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RESEARCH ON THE DEVELOPMENT POTENTIAL OF CYCLING ROUTES CONNECTING GREEN OPEN SPACES IN ATHENS

Efthimios Bakogiannis[*1], Maria Siti[2], Avgi Vassi[3], Georgia Christodoulopoulou[4] and Vasilios Eleftheriou[5]
[*1] Department of Geography and Regional Planning, National Technical University of Athens, GREECE.
*Correspondence Author: ebako@mail.ntua.gr

Keywords: Unification of green spaces, Athens, bicycle planning, green bikeways, bicycle access.

Abstract

Cycling is constantly gaining popularity in Europe both as a leisure activity and a viable transportation mode. Development of policies and infrastructure in Greece is following a rather inconsistent way, especially regarding the integration of cycling in existing open public spaces.

This paper presents a research, conducted from 2008 to 2010 in Athens, exploring the development potential of a dynamic cycling scheme which would connect existing large green parks, university campuses and other related uses.

The paper is structured in three parts. The first presents a comprehensive overview of cycling promotion policies and similar schemes in major European countries and cities, such as Denmark, United Kingdom, and Germany etc. The second part deals with particular infrastructure types and development attributes, and finally the third focuses on an Athens' case: the unification of Goudi Metropolitan Park with Police Academy Park, Polytechnic and University campuses.

The results and conclusions stress the key research facts and reveal the main limitations occurring by the complex ownership status and the licensing procedures.

Abbreviations:
UoA: University of Athens
NTUA: National Technical University of Athens

Introduction

In many cases where car is seen as the trouble, bicycle is the solution. It is healthy, safe, and faster than walking, cheap and friendly to other road users. Moreover, it adds on to the quality of a city and is easily accessible by almost everyone. Many cities in the world and even more in Europe, have chosen to integrate cycling as a viable transportation mode which, if combined with public transport and walking, provides the basis for sustainable mobility in urban centers. Furthermore, cities are enhancing their residents' relationship with the natural environment by developing recreational routes into urban parks for walking and in many cases for cycling. Athens has significantly delayed to incorporate cycling in its choices for transportation and recreation, however there are encouraging signs for future development. Despite the fact that Athens is densely built, there is a number of concentrated large green open spaces in the close vicinity of the historic centre. However these spaces remain scattered, as the presence of supra-local activities and the neighboring urban highways interrupt their cohesion. In this research, the approach is focused on the development of a linkage to relate those separated green spaces, despite the challenges of the topography, through an upgraded cycling route. This scheme will increase the popularity and significance of the places as well as motivate Athens to assess the importance of greenways and cycling planning in the urban environment.

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Aims and objectives

This paper aims to identify the development potential of a dynamic cycling scheme which would connect existing large green parks and university campuses in Athens, Greece. It examines all potential factors for the development of a leisure cycling network through urban parks in cities like Athens, by researching in depth similar European implementations in regard to planning principles, policy making and infrastructure attributes. The analysis is focused on the unification of greenways through cycling paths in accordance to existing facilities, geometrical characteristics, neighboring land uses, ownership status and utility networks. The objective of the final proposal is the detailed design of a green cycling network which would serve both leisure activities for visitors and Athenians and transportation needs of the students at the UOA and NTUA. In this last part, the focus will be on detailed dimensioning of proposed paths, suggested materials, nodes and links design, particular landscape solutions, signage and parking.

Cycling routes in open urban spaces around Europe and the USA: An exploration of planning principles, policies and cases

A brief overview of National Cycling Policies in selected countries

In most cities around the world bicycle planning and promotional campaigns are usually being carried out by local authorities, though there are some institutional processes in the national level, especially since 2004, when the European transportation ministers in Ljubljana signed a declaration pro national policies for bicycle promotion. This declaration set common targets and actions among the various ministries and government bodies, enhanced promotional activities in the political agenda and mainly aimed at encouraging and motivating local authorities to act in favour of cycling. Many countries worldwide have already shaped national planning principles and policies for bicycle integration in the urban environment, while others are making smaller or bigger increments in this direction.

The current research looked at five of them in depth, namely Denmark, Great Britain, the Netherlands, USA and Greece, in order to determine their main characteristics and transfer knowledge and experience to the proposed scheme. The selected countries differ in numerous ways regarding cycling integration, with Denmark and the Netherlands having the largest bicycle use share worldwide (EC Euro barometer, 2011), whereas Greece is acquiring one of the lower places in the list.

In the case of Denmark, energy crisis and environmental awareness have already turned the Danes into cycling since 1975, while in the beginning of the 1980s they demanded better traffic conditions for cyclists through demonstrations and managed to introduce the National Day for Cycling. Since now, Danish national cycling strategy consists of 3 main programmers (E.C.M.T., 2004);

- the Cycling into the 21st Century which includes policies for promoting cycling for better cities and healthier citizens, as well as measures for the increase of bicycle use and deterioration of car travels,
- The Promoting Safer Cycling- a Strategy which focus on specific actions for cycling promotion (development of green zones, traffic calming, increase of bicycle infrastructure, bicycle parking etc.),
- The Collection of cycle concepts which aims at the dissemination of knowledge to promote cycling into local authorities.

Moreover, Denmark has introduced the notion of the national cycle city (applied for Odense) and developed the national Bicycle Ideas Group.

