TeMA

Journal of
Land Use, Mobility and Environment

This special issue collects a selection of peer-review papers presented at the 8th International Conference INPUT 2014 titled "Smart City: planning for energy, transportation and sustainability of urban systems", held on 4-6 June in Naples, Italy. The issue includes recent developments on the theme of relationship between innovation and city management and planning.

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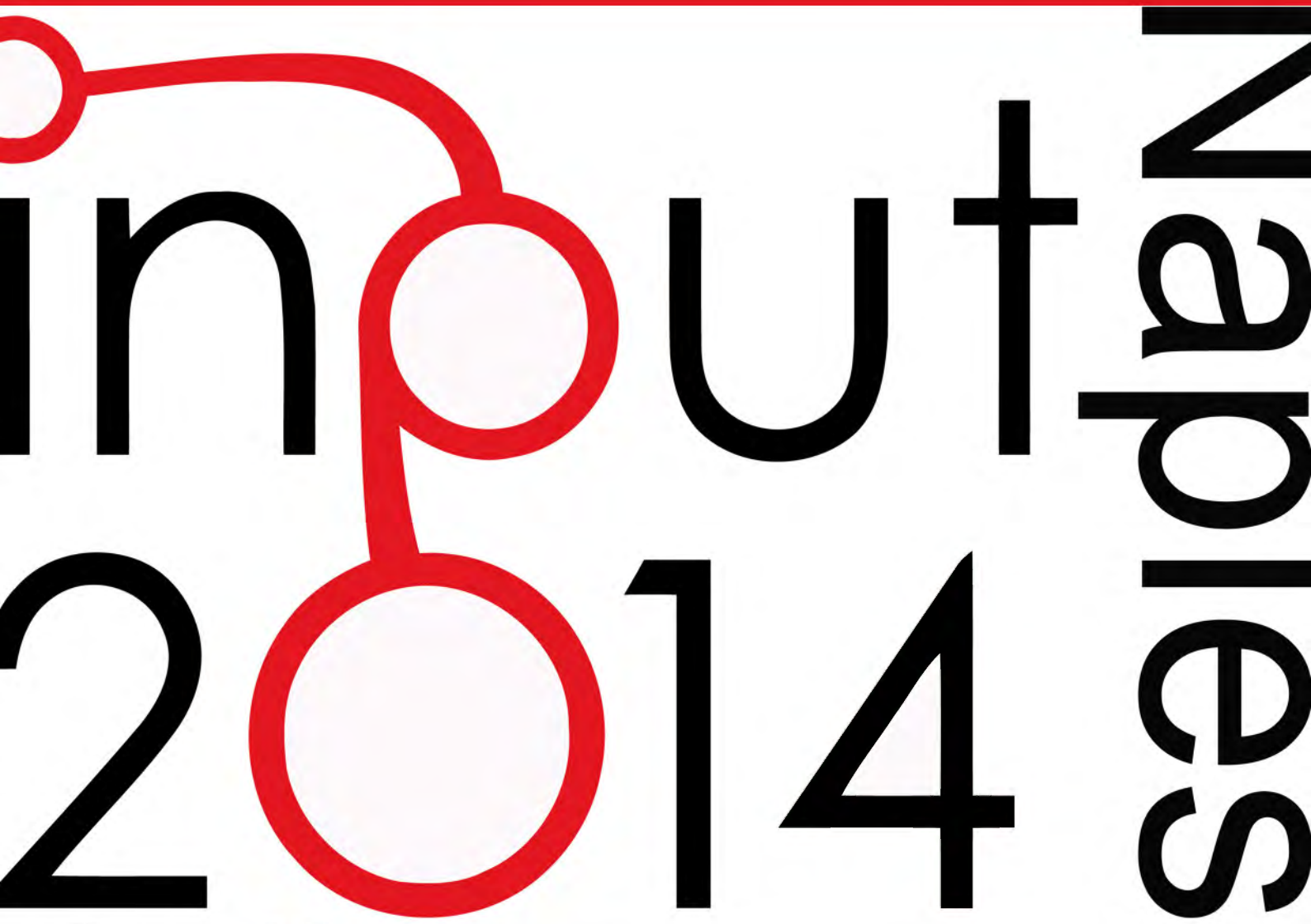

Smart City

planning for energy, transportation and sustainability of the urban system

Special issue, June 2014

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SMART CITY

PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

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TeMA Journal of Land Use, Mobility and Environment

