capture: Sep 2014, Georg. Papandreou, Nea Erythraia, Attica
<https://www.google.gr/maps/@38.090578,23.822123,3a,75y,80.37h,101.41t/data=!3m4!1e1!3m2!1sNrmNnjVV6ddScARtwJ4aAA!2e0?hl=en>

C4. 2nd High School of Agios Ioannis Rentis, Fleming Street.

Interventions in the surroundings of the 2nd High School at Fleming Street were part of an overall regeneration plan in the neighbourhood and the particular roadworks in the tangent streets followed the afore mentioned patterns.



Figure 15: Street view of Fleming street in front of the 2nd High School

Source: Google Street View © 2015 Google, Image Capture: Jul 2014, Leaf. Fleming, Ag. I. Rentis, Attica
<https://www.google.gr/maps/@37.958629,23.671537,3a,75y,243.63h,91.42t/data=!3m4!1e1!3m2!1sa9WOWIXn3tLXiStPwI9LmQ!2e0?hl=en>

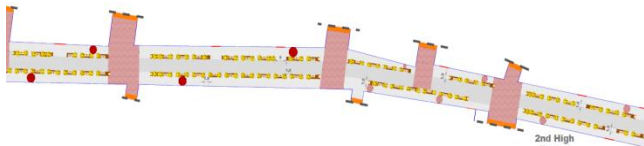


Figure 16: Street plan of the regenerated Fleming street

Source: Personal Archive

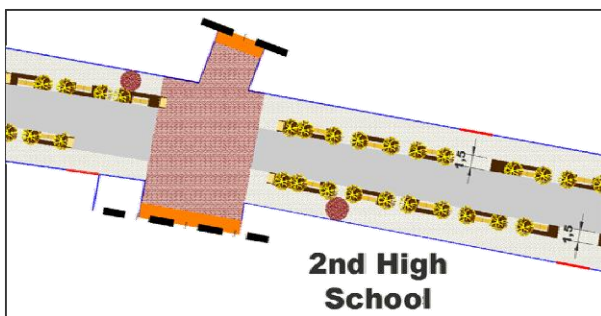


Figure 17: Street plan of the intersection at Fleming str. and the pedestrian access to school

Source: Personal Archive

C5. Primary School at Eleftherias Square

In the case of the primary school of Nea Ionia proposals included the pedestrianization of the adjacent street (Eleftherias street) as shown in figures 18 and 19 and its connection with regeneration elements to the neighbourhoods' central square.

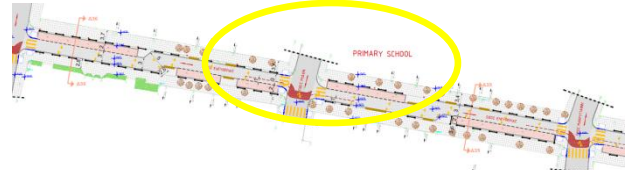


Figure 18: Street plan of Eleftherias street

Source: Personal Archive



Figure 19: Street plan of Eleftherias and Rodon streets including the primary school

Source: Personal Archive

C6. Primary and High School at Othonos Street in Municipality of Kifissia

An integrated plan was implemented in the territory of the largest School Building Complex in Kifissia, located at Othonos street, which includes the main primary and high school of the municipality. Interventions included traffic calming elements, road diet techniques, bright colouring of street elements, permanent and temporary parking spaces, installation of dense bollards, pedestrian friendly intersections as well as the enhancement of an existing bus station for the better service of students and teachers travelling to and from Kifissia city centre.



Figure 20: Street view of Othonos street in front of the school complex

Source: Google Street View © 2015 Google, Image Capture: Sep 2014, Othonos, Kifisia, Attica

<https://www.google.gr/maps/@38.076064,23.798565,3a,75y,314.18h,79.29t/data=!3m4!1e1!3m2!1s-ogiJHp92QoNGlOD3J1iWQ!2e0?hl=en>

C7. High School at Makedonias street in Vrilissia Municipality

The regeneration plans at Makedonias street (figure 21) have largely promoted school commuting by bike, as a two way bicycle lane is passing in front of the high school of Vrilissia connecting it with the closest metro station and other main facilities in the wider neighbourhood and as well as the nearby municipalities. Moreover, the case of the redevelopment of Makedonias street is a prime example of enhancing active school mobility as it combines better access to public transportation, both for bus and metro network, while it offers the potential of combined transportation alternatives (bicycle and metro, bicycle and bus, walking and metro, walking and bus).