Great Britain's government was also funding and implementing innovative promotion plans for cycling already since the 1980s, though in scattered and isolated ways, in cities like Nottingham, Cambridge and Stockton. In 1996, the National Cycling Strategy report was issued by the Department of Transport, in order to raise awareness of citizens and authorities and encourage the development of policies and infrastructures that would enhance cycling use. The report set a target for 2016; to quadruple travels with bicycle in the coming 20 years. Other actions, quite at the same time, included the issue of a national study called Cycle-friendly Infrastructure: Guidelines for

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Planning and Design, by the Institution of Highways and Transportation, the Bicycle Association & Cyclists Touring Club and the Bicycle association. Later on, in 1998, the White Paper was published by the English Department of Transport promoting further walking, cycling and public transport infrastructure. Since then and mostly after the '00s, Great Britain's government supports widely local mobility plans, which include a number of policies and practices to benefit cycling.

Regarding the Netherlands, the fact that 13 million of bicycles were in circulation in 2013, in a country with a population of 15,5 million, reveals practically the national vision pro cycling. Between 1990 and 1997, the Dutch government issued the national agenda under the name Dutch Bicycle Master Plan, and managed to complete 112 projects, which included 31 research programs and 41 pilot implementations aiming at the enhancement of infrastructure, improvement of safety issues, increase of bike parking facilities and the reduction of bike thefts. The Second Transport Structure Plan as implemented in the 1990s also aimed at the decrease of car usage by almost 50%. A particular element in the Dutch strategy was the involvement of local authorities in the initial configuration and further support of national policies, which conduced to the actual boost in cycling. The central government transferred a number of its powers to the local units, preserving though its responsibilities as a knowledge consultant, research and infrastructure financier as well as kept assessing and monitoring all the ongoing programs.

Regarding the U.S.A., national cycling policies have slowly emerged due to the realization of lack of funds and the fact that the extension of new road infrastructure was leading to further traffic jams. In the 1990s, the new legislation act Intermodal Surface Transportation Efficiency Act imposed the integration of bicycle planning in all local transportation plans, the financial support for public transport, walking and cycling infrastructure and obliged each state to appoint an expert in walking and cycling policies and plans. In the same decade, an influential new act, the Intermodal Equity Act for the 21st century defined bicycle as an equal transportation mode to cars and public transport, boosting its use in some of the states and attracting more funds.

Lastly, Greece has significantly delayed to introduce and implement a national agenda for cycling integration policies, however there is a number of initiatives generated by both ministries and researchers' groups. Most of the actions so far though, had scattered approaches and dealt with cycling as a viable alternative and by no means as an equal element in transportation choices. In 2001, the Ministry of Transportation and Communication assigned at the NTUA a research program for cycling integration in 17 Greek cities and dedicated specific amounts of funds for each of them, though only 4 of them have absorbed the given resources and built part of the proposed networks. Later on, in 2003 the Ministry of Internal Affairs encouraged local municipalities to promote cycling through a funding scheme, which unfortunately was impended due to obstructionism and lack of political will.

Indicative review of particular planning policies and implemented plans in European cities

As mentioned above, although the importance of national strategies for cycling is high, local authorities and municipal government bodies are those who implement most of the schemes and substantially drive integration attributes. The researchers looked in depth at a large number of cities in Europe, both the so called 'traditional' cycle cities and others with small bicycle share, regarding their performance in cycling promotion.

The table below (Figure 1) summarizes the findings in six of the studied cities.

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City	Population (2004)	Area (km^2)	Total Bicycle network length (km)	Cars per capita ratio (passenger cars/1000 people)	Trips by car (work related activities) (%)	Bicycle use (%)	Goals and Financing
Copenhagen	501.664	455	323	275	26%	34%	The latest plan for promoting cycling (2002 – 2012), had these goals: • Increase of bicycle use, for travels from and to work, up to 40% • Increase of safety and 50% reduction of accidents' possibility • 10% increase of bicycle traffic speed (>5km route length)
Odense	185.206	304	510	312	46%	26%	4-year project, containing 50 sub-projects. Total investment so far reaches 2.7 million Euros.
Strasburg	467.584	78	400	418	n/a	12%	The aim of the city is to reach 25% in daily bicycle use share.
Freiburg	213.998	153	135	340	61%	20%	Total investment so far reaches 13 million Euros.
Geneva	184.758	282	100	n/a	n/a	4%	Total investment so far reaches 4 million Euros.

Figure 1: Key attributes of the studied cities, regarding cycling promotion goals and results.
Source: Own construction

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In general, it was observed that;
Copenhagen has developed extended infrastructure, integrated at a clear and readable bicycle network. It also has ongoing projects upgrading the existing substructures and constantly applies new policies and plans pro cycling. City bike, a bike sharing scheme with free bikes well distributed at numerous focal points (125 stations) in the city, was one of the exceptional paradigms in the city, dating back to 1995. Moreover, intersection improvements works are constantly developing and researches on user's satisfaction are evolving. Information and awareness campaigns also increase the popularity of cycling and all its related activities and upcoming plans.
Freiburg has also invested a lot on cycling upgrade and has prioritized walking and cycling in its historic centre. It is considered one of the highly committed cities to sustainable mobility approaches and is steadily restricting car usage.
Geneva, although it is not considered to be a traditional cycle city, has managed to increase its daily bicycle use percentage from 2% to 4% in a 10-year period and supports further plans and campaigns which increase bike use by 0,5% each year.