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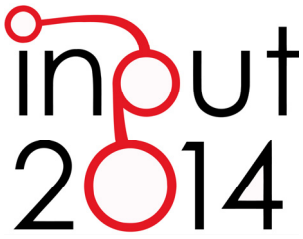
TeMA Journal of Land Use, Mobility and Environment

This special issue of TeMA collects the papers presented at the 8th International Conference INPUT 2014 which will take place in Naples from 4th to 6th June. The Conference focuses on one of the central topics within the urban studies debate and combines, in a new perspective, researches concerning the relationship between innovation and management of city changing.



TeMA Journal of Land Use, Mobility and Environment

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EIGHTH INTERNATIONAL CONFERENCE INPUT 2014

SMART CITY. PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

This special issue of TeMA collects the papers presented at the Eighth International Conference INPUT, 2014, titled "Smart City. Planning for energy, transportation and sustainability of the urban system" that takes place in Naples from 4 to 6 of June 2014.

INPUT (Innovation in Urban Planning and Territorial) consists of an informal group/network of academic researchers Italians and foreigners working in several areas related to urban and territorial planning. Starting from the first conference, held in Venice in 1999, INPUT has represented an opportunity to reflect on the use of Information and Communication Technologies (ICTs) as key planning support tools. The theme of the eighth conference focuses on one of the most topical debate of urban studies that combines , in a new perspective, researches concerning the relationship between innovation (technological, methodological, of process etc..) and the management of the changes of the city. The Smart City is also currently the most investigated subject by TeMA that with this number is intended to provide a broad overview of the research activities currently in place in Italy and a number of European countries. Naples, with its tradition of studies in this particular research field, represents the best place to review progress on what is being done and try to identify some structural elements of a planning approach.

Furthermore the conference has represented the ideal space of mind comparison and ideas exchanging about a number of topics like: planning support systems, models to geo-design, qualitative cognitive models and formal ontologies, smart mobility and urban transport, Visualization and spatial perception in urban planning innovative processes for urban regeneration, smart city and smart citizen, the Smart Energy Master project, urban entropy and evaluation in urban planning, etc..

The conference INPUT Naples 2014 were sent 84 papers, through a computerized procedure using the website www.input2014.it . The papers were subjected to a series of monitoring and control operations. The first fundamental phase saw the submission of the papers to reviewers. To enable a blind procedure the papers have been checked in advance, in order to eliminate any reference to the authors. The review was carried out on a form set up by the local scientific committee. The review forms received were sent to the authors who have adapted the papers, in a more or less extensive way, on the base of the received comments. At this point (third stage), the new version of the paper was subjected to control for to standardize the content to the layout required for the publication within TeMA. In parallel, the Local Scientific Committee, along with the Editorial Board of the magazine, has provided to the technical operation on the site TeMA (insertion of data for the indexing and insertion of pdf version of the papers). In the light of the time's shortness and of the high number of contributions the Local Scientific Committee decided to publish the papers by applying some simplifies compared with the normal procedures used by TeMA. Specifically:

- Each paper was equipped with cover, TeMA Editorial Advisory Board, INPUT Scientific Committee, introductory page of INPUT 2014 and summary;
- Summary and sorting of the papers are in alphabetical order, based on the surname of the first author;
- Each paper is indexed with own DOI codex which can be found in the electronic version on TeMA website (www.tema.unina.it). The codex is not present on the pdf version of the papers.

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USING GIS TO RECORD AND ANALYSE HISTORICAL URBAN AREAS

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ABSTRACT
A significant part of the cultural heritage of towns and cities worldwide is the built heritage. The historic centre of several European cities has been preserved as an important part of the urban landscape. New analytical tools and concepts are thus required, which would enrich and expand the conventional methods and achieve sustainability of cultural heritage in any urban context, among which are Geographical Information Systems (GIS), digital mapping systems that link spatial and non – spatial data of landscape features, and can contribute substantially in documenting different urban features and furthermore in modelling the urban process and its impact on heritage regions. This paper is part of a wider research still in progress and refers to the creation of a specialised GIS, which includes a great range of geometric and descriptive information that can be used for the interpretation, monitoring, visualisation and evaluation of urban heritage areas. The case study of the paper is the Old Town of Xanthi, one of the most important examples of the 19th century's urban civilization in Northern Greece. The paper focuses on the elaboration of the data concerning the built environment and more precisely to its systematic retrieval and import to the GIS system; moreover it examines 17 chosen variables using a combination of Multivariable analysis methods (Correspondence and Hierarchical Cluster Analysis). The analysis has shown the existence of four distinctive and very interesting groups which have their own specific characteristics. Ideas for further research include the collaboration with specialised sophisticated software which would facilitate the thorough examination, analysis and correlation of parameters involved, towards the principles of sustainable and smart city development.