Figure 21: Street view of Makedonias street in front of the school entrance

Source: Google Street View © 2015 Google, Image Capture: Aug 2014, Makedonias, Vrilissia, Attica

<https://www.google.gr/maps/@38.033597,23.836623,3a,75y,210.78h,89.44t/data=!3m4!1e1!3m2!1srgDLmkzPaReny4f0lbgXWg!2e0?hl=en>

C8. Primary School at Seferi street in Neo Psychiko

An ideal precedent for our research was found at Seferi street in the Municipality of Filothei- Psychiko. In this case the school is located at a focal place of the neighbourhood serving proportionately the nearby residents and lays at a traffic calmed street where all road users can access the school in balance. Cars are forced to follow an S type route in slow speeds and parking places are limited. Special attention was also given in the allocation of traffic signs informing for students mobility (figure 22).



Figure 22: Street view of Seferi street in front of the primary school

Source: Google Street View © 2015 Google, Image Capture: Sep 2014, Georg. Seferi, Neo Psychiko, Attica,

https://www.google.gr/maps/@38.003937,23.779092,3a,75y,229.75h,84.22t/data=!3m4!1e1!3m2!1sRkPotiYzollsvHj_B7frYw!2e0?hl=en

C9. Primary School at Perikleous Avenue in Cholongos Municipality

The major issues tackled in the case of the primary school at Perikleous Avenue were related to the increased traffic congestion in front of the school unit. Perikleous Avenue is a main artery surpassing the key neighbourhoods in the Municipality of Cholongos, concentrating a number of land uses. In order to separate the street environment from the school and increase safe access, sidewalks are enlarged and isolated from the streets with greenery, while traffic islands are located in the middle of the street to act as refuge islands for pedestrians crossing the road.



Figure 23: Street view at Perikleous Avenue in front of the primary school

Source: Google Street View © 2015 Google, Image Capture: Dec 2014, Perikleous, Cholongos, Attica
https://www.google.gr/maps/@37.998276,23.799594,3a,75y,122.46h,97.25t/data=!3m4!1e1!3m2!1sIT16-IXds6wAYiiBW_2KTw!2e0?hl=en

C10. Primary School at Achilleos street in Paleo Faliro

The last explored case deals with the primary school at Achilleos Street in Paleo Faliro region in south Attica. The particular element that made this case worth examining is related to the tram route that passes in front of the school exposing students to higher risks compared to other school units' locations. Protective railings are located in the perimeter of the school in order to isolate the tram lines from the sidewalks (figure 24) and speed bumps together with special signalling are warning drivers for the students' presence.

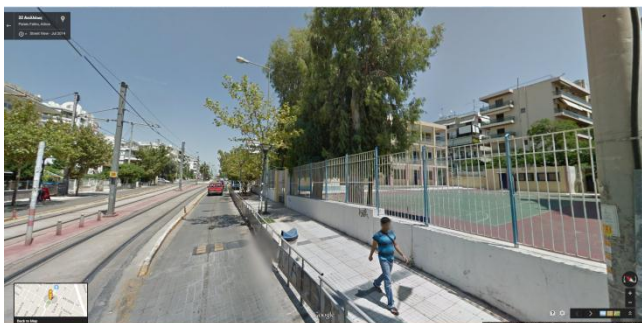


Figure 24: Street view of Achilleos street in front of the primary school

Source: Google Street View © 2015 Google, Image Capture: Jul 2014, Achilleos, Paleo Faliro, Attica
<https://www.google.gr/maps/@37.924233,23.701259,3a,75y,52.66h,95.36t/data=!3m4!1e1!3m2!1sJOBdXKlAUKW6cNFq2sTgmQ!2e0?hl=en>

D. Enhancement of school mobility management: Strategies, Policies and Measures.

D1. Enhancement of walking, cycling and public transportation

Researchers in transportation, urban design, and city planning have long understood that neighbourhood design and the way land is developed affects travel behaviour ([8], [9] in [10]). Active school commuting is based on the efficiency of the provided infrastructure in a neighbourhood, the terrain, the overall environmental conditions of an area and the daily habits of a community. Promoting walking and cycling means making the environment of a place more safe, communicative, readable and attractive, which can only be implemented if car circulation is substantially reduced.

Greek cities have to make multiple steps to creating the proper environment especially for school zones. Increasing awareness for walking and cycling benefits along with informing drivers for the needed respect for vulnerable road users are ranked first in the priorities of active school commuting.