Review on infrastructure types and development attributes

The types of cycling routes in green spaces, as developed internationally, vary depending on the surroundings (rural and/ or urban), the facilities they connect and the aims they serve. Greenways are attractive recreational routes for pedestrians and cyclists and are usually found in forests, near rivers, lakes, or even seashores, close to abandoned rail lines, inside urban parks, or close to pre-existing promenades. Some of the successful common practices are redeveloped linear connections, among existing green spaces aiming at the unification of open spaces around cities, which is the case of the current scheme in Athens. These cycling routes are either exclusive bike lanes or shared spaces (with pedestrians) integrated at leisure zones.

Their geometrical attributes, such as width, cross-slope/ inclination, curve radius as well as the surface materials, derive from specific regulations as defined by each country, with most of them sharing the key attributes. The fact that the typical regulations of most countries refer only to cycling paths incorporated to the street environment, allows the planner a level of freedom in designing paths inside urban parks, however some indicative features are usually followed.

In this part, a quick overview of the main regulations is presented, with a differentiation for cycle lane width prerequisites in Belgium, Great Britain, France and Germany. The key planning principles are to be followed in the case of the Athenian green cycling route.

Cycle lane width

In Belgium the minimum width- for exclusive lanes- is 1.2meters if there is no on-street parking, which is increased at 1.75m for parallel delineation with car parking. For recommended cycle lanes- but not exclusive (marked with white dashed lines), the minimum is 1.3m (when there is parking), and 1m when there is not.

In Great Britain the minimum width for one-way lane is set to be 1.5m while regulations suggest 2m, and for two-way lanes the minimum is set at 3 meters.

France sets the width range for an exclusive one- way lane at 1.2 to 2.5 meters, while considers as ideal 1.7 meters. When it comes to recommended lanes the width can be between 0.75 and 1.2m. Lately in Paris one way bike lanes have to be 1.5-1.8 meters wide and two-ways must be at least 2.5m.

Lastly, in Germany one-way bike lanes can be between 1.5 and 1.85m.

Cycle lane cross- section

The suggested cross-sections are always set in accordance to the length of upslope, the local wind conditions, and the potential

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momentum developed by the cyclist. Moreover, at the beginning of the cross-slope, there cannot be any intersections with traffic lights or intersections where other traffic streams are prioritized. And similarly for road sections with declivity. The maximum slope for urban cycle lanes is defined at 6%. Figure 2 below shows the eligible inclines according to specific cycle lane lengths and Figure 3 estimates the width increases to be planned in the indicative inclined section.

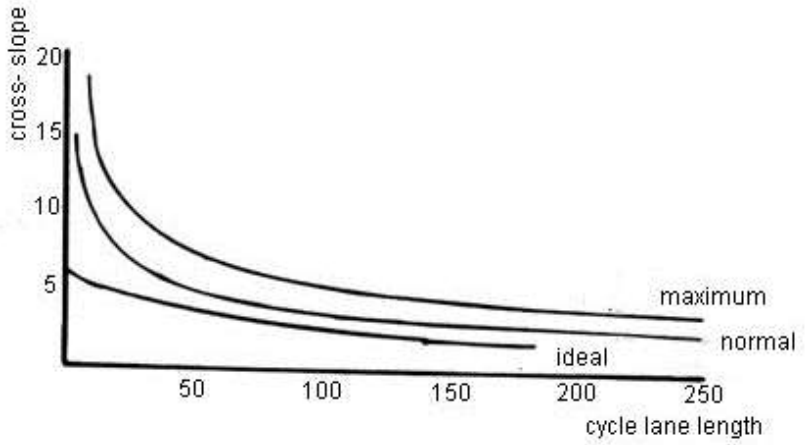

Figure 2: Eligible inclines according to specific cycle lane lengths.
Source: Vlastos & Birbili, 1999

Figure 3: Width increase according to the length of inclined section
Source: Vlastos& Birbili, 1999

Length of cross slope section (meters)			
Incline (%)	25-75m	75-150	150-
>3 & <6	-	20 cm	30 cm
>6 & <9	20 cm	30 cm	40 cm
>9	30cm	40 cm	50 cm

Curve radius
In urban areas:
Cycle fast lanes (with a 30km/h speed limit): R > 20m
Secondary cycle lanes (with a 25km/h speed limit): R > 15m
Cycle paths (with a 20 km/h speed limit): R>10m
In rural areas:
Cycle lanes (with a 30 km/h speed limit): R>20m

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It should be noted here that there is a number of cases where turns are designed with smaller curve radius in order to reduce the cyclist's speed, with the minimum radius being 4 meters.

Infrastructure principles and observations

According to Vlastos & Birbili (1999), the surface level of the new infrastructure, in both cycle corridors and lanes, should be at least 7.5cm above traffic level for flooding purposes. Indicative cross sections of cycle lanes at figures 4 and 5 depict some of the alternative configurations with cobbles or cast cement materials.

