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Cover Page Footnote

We would like to special thank to Catarina Freitas and Sofia Mrejen, from Almada Municipality and Mário Alves consultant at Almada Municipality; to Luísa Forjaz from Sintra Municipality; to Natália Cunha and Isabel Ferro, landscape architects at CEAP, to Sofia Campo, engineer at CEAP and to André Neves who's master thesis on landscape architecture was on the scope of this paper.

Soft Mobility Towards Ecological Sustainability in Lisbon Metropolitan Area – case study of Almada Municipality

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Introduction

Automobile traffic congestion and air pollution in the Lisbon Metropolitan Area (LMA), an area with close to 2.8 million people, has increased dramatically in the last 30 years as a result of suburban sprawl. The sheer size peri-urban areas have reached lends itself to urban politics and subsidized rents, an issue that has not yet been resolved due to lack of political will. This has driven down rental prices of old leases, accompanied by the degradation of buildings located in the city’s historic centre, and has also resulted in very high pricing of current leases inaccessible to most citizens. This is the way in which the peri-urban areas have grown, much like in many Western cities that have absorbed the rural exodus. Peri-urban areas also offer lower rents and housing prices than what historic centres offer. However, this growth has not been accompanied by a plan that accounts for the supply of transportation infrastructure and other public facilities or by relevant policies for the decentralization of employment.

The relocation of various services, in addition to office locations, from the inner city to peri-urban areas increased inefficiency in regards to transportation and automobile use with serious consequences for public transportation. For example, in 1998 LMA residents completed 4.9 million daily commutes to or from Lisbon of which 24% were on foot and 76% by motorized transportation. Of the motorized commutes, 57% were Individual Transports (IT); 36% were Collective Transports (CT); while 7% were a combination of both (DGTT, 2000).

Of the European Union-15 group members (the number of EU members prior to 2004), Portugal has the fastest-growing greenhouse emissions, with 40.5% in 2002 and 49% in 2010, rather than 27% mandated by the Kyoto Protocol. As a consequence, Portugal is facing a punitive fine in excess of 1.5 thousand million Euros for not complying with the emissions quota (REA, 2005).

In October of 2012, the European Union Court of Justice declared that from 2005 to 2007, the Portuguese Republic did not meet the limit values established in Article 13 of Directive 2008/50/CE of the European Parliament and of the Council on the 21st of May, 2008 regarding the quality of ambient air and cleaner air in Europe.

All these factors have resulted in suburbs where individuals are responsible for their own transportation, spending much of their time commuting to and from work and home, in addition to household budgets with a high incident of transportation costs.

Europe has already proved that augmenting road and highway infrastructures only leads to more automobile traffic congestion, thereby demonstrating the need to find new models of mobility (Export Group on the Urban Environment, 1996)

Containing clearly demarcated urban areas is one of the processes used to reduce traffic congestion and air pollution, among other benefits. Another process is the development of a multi-modal transportation system in which Soft Mobility plays an important role.

It is implicit that transport actors include all means of transportation, not excluding the pedestrian and the bicyclist. Cycling is the fastest mode of transportation in short distances up to 3 kilometres (Dekoster and Schollaert, 2000), which means greater adjustability when

connecting to public transportation interfaces. The current lack of accessibility to transportation interfaces is considered to be a factor in the decision individuals make to use automobiles (Lowe, 1990). Addressing this particular aspect calls for the creation of more cycling paths linked to public transportation systems, in addition to improving the security and comfort of bicycle parking facilities. As much as possible, cycling paths should be integrated with ecological structures, thereby raising the standard of environmental quality. This concept is true at local and municipal levels and on a regional scale.

This article addresses this concept, showing the overall planning of projects with different types of Soft Mobility structures in various situations, from the restoration of old railroad lines to urban cycling networks with the underlying assumption of a mutually advantageous association between both mobility and ecological structures.

Background and Literature Review

Since the decade of the 1990s, the presence of sustainability in city planning models has been rigorously discussed with various recommendations, namely from the European Union, in the context of design, urban management and infrastructure. The majority of contemporary studies recognize urban sprawl, and the consequent proliferation of infrastructures as one of the main factors that negatively influence urban mobility (Expert Group on the Urban Environment, 1996). The excessive use of individual transport, much to the detriment of collective or soft mobility modes, has resulted in the poor planning of urban expansion, the disarray among diverse modes of collective and individual transportation and a shortage of the former.