KEYWORDS
GIS, Urban heritage, Built environment

1 INTRODUCTION

A significant part of the cultural heritage of towns and cities worldwide is the built heritage, which has a crucial role to play in all three dimensions of urban sustainable development (environmental, economic and social) (Tweed and Sutherland, 2007). The historic centre of several European cities has been preserved as an important part of the urban landscape, escaping demolition policies related to modernistic and post – modernistic redevelopment. Old towns, increasingly perceived as urban forms from the past, are being restored and moreover, it is attempted to incorporate them in the contemporary urban functions, by recognizing their importance (Nyseth and Sognnæs, 2013).

A key element for protection of historical areas is acquiring access to all information related to them. Traditional research methods are not able to meet successfully the need of collecting, elaborating and analysing mass data (Rui, 2008). New analytical tools and concepts are thus required, which would enrich and expand the conventional methods and achieve sustainability of cultural heritage in any urban context. Among these are Geographical Information Systems (GIS), digital mapping systems that link spatial and non – spatial data of landscape features, and can contribute substantially in documenting different urban features and furthermore in modelling the urban process and its impact on heritage sites (Al – kheder, 2009). Generally, multi-disciplinary data can lead to a correct assessment only providing that they are well integrated; GIS technology combines database management with geometrical and spatial referencing (Carver, 1991; Webster, 1994; Crosetto and Tarantola, 2001; Malczewski, 2006; Fabbri et al., 2012). Therefore, GIS tools contribute to the simplification of the inventory, evaluation and preservation of sites with historic or cultural value (Duran et al., 2003).

The objectives of a GIS used for the aforementioned purposes include the following: organisation, management and visualisation of the unique aspects that characterize each built heritage urban core, as well as the creation of thematic maps in order to make the system easily conceived and user friendly. Its use could lead to efficient ideas for urban transformations and relevant plans for the use of heritage assets, leveraging the existing heritage and territory potentials towards the principles of sustainable and smart city development (Restussia et al., 2011).

Central and local authorities responsible for cultural heritage in many cities tend to increasingly use i GIS technology as a basic component in their attempt to build corporate information systems (Petrescu, 2007). Elements with an inherent spatial dimension comprise cultural heritage. The spatial aspect of heritage elements is essential for their management; thus, the fact that several of such systems are based on GIS – related technology should not be a surprise (Parcero – Oubina et al., 2013).

This paper is part of a wider research still in progress and refers to the creation of a specialised GIS, which includes a great range of geometric and descriptive information that can be used for the interpretation, monitoring, visualisation and evaluation of urban heritage areas. This GIS system can provide the basis for comprehensive interventions in the area, within a process of ongoing planning and monitoring of the evolution and the evaluation of the effectiveness of measures and projects in order to ensure the best outcome with the most efficient allocation of the available resources. The potential of the system's cooperation with specialised software is particularly interesting; it could facilitate the thorough examination, analysis and correlation of parameters involved in relevant practices of urban space's upgrade and renewal, towards the principles of sustainable and smart city development (Multicriteria Analysis, Bioclimatic design and planning etc.). The case study of the paper is the Old Town of Xanthi, one of the most important examples of the 19th century's urban civilization in Northern Greece.

2 AREA OF RESEARCH

2.1 GENERAL DESCRIPTION AND CULTURAL VALUE

The Town of Old Xanthi is located in the heart of modern Xanthi, one of the most important urban centres of the Thrace region in the northern part of Greece, with 55.000 inhabitants. Old Xanthi is a unique pole of attraction surrounded by places of exceptional cultural, historic and ecological value.

Old Xanthi covers an area of 31 Ha, occupying 1/7 of the total city's area. It extends along the foothills of Xanthi, bounded by a thick forest to the west, a river valley to the east and by the centre of the modern city to the south (Figure 1). The flexibility of the urban pattern with its irregular street system and hilly terrain provides a pedestrian environment full of sights and landmarks (Giannopoulou et al., 2012).