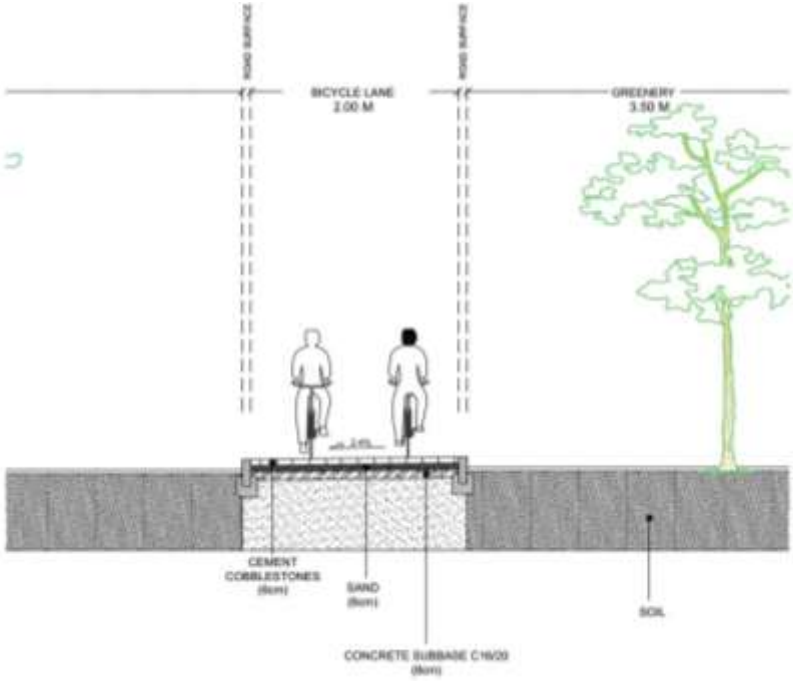

Figure 4: Cycle lane cross section with cobble stones
Source: Own construction

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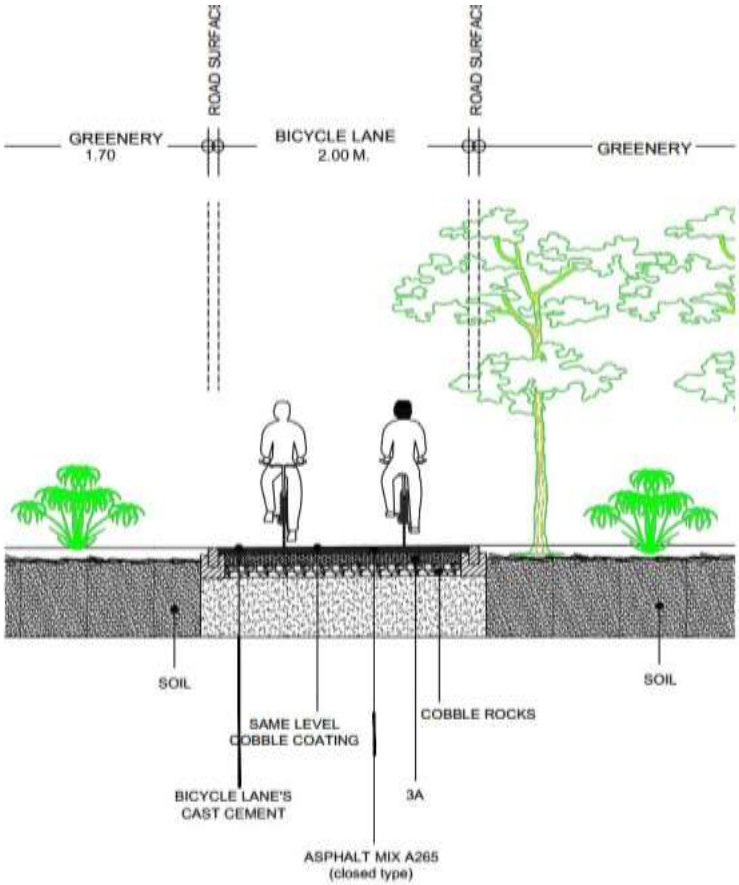

Figure 5: Cycle lane cross section with cast cement
Source: Own construction

Colors, materials and signage also play an important role, as they define different functions and ensure a higher level of safety. The usual materials for cycle lanes should be smooth, porous and reflective, while in new schemes a lot of attention is paid on recyclable materials. Materials vary from typical asphalt mix to concrete cement, resin mix materials, cobble stones et cetera and are chosen according to the regeneration aims, funding, weather conditions and other factors. Also, the systematic maintenance and renewal of pavements for both pedestrians and cyclists is an important matter of safety.

Clear, readable and frequent signage is crucial for safety and should include both traffic signs/ labels (figure 6) and horizontal colored stripping in order to notify all road users. The height of traffic signs is usually between 1 and 1.5meters.

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Figure 6: Bicycle traffic signs
Source: Own construction

The proposed scheme: Study area identification and analysis

Identification and analysis

An in depth analysis was conducted, prior to the proposal, in the study area regarding previous studies, existing land uses and facilities, focal service nodes, walking and cycling paths, transportation choices, ownership status and a number of other parameters. The study area concentrates various supra-local services and includes large areas of open green spaces, which however remain scattered and underused for recreational purposes.

Location, accessibility and attraction nodes

The area stands in the eastern part of the Athenian basin and is surrounded by Mesogeion Ave., Katehaki Ave., Ymitou ring road, and Karamolegkou Street. The neighboring municipalities are Vyronas, Kaisariani, Papagou and Athens. Figure 7 depicts the key attributes of the area.