In this regard, several European Directives (CEC, 1990; EC, 2001 & 2007; Expert Group on the Urban Environment, 1996;) established lines of action to promote the continuity and connectivity of transportation infrastructures, as well as the integration of all modes of transportation, namely soft modes of transportation.

More recently, the European Commission's Action Plan on Urban Mobility (EC, 2009) recommended larger efforts in the development of sustainable urban mobility plans, proposing twenty measures with the objective of promoting and supporting local, regional and national authorities in policymaking and implementation of sustainable urban mobility plans.

In Portugal, these recommendations were recently included in "The Sustainable Mobility Project" (2006-2010), cofinanced by the European Union (FEDER), which addresses the scope of policymaking efforts for planning sustainable mobility in 40 municipalities, involving 15 research centres and universities. The main conclusion of this project was elaborated in a best practices manual for sustainable mobility (APA & CESUR, 2010). More recently, The Inter-ministerial Working Group finished the "Plan for Promoting the Bicycle and Other Soft Modes" with the objective of recognizing modes of soft transportation and their integration into transportation networks and urban planning (GTI, 2012).

In the Lisbon Metropolitan Area, the Landscape Architecture Research Centre "Prof. Caldeira Cabral" recently studied various cities, namely Lisbon, Seixal, Loures, Almada and Sintra with the goal of integrating cycling networks with ecological networks. The results obtained were then applied to create a model on a larger scale for the greater Lisbon area. The goal of this paper is to present the methodology of planning bicycling networks that are integrated into the ecological structure to the greatest extent possible.

Methods

The first approach to the methodology is mapping the ecological network (**Figure 24**), which is not the goal of this paper but represents the first step in the methodology for planning a Soft Mobility Network associated with the ecological structure to the greatest extent possible.

It is intended, preferably, for the use of existing roads, paths and networks including roads, streets, and rural paths, acting as a base to further develop cycling and pedestrian networks. This underlying assumption reduces the cost of construction, takes advantage of the public space and employs multi-functionality.

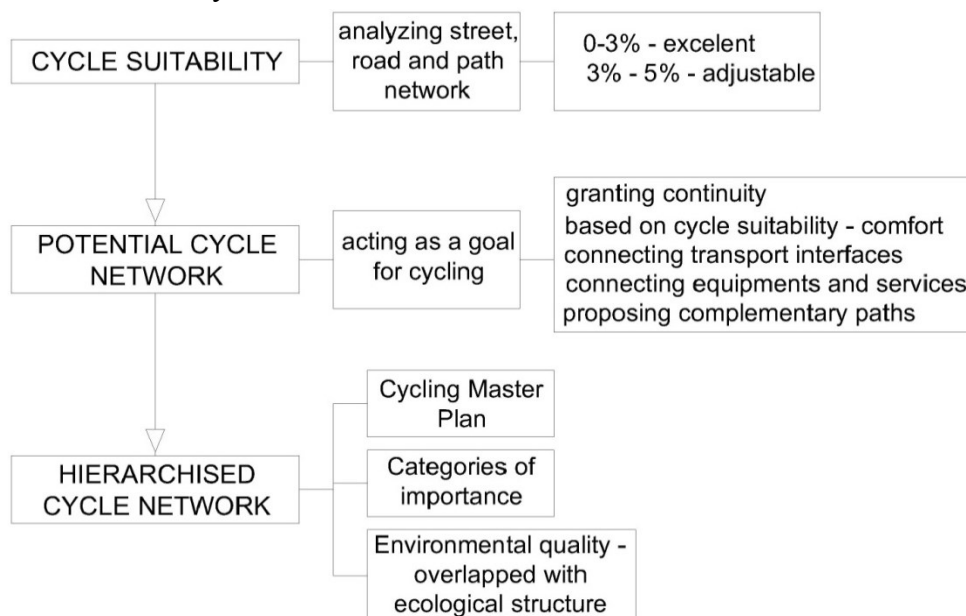


Figure 24 - Cycle Network Methodology scheme

The first phase of planning the cycling network is called Cycle Suitability and begins by calculating the longitudinal declivity of existing roads and path networks, using databases to select chunks that present suitability for cycling with total comfort (declivity adjusted for all ages) and quality (environmental quality). Therefore, the first Cycle Suitability criterion is obtained by the following longitudinal slopes: 0-3% (excellent cycling conditions) and 3%-5% (medium conditions). With Geographic Information System (GIS) technology, it is possible to evaluate the declivity of all paths with considerable detail using a specific algorithm.