The public and private buildings are excellent examples of several periods of the late 19th and early 20th century architectural styles', mingled with a variety of examples of vernacular architecture. The older buildings, most of them built by traditional craftsmen, are easily recognised by their masterful combinations of masonry and wood construction – heavy and solid on the ground floor with a light frame on the first floor. Nineteenth century's eclecticism influenced most of the buildings in the urban centres of Northern Greece, borrowing styles from all over Europe. Old Xanthi followed this pattern, adapting a rich variety of styles and building systems to the local needs and its unique microenvironment. By 2011, Old Xanthi contained about 10% of the city's total population.

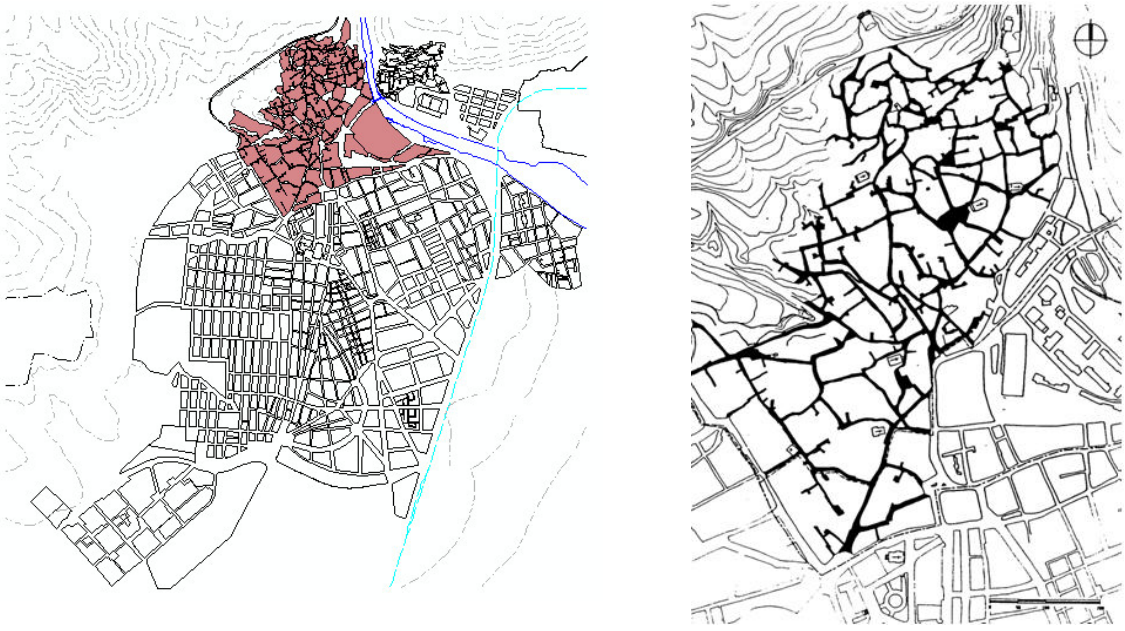


Fig. 1 a) Area of research; b) Urban tissue

2.2 HISTORICAL BACKGROUND

The Old Town was founded in the third decade of the 19th century as revealed by the age of many churches around which the first neighbourhoods were developed. Between 1870 and 1910, the town became the major commercial, administrative and military centre of a region the economy of which was shaped by tobacco production and manufacturing; its history mirrored the economic rise and fall connected with single industry. During the period of economic growth, tobacco merchants, builders and technicians settled in the

town from all over Northern Greece. A complex urban fabric evolved rich in community buildings and imposing private mansions erected by the emerging wealthy class.
The dawn of the 20th century found the centre of Old Xanthi unable to support further growth. New housing and manufacturing sectors emerged further south and, along with the influx of refugees fleeing Asia Minor in 1924, created a new city, double in population, while the centre gradually shifted southward.
After World War II, the drastic decline of the tobacco industry combined with weak regional economic policies, forced most tobacco entrepreneurs to relocate to greater urban centres and a large portion of the workforce to emigrate to the industrial centres of Europe. Abandoned by the original wealthy settlers, Old Xanthi became a typical example of a declining, low income residential area. In 1970s, a relative recovery in the city's economic life took place, determined by the emergence of new economic activities. In 1993, the "Plan and Program for the reservation – restoration and growth of Old Town" (TEAM4, 1993), defined main institutional measures concerning building regulations, land use and protection. In this context, the Municipality of Xanthi has implemented individual interventions in buildings and public spaces.