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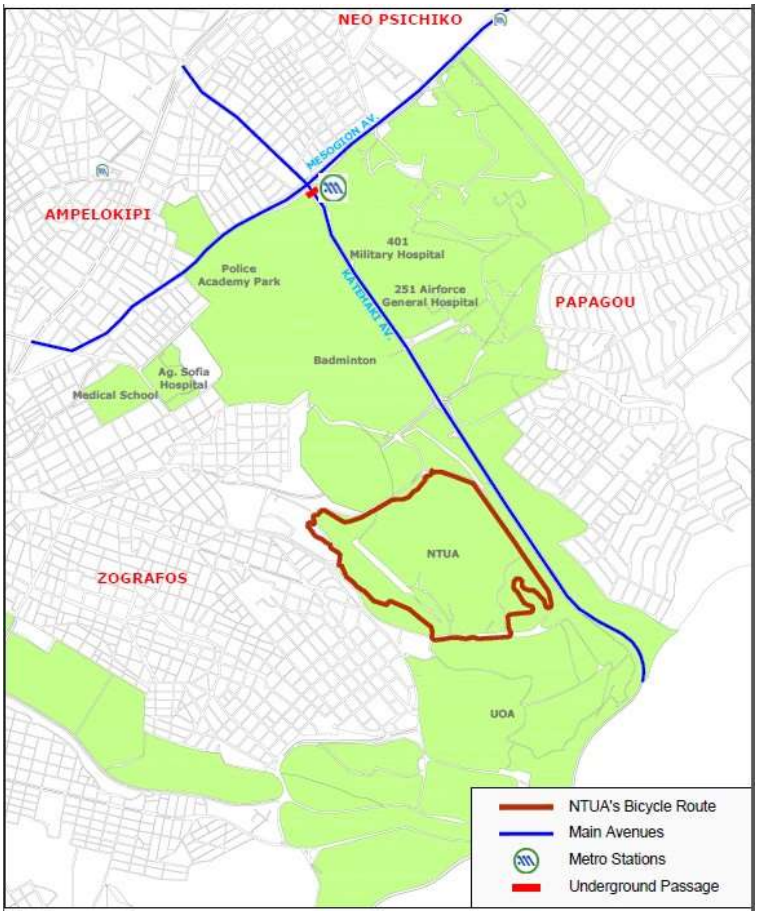

Figure 7: study area
Source: Own construction

The area is highly accessible through metro stations (Katehaki, Megaro Mousikis, Evangelismos) and numerous bus lines. However, the presence of cars is intense and this is mostly due to the area's increased accessibility through the neighboring urban highways.
It embraces the two larger university campuses of Athens (University of Athens-UoA and National Technical University of Athens-NTUA), the Police Academy Park and Badminton facility, which is now turned into one of the most important music and sports arena. It also stands nearby essential services such as hospitals (civil and military), the Medical School, military camps, special police centres, municipal farmsteads etc.
The area presents a number of advantages regarding its potential for cycling promotion, as it is close to the Athenian city centre and is still full of green, has adequate transportation features, diverse landscapes and interesting cityscapes. Indeed, a number of issues arise

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when it comes to activities that are fenced and inaccessible and others that operate only during the day, both of which create a sense of insecurity and solitude.
Moreover, each of the afore-mentioned activities drive a number of travels.
Goudi park, which includes the Police Academy park, the Stratou grove, Zografou Park as well as many of the Olympic facilities (badminton arena, riding centre, swimming centre), attracts residents from Zografou, Goudi as well as employees of the neighboring facilities. Other Athenians do also visit the facilities in weekends and holidays.
The two university campuses (NTUA and UoA) contain the educational departments, student's dormitories, rectors and management buildings, libraries, sports facilities and others, and attract almost 13.000 people per weekday.

Existing land uses

The detailed study of the existing land uses in Goudi Park is depicted on the map below.

Figure 8: Existing land uses
Source: Own construction

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Ownership status

One of the most important issues while conducting this study was the identification of the ownership status in the delineation zones of the preliminary cycle lane configuration. The institutional bodies and stakeholders involved in owning and managing the area are listed below;

Municipality of Athens
Municipality of Zografou
Municipality of Papagou
Olympic Properties
NTUA
UoA
Ministry of Public Order and Civic Protection
Ministry of National Defense
Ministry of Communication and Mass Media

Obviously, the status is extremely complex and has a long history of concessions. According to studies, the wider study area has 53 different stakeholders and the planning regulations vary in many ways. Statutory and implemented boundaries often differ, developing further conflicts, while also some of the plots abide in controversial legislation. Furthermore, the high presence of natural elements and upgraded landscape have led to additional protective legislation context. The different ownerships are usually separated through walls, railings, fences and other structures (figure 9) as they facilitate vulnerable uses, which is preventing further the unification of the spaces. Throughout the preliminary study of the proposed cycling route, the research team identified two of the key ambiguous land zones (blue signs at figure 13) in terms of ownership complications, with one being the transition zone between the NTUA and UoA campus and the other being the linkage of Goudi Park to Katehaki metro station through the Police Academy and Greek state broadcaster (ERT).

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Figure 9: Different ownerships and structural obstacles.
Source: Own construction

Previous studies

It should be noted here that the Organization for Strategic Planning in Athens is promoting the strategy of Green Spaces Unification focusing on the whole Athenian conurbation for years, though with contentious results.