Among the main benefits of walking, that need to be highlighted for enhancing awareness, are the facts that it is a mode available to almost everyone, easy to be combined with other means of transportation. Moreover, it is a kind of a free physical and daily exercise which improves public health and social behaviour as argued and proven by numerous researchers since the '80s ([10], [11] and many more). Regarding cycling, awareness should be based on the fact that it is one of the cheapest and cleanest means of transportation which allows flexibility and occupies limited space compared to any other vehicles. In the same direction, the role of public transportation should be upgraded and act complementary to walking and cycling for school commuting.

The key policies and measures to be implemented in order to improve school mobility include low and medium cost infrastructures as well as the establishment of an overall strategy that would downgrade the car-centric model in the territory of urban neighbourhoods.

The main traffic measures are grouped into four (4) general categories, according to literature by the Urban Design Collaborative [12], Cooner [13], the Pedestrian and Bicycle Information Center [14] and Tsipra [2].

1. Traffic measures, including car pooling, temporary parking place implementations, local parking prohibitions, organized departures and arrivals from and to school, school zone markings, school traffic wardens etc.
2. Speed reducing measures which can vary accordingly among signs and labels, traffic calming attributes, 30km/h zones, street furniture, pedestrianizations and constant monitoring of travel speeds and policy obedience
3. Special implementation measures in intersections, such as synchronized traffic lights, counting traffic lights, traffic dividers, auxiliary lanes, special horizontal colouring, ensuring visibility of pedestrians, drivers and cyclists by proper alignment of labels and greenery etc.
4. General educational measures and policies for students including the introduction of walking buses, the development and distribution of safety route maps etc.

The measures and infrastructure proven to enhance school mobility in the developed countries, falling into category 2 and 3 (above), include traffic calmed streets, woonerf zones, protected bicycle and pedestrian networks, integrated street furniture and informing street signs. At the street level, infrastructure and policy improvements should tackle both car speeds and traffic volumes while at the same time increase public green spaces in linear and spotted concentrations [15].

Speed control, according to the Fehr and Peers and the Project for Public Spaces (PPS) can be achieved through; speed humps, speed tables, raised crosswalks, raised intersections, textured pavements, traffic circles, roundabouts, chicanes, re-aligned intersections, neckdowns, center-island narrowings and chockers. Volume control can be implemented through median barriers, diagonal diverters, half and full street closures.

Examples of such measures and combinations of actions with specific policies have been studied in depth and proposed in various authorities by the group of authors and other colleagues regarding school zones in the town of Drosia near the city of Halkida (figures 24), in the city of Katerini (figures 25) and Mandra (figures 26).



Figure 25: Proposals in Drosia included the replace of asphalt pavement with cobbles, the enlargement of sidewalks, redevelopment of intersections into raised crosswalks, development of light chicanes and chockers and the enrichment of the street greenery.

Source: Personal Archive

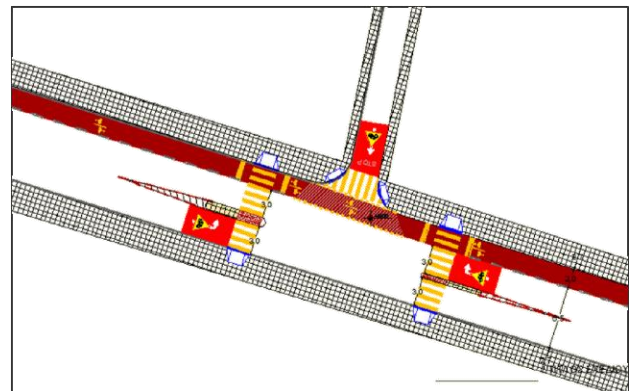


Figure 26: Proposals in the adjacent street to the Primary School of Katerini included the enlargement of sidewalks and establishment of a two-way bicycle lane in the same level as the sidewalk, the development of small median islands to act as refuge places, horizontal signs in speed humps in front of the school entrance, extra protective signaling etc.

Source: Personal Archive

More recent approaches in urban design suggest the development of shared spaces, which according to Hamilton-Baillie [16] are the default mode of streets before the separation of vehicles and pedestrians became the accepted approach to designing public spaces.

In other words, shared spaces are streets 5-12 meters wide without markings and barriers, without actual separation among their users designed to integrate users, which however have been widely criticized for children's safety and are applied in limited school zones, such as in neighbourhoods of Brittany in France and in the Italian medieval cities like Sienna and Verona.

