Using GIS to analyse parking attributes in urban areas

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Abstract

Recently, parking problems have been getting worse and are now also affecting residential areas, in addition to commercial and business areas. The term 'parking problem' does not only refer to the search of free parking spaces anymore; it requires careful and in depth analysis of the various factors that influence parking demand. Geographical Information Systems (GIS) can be used as a reliable and efficient tool to record the aforementioned factors. This paper addresses the identification of supply and parking demand of an area where the urban environment has changed, in Xanthi, a city of about 55,000 inhabitants situated in northern Greece, using GIS technology. The proposed methodology can contribute to the selection of suitable parking policies, according to specific characteristics of blocks, buildings, land use and attributes of the road network. It suggests a useful and comprehensive approach for decision makers who struggle

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to find parking solutions for the city of the 21st century, towards the principles of sustainable and smart growth.

Keywords

Urban environment, Parking supply and demand, GIS

Introduction

The significant increase in private car ownership index after 1980, at a time when urbanization in Greece has reached (and even surpassed) a peak point, had as a result, a large number of Greek cities not having been designed so as to fulfill the new mobility needs and parking requirements; especially under the current conditions of saturation of the built environment (Ioannou *et al.*, 2004).

Among the major factors that influence parking demand, are: land use, attributes of the urban tissue, built environment and road network (Gribb, 2015). Computer systems and their credibility as analysis tools allow describing and understanding a large number of the relationships and interactions which form a spatial problem such as parking, Geographical Information Systems (GIS) use an interactive environment, contributing to the effective management and visualization of these spatial data. GIS analysis gives the opportunity to incorporate, combine, and illustrate data collected regarding an urban parking system (van der Waerden and Timmermans, 2005; Chaturvedi, 2012). The use of GIS technology opens new and interesting pathways for urban parking planning and policy-making.

Research objectives

This paper addresses the identification of the existing parking spaces and parking demand of an area, when the urban structures change, using GIS technology. It is part of a wider research still in progress and refers to the creation of a comprehensive GIS system which includes a great range of geometric and descriptive information for the interpretation, monitoring, visualisation and evaluation of urban areas (Giannopoulou *et al.*, 2014). This GIS focuses on Xanthi, a city of about 55000 inhabitants (2011), situated in northern Greece. The research area has been built at the beginning of the 20th century as a refugees' residential neighborhood with modest – height buildings. The proposed methodology can contribute to the selection of suitable parking policies, according to specific characteristics of urban environment.

Research area

The research area is one out of the four refugees' neighborhoods which were created in the city during the period 1924 – 1930 (Fig. 1.a). This neighborhood was planned using strict rectangular grid with elongated blocks, divided in small sites, with street width 8–10m and residential units having semi–basement and mezzanine. The reconstruction of the area began in 1970 using the process of consideration, which was the main building mechanism then. This, in combination with the failures of the General Regulation on Construction of Buildings (high density, built – unbuilt space relationship etc.), have led to the almost global domination of multi-storey buildings and in public space shrinkage. The influx of a significant number of new inhabitants and employees has resulted in the

occupation of public space by parked cars, creating accessibility and mobility problems for pedestrians and vehicles and a negative impact on the urban environment and sustainability.

Methodological framework

The GIS data base that is formed is capable of incorporating data which describe the existing situation and furthermore, data that can be used to establish propositions for solving the identified problems. A significant volume of primary and secondary geometric and descriptive information concerning the nature and characteristics of the area, which affect parking, was collected. More specifically, a unique card for every main building of the area was completed by a fieldwork survey including a series of attributes that refer to the built environment and the existing floor and upper land use. Moreover, attributes regarding the street network and parking supply per block were added.

Results and discussion

The cartographic representation through the production of thematic maps using GIS technology conducts a first approach of identifying the basic characteristics of the urban environment and achieving a complete overview of it (Fig. 1.b,c,d). The estimation of parking supply included the legal offered on-street parking spots (unrestricted parking spots, parking spots with time restriction and special parking spots)and the official off-street parking spots (private outdoor and indoor spots and public outdoor and indoor spots) (Fig. 1.e). The estimation of parking demand

took place with the aid of land use data of the research area and specific suitable coefficients. The method uses the surface area of different categories of the recorded land use and the coefficients that are included in the relevant laws and define the number of parking spots depending on the use and size of each building (maximum and minimum values are set for each coefficient). For the application of the method, the calculation of the surface areas of different categories of land use (buildings scale) was performed, separately for the ground and upper floor use. The area values for the different ground floor use were calculated by the ratio of the total built area with respect to the number of different use. Two different scenarios were formed, one corresponding to the maximum (Fig. 1.f). and one to the minimum values of the coefficient. The results from applying the methodology on site showed its effectiveness in the selection process of the right parking policy.

Conclusion

The use of a comprehensive GIS environment not only contributes to improving the quality of research but also offers the possibility of continuous updated information and monitoring of the factors that influence development of parking policies' implementation. Ideas for further research include the collaboration with specialized software which would facilitate the thorough examination, analysis and correlation of parameters involved, towards the principles of sustainable and smart city development.

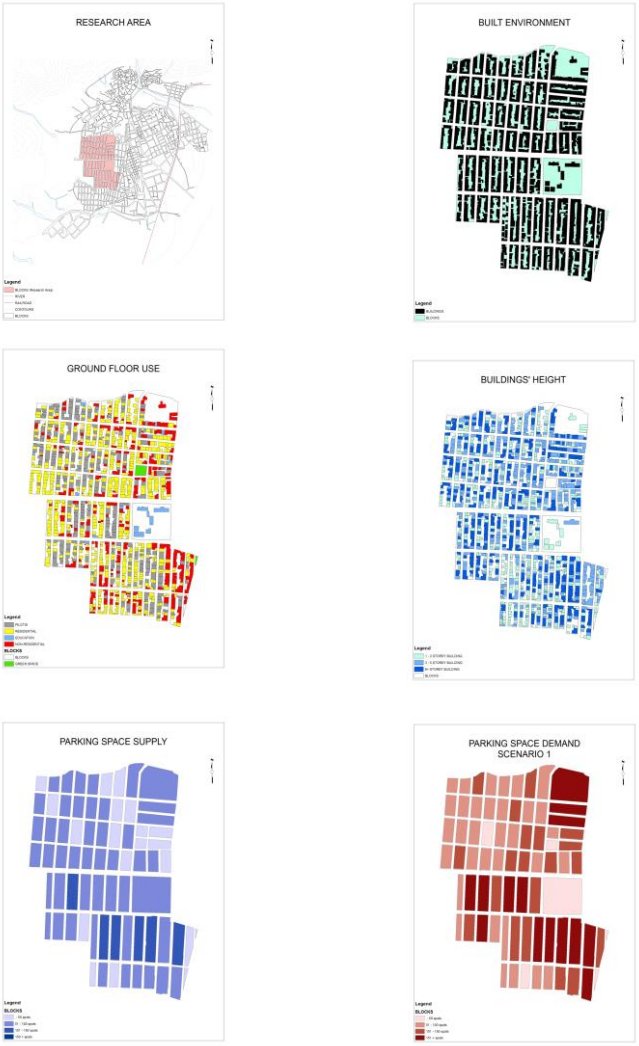

Figure 1 - a) Research area b) Built environment c) Buildings' height d) Ground floor use e) Parking space supply f) Parking space demand – Maximum values scenario

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