Previous studies have focused on the enhancement of the wider Metropolitan Goudi Park, with one of the most important being the research by the Urban Environment Lab of NTUA since 2006. This study was dealing with the planning of Goudi Metropolitan Park - an area of 4.500 acres, which would integrate the pre-existing activities (education, administration, health care and sports facilities) with new uses for culture, sports and recreation. The U.E.Lab had proposed the determination of two distinctive development zones (figure 10);

- the central zone (1.450 acres) which would be the main regenerated public space for recreation with cultural uses in the existing listed buildings and other facilities, supported by walking and cycling routes
- and the secondary development zone, expanding in an area of 2.400 acres, which would incorporate the educational facilities, health care and other administration bodies that are located within its boundaries, in a unified scheme of conservation, protection and enhancement.

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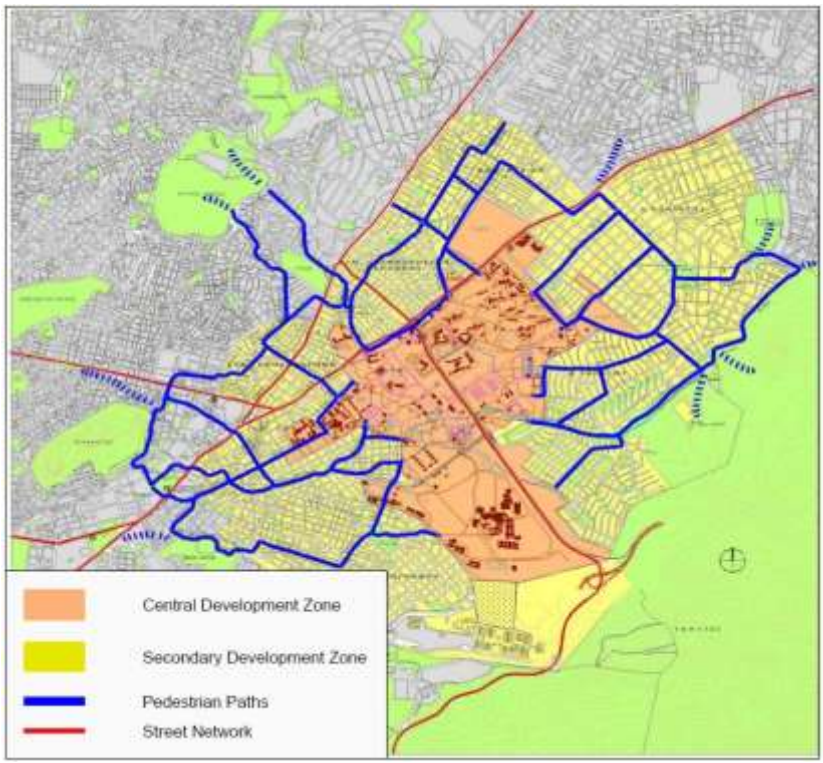

Figure 10: U.E.Lab NTUA proposal_ two development zones of Goudi Metropolitan Park
Source: U.E.Lab NTUA

The same research had also proposed traffic arrangements and specific landscape intervention among others. Moreover, it demonstrated 3 development cores, one of which will be the basis of the current proposal in this paper. This was the first linear development, starting from Mesogeion Avenue close to Katehaki metro station, crossing the Metropolitan Park in SE-NW direction and ending at the NTUA campus. In the proposal, one of the main suggested infrastructure was the opening of an underground passage linking the station to the enhanced route, allowing students and employees of the campuses to cross in a safe and upgraded way the existing large crossroads of Mesogeion and Katehaki avenues.

In the above direction, there are some completed individual schemes inside the NTUA campus that will be incorporated in the current proposal, such as the policy for deterioration of through traffic and speed reduction with speed bumps as well as the completed cycle lane (figure 11 and 12) that circulates the institution. The cycle lane is configured a few meters away from the street, very close to walking paths and has a width of 2.5 meters.

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Figure 11: Image of the completed cycle lane inside the NTUA campus
Source: Authors' archive

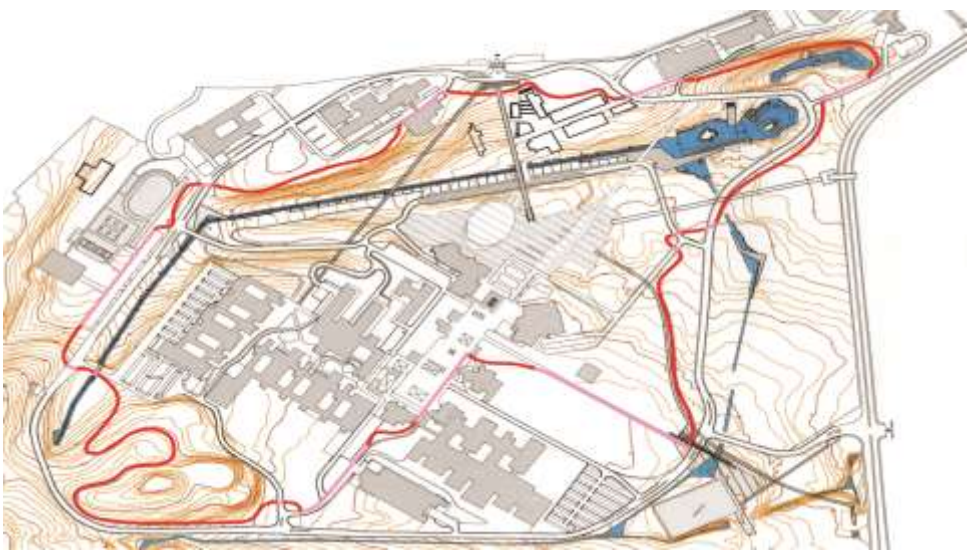

Figure 12: Plan of the completed cycle lane inside the NTUA campus
Source: Own construction

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This existing cycle lane is in use since 2005 and attracts daily several students and athletes from the wider area. It is also used by residents of Zografou, Goudi and Ilisia area, however is completely segregated from the other neighboring suburbs and facilities due to the extended presence of highways and becomes even more hostile to reach it due to the absence of proper signaling. Indeed, its spatial contiguity to Katehaki metro station as well as the planned extension of the metro line to the campus is expected to attract more cyclists in the coming years.