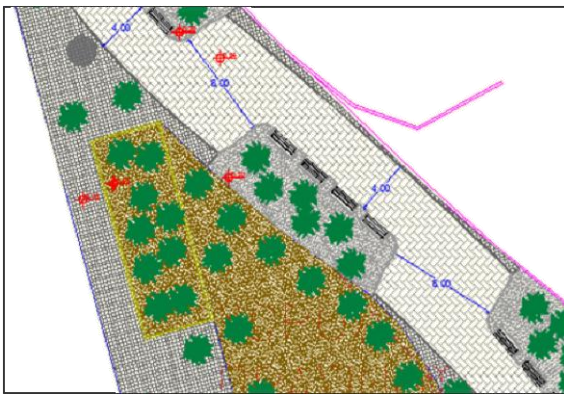


Figure 27: In Mandra, the proposal included the transformation of a dirt roadpassing in front of the High School, into a green and walking friendly shared space, paved with cobbles.

Source: Personal Archive

One of the most successful policies implemented in street networks around school units is the conversion of two-way arterial roads into redeveloped one-ways, incorporated in a network system of converging and diverging one-ways, which discourage through traffic and propose a different approach in street hierarchy.

Indicative street sections shown below, present optimal distribution and service of activities and transportation means for schools located in arterial roads with 18-22meters width (figure 28) and local streets with 8-10 meters width (figure 29). The coexistence of pedestrians, cyclists and greenery add on the viability and safety of the street while also decreases the free and uncontrolled car movements, gives space to vulnerable users, organizes the parking places and reduces traffic speed.



Figure 28: Proposed street alignment for arterial streets passing by educational units in the area of Chalandri in Athens

Source: Personal Archive

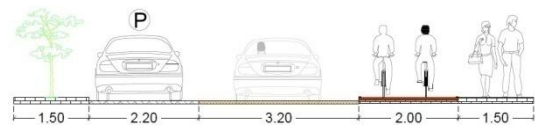


Figure 29: Proposed street alignment for local streets passing by educational units in the city of Katerini

Source: Personal Archive

D2. Enhancing awareness for active school commuting

City's residents, and especially parents and children, should understand and appropriate the benefits of sustainable means of transport. In order to ensure the effectiveness of the afore-mentioned policies and measures, people's attitude should be educated accordingly. Although various schools have included 'Road safety education' classes in their curricula, there is a lot more potential ways to inform and engage the public in such transformation. Communicating the benefits of active school mobility can be conducted in two separate levels, as it regards different, however supplementary audiences, namely the children and their parents.

At first, children should be informed about the benefits of active commuting and soft means of transport at an early age through the typical classes (i.e. Road Traffic Education) and through alternative educational procedures (i.e. games, simulation workshops, events, etc.). Road traffic education is the first step towards learning and understanding the traffic regulations, risk factor impacts as well as the post-accident management.



Figure 30: Children in Road Traffic Education

Source: http://teleytaiothranio.blogspot.gr/2010/12/blog-post_7036.html

Children's awareness can immediately influence their parents' behaviour, especially if combined with parallel actions in educating them. Issues that should be regarded in parents' introduction in sustainable school mobility include the social, environmental and economic benefits of a different commuting behaviour, and most importantly the negatives deriving from the current travel behaviour in terms of accidents, pollution, and many more. Involving the parents and the general public in such learning procedures is mostly completed through typical participatory schemes, such as workshops, charettes and public events, where the experts' presentations should focus on both good practices of sustainable mobility and its implications as well as on the outcomes of their continuing car-dependent habits. Statistics on road accidents and instances of children fatalities can alert the disbelievers of the urgent need for a shift to sustainable mobility.

Renowned ways of enhancing awareness include:

- Television spots and social media campaigns
- Books and articles on the press
- Workshops, interactive seminars and targeted charrettes
- Other campaigns, such as cycling tours, and events on public places (malls, playgrounds, parks etc.)

A good example on adults' and children's awareness on sustainable mobility was BAMBINI Intelligent Energy System project- Move SMART from the start [17], where 10 countries (Slovenia, Belgium, Netherlands, Poland, Romania, Italy, Bulgaria, Germany, Greece and France) participated and developed targeted innovative games and books on alternative means of transport, promoted sustainability in school commuting, proposed the redevelopment of home zones into traffic calmed neighbourhoods for children, and organized many awareness programs for children's transportation. Good practice guides on developing friendly home zones and organizing awareness events have also been developed through the Bambini project. The participant cities had implemented numerous temporary road closures (i.e. in Bois-le-Roi, France, in Plovdiv, Bulgaria etc.) as well as organized mentoring workshops to communicate their objectives. During these events children were also introduced to alternative modes, such the pedibike, the patini and others.

Other similar awareness programs were created by RACV [18] in the city of Victoria in Australia, the British Road Safety Department in the UK, the European Transport Safety Council (ETSC) and many more. RAVC focused on designing programs for children of all ages [18].