The second phase, Potential Cycle Network, reconciles declivity with accessibility to main public facilities, particularly main transportation interfaces, schools and universities, police stations, local institutions, recreational spaces, financial and commercial centres, thereby creating an overall plan for the suitability of cycling. This network proposal includes new cycling paths beyond existing roads, streets and path networks (Cozzi *et al*, 1999).

The third phase reconciles cycling characteristics, derived from the two prior phases, with those of the ecological structure in order to define an integrated master plan, referred to as the Hierarchised Cycle Network, which defines different categories of cycling paths according to their importance.

Defining integration or coexistence typologies among various models of mobility is not an easy task. Modernism passed on the tradition of mono-functional separation, a practice still advocated in Portugal by the majority of experts and also supported by a piece of legislation that gives priority to automobiles. On the other hand, in countries where bicycles are primarily used, as in Holland, legislation increasingly gives priority to bicycles over automobiles and protects the coexistence among the automobile, the bicycle and the pedestrian in accordance with postmodern principles of multi-functionality.

Nonetheless, accidents exist, therefore making it necessary to define a concept in which different typologies address different situations by the speed or volume of traffic.

Obtaining various levels of integration is accomplished through the project and involve, aside from mobility, criteria for the rehabilitation of public space in environmental, cultural, recreational terms, etc. (Selberg, 1996). The creation of a Soft Mobility network creates conditions for urban rehabilitation, not according to area, but through lines that extend the intervention of vast areas of the city with its connection to surrounding areas—establishing itself as a “Trojan Horse” of renovation.

The integration of pedestrians, bicycles and automobiles in the same space requires a speed that does not exceed 30 kilometres per hour along with a lower volume of traffic (Cozzi *et al*, 1999). This objective can be reached with measures that involve human perception and the correction of driver behaviour, which can be fixed by traffic calming designs (Selberg, 1996) and avoiding the utilization of unaesthetic and inefficient signposting. Interventions in the streets can be done with full closures, half closures, middle interruptions or diagonal diverters (Prinz, 1980). This author also classifies interventions as vertical measures that force the reduction of speed and horizontal measures that introduce physical obstructions to the driver’s eye and reduce the road space to minimum widths. The specific details of these intervention measures do not fit into the scope of this article, but several authors address them.

The methodology used to reach a definition of cycling path typology, with the function of integrating other modes of transportation, is synthesized in the following diagram (Figure 25):