Proposal description

As mentioned earlier the suggested cycling route aims at the enhancement of leisure activities in the study area, as well as the promotion of cycling culture in Athens as a viable transportation mode. The key parameters taken into account were;

- any pre-existing studies for the wider study area
- the enhancement of the natural environment and utilization of downgraded infrastructure
- the connection with main attraction nodes and transportation stations
- the connection between existing controversial land uses
- the potential linkages with the neighboring municipalities
- the deterioration of through traffic links and introducing of traffic calming measures
- the enhancement of leisure activities
- the protection of green open spaces and the needed removals of fencing and walls
- the origin-destination survey conducted by the research team for NTUA and UOA

The study of the detailed cycling route included a number of sub-studies, after the configuration of the preliminary study route. Firstly the research team went through the detailed mapping of the suggested route and produced topographic maps. The instruments used, in order to establish a geodetic control network and measure the detailed features of the area, were a G.P.S. Topcon HyperPro, and a total station Leica TCR407power. Afterwards, the study focused on the identification of 4 distinct sections (figure 13), namely the part at Goudi park, the part at NTUA, the part at the UOA and the part at Ilisia grove, as seen in the figure below.

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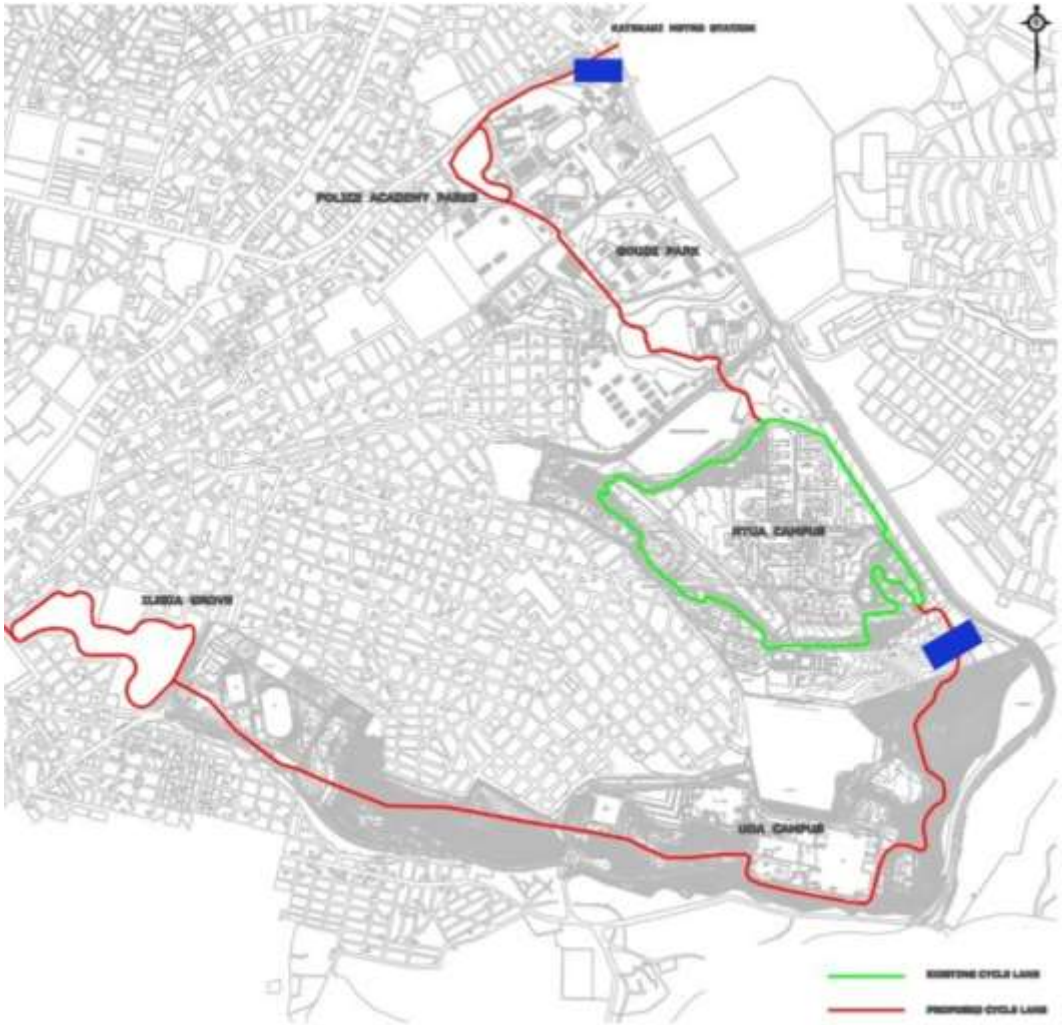

Figure 13: Cycling route proposal - 4 studied parts
Source: Own construction

The part of the cycling route at Goudi Park has a length of 2.250 meters and links the universities and Katehaki metro station, while it also operates autonomously inside the Police Academy. We studied three alternative scenarios for the delineation of the route for the link to the metro station, with one using the existing street network of Mesogeion Avenue, the second passing through Goudi Park and

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the third utilizing Katehaki Avenue. Finally the first alternative was chosen and the parts inside the park were aligned to serve all the related activities equally. The final route avoids where possible the conflicts of ownership.