They created the Street Scene Program, which dealt with passenger safety, pedestrian safety and bike safety. In this program, students explored road safety issues and created road safety advertisements to tackle those issues. Moreover they organized the implementation of an energy breakthrough event, which was designed to provide opportunities for students, teachers, parents and the local industry to work together in order to design and construct a vehicle, a machine or an innovation in technology that will represent an energy breakthrough. The Automobile and Touring Association of Greece collaborated closely with the British Road safety Department and developed programs to inform schools, teachers and parents on road accidents near schools, and promoted the enhancement of road safety through school traffic wardens, school buses, and guides on road traffic education [19]. The guide entitled Teaching Children Road Safety was separated in 4 parts depending on the children's age, 1-4years old named "Protect your child", 5-6year old named "Teach your child", 7-9 year old named "Crossing an intersection, with no traffic lights" and for 10-15year old named "Teach your children to think for themselves". Moreover, the European Transport Safety Council [20] in many of their document releases since 2009, realizing the increases in total numbers of young people road deaths, is suggesting stricter punishments for violations on traffic rules for reducing road deaths among young people.

Lastly, a quite recent awareness program created by the New York City's mayor implemented in the early 2014 was the campaign "Vision Zero". This has set new rules on streets, such as reducing speed limits around school zones, suspending taxi drivers' licenses when causing a death on a serious injury, while also has included in the authorized crimes' list the injuring of a biker or a pedestrian [21]. The same campaign has attempted to urge also the local authorities to maintain traffic lights, signs and all traffic signaling equipment as well as to renew the older elements with to up-to-date material.

II. CONCLUSIONS

This paper has discussed the issues of neighbourhood planning and school location as well as the importance of traffic conditions in reaching educational facilities. Schools, as public infrastructures, are key determinants of the neighbourhood's quality and the overall regional growth. The streetscape in school surroundings is considered a priority place, linked with safety, accessibility, communication and comfort. Many countries transform such places aiming to simulate the street safety and attractiveness to the environment of the school yard.

Exploring the Greek reality, led to the identification of the numerous deficiencies regarding school planning distribution and the downgraded street environment. The lack of a concise strategy for school integration in neighbourhood planning has inherited abstract solutions and thoughtless redevelopment plans. Recognizing the need for general transformations in the Greek urban environment, we have focused on the first priority alterations which regard vulnerable areas around school zone, as an important share in daily travels refers to short distances for school commuting. A number of factors affecting school mobility has been explored, varying from strategic urban planning, determination of land uses, land availability, school allocation criteria - in terms of population density and principles of planning standards-, and traffic attributes. In order to decrease the identified elements of inadequate planning and limited safe accessibility to school zones, proposals aimed at targeted zones in the street network adjacent to schools as well as policies at the larger scale (neighbourhood level). The specific proposals for traffic calming implementations refer mostly to the enhancement of the street geometric alignment, while the exploration of enhancing awareness policies discusses the alteration of mobility habits in the contemporary family. A small number of integration practices is presented in some Athenian school areas, with some of them being the local precedents in our future research. In general it can be said that proposals seem innovative for the Greek planning discourse, even if they are considered common sense for the North- European cities and other developed countries. Lastly, the focus on awareness enhancing policies is briefly mentioned as a crucial part for the effectiveness of every individual measure.

School mobility represents probably on the most crucial targets for future smart and compact cities, as it is related to the decrease of accidents, air and noise pollution and the upgrade of the city's environment of vulnerable road users. Apart from the aesthetic upgrade, diversity in the street can ease its bioclimatic functions while increasing the liveability of the place. Critical infrastructures that should be emphasized through different colours and materials in the wider territory are; pedestrian and cyclists' intersections, speed bumps, street sections in front of school facilities, public transport stops, parking places and the surrounding junctions among others. Clear separation of the different uses along with general comprehensive traffic policies can mitigate the congested areas and introduce the potential for walking and cycling with safety to and from the educational units.

These can upgrade the totality of the territory where school facilities are located and act as regenerated nodes in a city, with all the typical benefits that these commonly attract, such social and economic development as well as environmental and aesthetic upgrade.

Concluding, there is no Greek formal policy apparatus to deal with issues of school allocation and school mobility management so far, except from the general guidelines given in strategic regional and city planning. Therefore, the objectives of further research on issues of school mobility in the Greek urban planning and transportation should focus on the coordination of multidisciplinary approaches such as land uses, housing policies, transit oriented development etc. A comprehensive strategy in school mobility should have policies at the national and local level and engage a large number of the public in order to present long-term advantages.

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International Journal of Emerging Technology and Advanced Engineering

Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 5, Issue 6, June 2015)

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