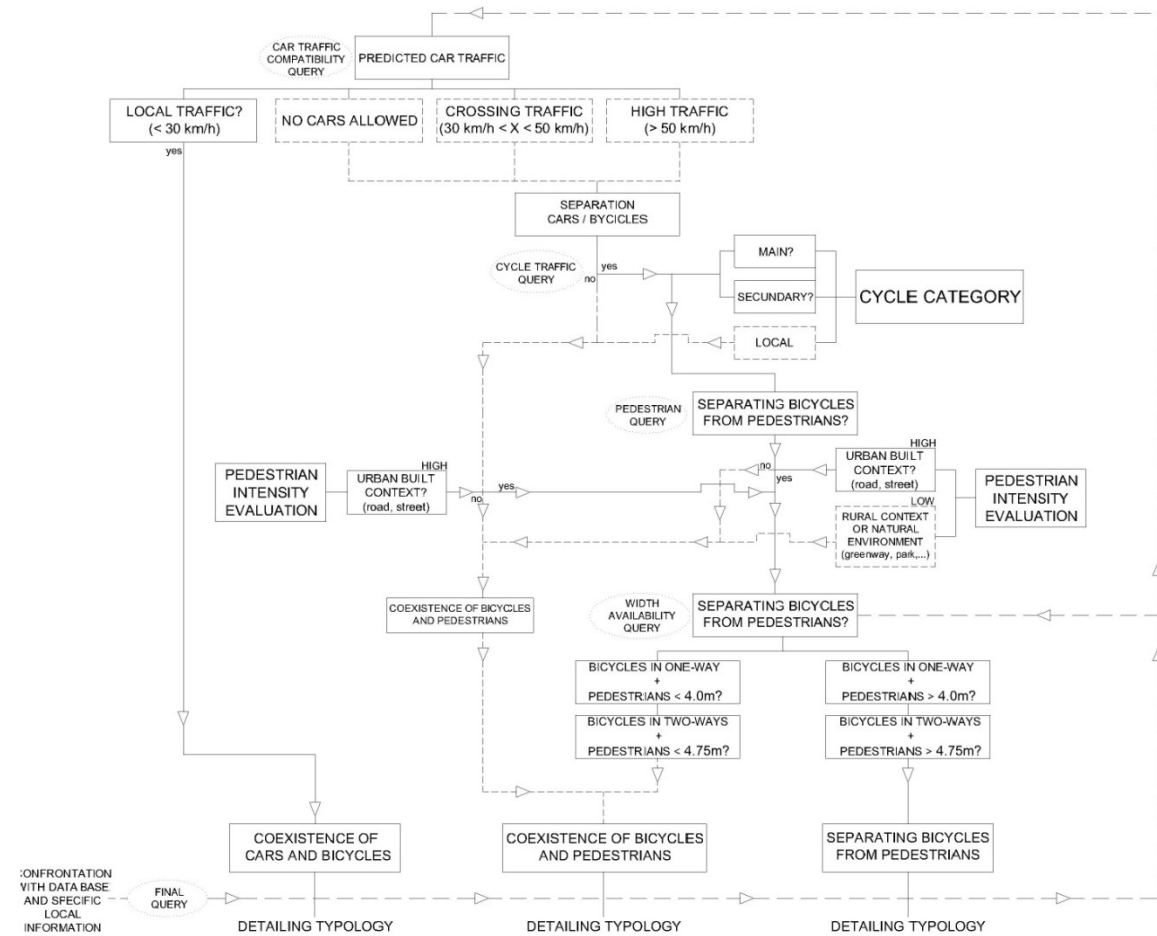


Figure 25 – Model for Cycle Typology definition (Magalhães *et al*, 2005)

One-Way Cycle Lane / Track			Two-Ways Cycle Track		
Bicycles / hour	Width (m)		Bicycles / hour	Width (m)	
	Italy	Almada		Italy	Almada
0 – 150	1,50	1,25 to 1.50	0 – 50	1,50	1,80 to 2,00
150 – 750	2,50	1,50 to 1.80	50 – 150	2,50	2,00 to 2,50
> 750	3,50	1,80 to 2.00	> 150	3,50	3,00

Table 3 – Cycle width requirements in Italy (Cozzi *et al*, 1999) and proposed values for Almada Municipality Cycle Network.**Results**

The objective of this paper is to present a planning model for cycling networks that can serve as a guide for city planners, the results of which were obtained from actual drawn up plans based on the agreed protocols of several municipalities. The method presented defines the integration typologies among various modes of transportation (pedestrians, bicycles and automobiles), as well as the integration of cycling networks with ecological structures (Figure 26 and Figure 27).

This methodology was applied to a municipality located in the Metropolitan Area of Lisbon named Almada, which has a Soft Mobility Network constituting part of the Landscape-Land-Use Plan that is currently in the process of being approved by the city.

**Figure 26 - Potential Cycle Network for Almada Municipality overlapped with Ecological Network****Figure 27 - Hierarchised Cycle Network for Almada Municipality**

The results obtained with the network proposal were used to influence the Almada City Hall by demonstrating the need for an integrated plan among all its components, including Soft Mobility. Its implementation will be gradual, as public spaces are rehabilitated and the new areas of urban expansion are developed by private entities (Figure 28).

Lastly, the proposed methodology has already been tested on a municipal scale and can also be applied to a regional scale.



Figure 28 - Scene of proposed traffic calming designing measures for Almada Cycle Network coexistence between bicycles (a); pedestrians typology along qualified greenway in Almada Cycle Network (Magalhães & Mata, 2005b) (b) and typology - separated bicycles from pedestrians – in implemented cycleway plan for Almada Cycle Network (c) (Magalhães *et al*, 2005a)

Conclusions

Reducing the private use of the automobile implies improving access to public transportation through a cycling network connected to public transportation interfaces, preferably utilizable up to a distance of 3 kilometres (Dekoster and Schollaert, 2000).

Convincing people to use bicycles as a mode of transportation for commuting to and from home and work requires absolute security in a network. This is where an appropriate selection of integration typologies plays a decisive role. On the other hand, the integration of a cycling network with an ecological structure increases the quality of paths and their appeal. The method of utilizing the two structures (soft mobility and ecology) as the basis for landscape planning is an innovation dependent on current methods. The concretization of these two structures as a tool for rehabilitating the urban and suburban space is beyond the mere implementation of the Soft Mobility structure.

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