The part of the cycling route at the NTUA campus has a length of 4.000 meters. It was kept at its existing delineation and special attention was paid at the linking parts (in entrances and exits of the campus) regarding signaling and intersection improvements.

The part of the cycling route at the UOA campus has a length of 4.500 meters and used some of the inner-campus street networks as well as an existing long pedestrian path that runs through the center of the campus, due to the particularities of the landscape. It links educational departments, parking places, sports facilities and many more.

The latter part of the cycling route which runs through the Ilisia grove has a total length of 1.450 meters and was inscribed on existing paths and unpaved roads (soil), achieving to circulate the whole area of the grove.

The width of the cycling lanes varies from 1.6 to 2 meters and structural details were provided for each part (through maps, cross sections etc.) which specify materials, curve radius, cross slopes and all analytic calculations for the construction of the scheme, as well as the allowed deviations from the prerequisites.

The selection of surface materials was studied thoroughly and suitable materials and coatings were selected according to the specific needs. Among the various alternatives, we chose cobblestones, natural granite paving blocks, photo catalytic coatings as well as compressed earth blocks and mixes of granular materials. All materials followed the European Standards prototypes (EN1342, EN1338:2003, EN 13369, EN1342 etc.).

Analytical solutions were also provided for all intersections and linkages, following national and international standards in regard to optimal conditions, safety and accurate signaling.

Urban furniture proposals were demonstrated and indicative locations were provided for benches, lighting, taps, and litter baskets etc., based on the development of a uniform route with wooden structures in order to enhance the existing natural environment. Moreover, places for temporary rest and recreation were located at a frequent base throughout the whole cycling route and parking places were demonstrated at focal points. Complementary to the above, spaces for automatic bike rental were indicated and details on a proposed bike sharing scheme were also determined.

Lastly, the research team reviewed the construction works and set specific prerequisites for excavations, concrete and asphalt works, lighting and signaling, coatings, drainage etc.

Economic plan

The study also looked into the economic plan of the suggested proposal and calculated the expenses regarding the construction and surveillance works. The total cost of the construction is estimated to reach 1, 62 million Euros and the funds will be provided by the NSRF funds of Attica Prefecture. According to the NSRF, 70% of the total expenses will be invested by EU funds and the remaining 30% will be supplied by Greek national funds.

Conclusions and research limitations

Developing cycling routes in open spaces and greenways for recreational purposes is a common practice for urban areas, as it enhances the relationship of the residents with their natural environment and upgrades the urban landscape. The proposal seeks to connect supra- local activities in the Athenian urban environment, through a green cycling route subject to the European prototypes, as well as to promote cycling as a viable mode of transportation.

Greece lacks official technical requirements for cycle lane construction for both the urban and rural space. Since now, the construction of cycle lanes was following the literature available by the NTUA as well as some guides by the Greek Ministry of Transportation. The

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latter was forced to form a committee to develop such requirements in 2013 and since then little progress has been done. As a result, the research has conducted an in depth exploration of foreign principles and planning policies and has adjusted the requirements in the Athenian context.

According to the Greek legislation, after the completion of a study and before the implementation of the proposed infrastructure there is a number of procedural steps with the most important being the stage of maturation. This stage includes authorizations and audits from the local authorities and the Ministry of Transportation, environmental approvals and legitimacy controls etc., which last approximately 12 to 16 months. Due to the aforementioned procedural complexity and in order to avoid further delays arising from the ownership conflicts, the research had to explore in depth all the alternatives in cycle lane layout. The study area belongs to a number of stakeholders, such as municipalities, public authorities, military and academic institutions and consequently the authorization of all the above is difficult and many times impossible for issues of privacy and safety. Hence, the proposed layout was modified to deal with all the aforesaid matters as well as with some topography implications in the close vicinity of the university campuses.

Other issues that emerged were related to the linkages with metro stations and were resolved by taking up space from traffic lanes and parking spaces.

In general, the research attempted to approach the matter in a holistic way and examined similar implementations and planning principles that drive such schemes in the European context. The overview of the infrastructure elements helped at the formulation of the layout configurations and the final product is a complete and robust cycling route that is expected to unify many of the neighboring uses and regenerate the studied open spaces. The provision of the detailed dimensioning among the analytical description of materials, signage, parking facilities et cetera can also be considered a useful precedent in similar future studies.

Acknowledgements

The authors would like to thank Prof. Thanos Vlastos, who was the scientific director of this research as well as Dr. Dimitri's Milakis, Sofia Papastrati, Trisevgeni Papagerasimou, Ioannis Marakakis, Christos Karageorgopoulos, Angelos Liveris and Kostas Liveris for their significant contribution in the research.

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