3 METHODOLOGICAL FRAMEWORK

The creation of the specialised GIS was based on the structure of the existing GIS that had been created to cover the needs of the aforementioned Plan and Program. The existing GIS included geometric information (blocks, lots, buildings, streets etc.) and very limited descriptive information that specified only a few properties of the objects (mainly from the urban analysis), without covering the full range of the collected primary data the majority of which was not coded, while a wide detailed field recording is ongoing. Therefore, the full data retrieval and its systematic recording at the new redesigned database were considered necessary, combined with the application of suitable transformations in order to fit the current National Reference System, and to allow comparisons with up to date data. The present paper focuses on the elaboration of the data concerning the built environment and more precisely its systematic retrieval and import to the GIS system; moreover it examines 17 chosen variables using a combination of Multivariable Analysis methods (Correspondence and Hierarchical Cluster Analysis) (Markos et al., 2010) for the data interpretation and evaluation.

3.1 THE EXISTING PRIMARY DATA

The analysis of the built environment was based on detailed fieldwork recording. A card was completed for all the buildings of the region. Every main building that is located within each property was recorded at this unique card. For the out auxiliary buildings and the additions no separate card was completed; these are mentioned as part of observation and description of main building's changes. The card contains the building's code, its address, name (if any), owner and ownership status, brief description of its configuration and construction, height, condition of the structural system, façade and roof, potential additions, deteriorations of the façade's elements or morphology, map extract (scale 1:2000) where the contour and coverage of the building are pointed out, and finally, a representative picture of it.
For the remarkable buildings, and for some less interesting, additional information was recorded at an extra card, with the aim to fully identify the built environment, such as: more representative pictures of the building, observations of typological and/or morphological nature, decorative elements, plans, and relevant literature.
The Plan and Program also included quantitative and qualitative recording of the region's urban data (indexes that can be systematically coded, analytical inventory of local and hyper local uses and

environmental data, mainly at public spaces). Moreover, a sampling survey took place by distributing a questionnaire to a 10% of the total population for recording data concerning housing conditions (household size etc.) as well as certain demographic and socioeconomic characteristics of the residents (age, sex, geographic origin, educational level, job).

3.2 CHOICE AND ANALYSIS OF VARIABLES

The description of the 17 variables that were used, concerning 1088 recorded main buildings, follows: Variable XX1 refers to the Code of the block, while variable XX2 describes the ownership status of each building. Variable XX3 refers to the classification of buildings depending on their period of construction (it was based on the existence of age on the facades, on the ownership titles, on the typical way of building and use of specific materials or to historical data directly related to the construction activity). Variable XX4 gives an estimation of the buildings' height based on the number of storeys, whilst Variables XX5 – XX8 present the original as well as the current use of the ground and upper floors of the buildings. Variables XX9 – X11 describe the condition of the structural system, the façades and the roof respectively. Variable X12 refers to the architectural typology of the building and X13 indicates the existence or not of additions of any sort. Variable X14 refers to deteriorations of the original building in relation to the potentiality of recovery and return to the initial condition. The existence of outer or/and inner decoration and other special morphological elements is described by the use of variable X15. Variable X16 is used for the qualitative assessment of the building based on criteria such as its architectural value, its morphological and typological elements and their degree of conservation, the symbolic or historic value of its use or its inclusion in an interesting residential complex or characteristic street façade. Finally, variable X17 presents the legal protection status of the building.

The classification for all the aforementioned variables is presented at Table 1.

The cartographic representation of several of the variables, which are grouped later with the aid of Multivariable methods, through the production of thematic maps consists a first approach of the basic characteristics of the built environment and contributes to achieving a complete overview of it (Figure 2 – 6).

3.3 CORRESPONDENCE AND HIERARCHICAL CLUSTER ANALYSIS

Correspondence and Hierarchical Cluster Analysis are two of the most well – known and widespread methods of data analysis which belong to the wider area of Multivariable Statistical Analysis and have experienced rapid development mainly in France, after 1970. The advantages of these methods include the following: processing of large tables that contain heterogeneous data, elaboration of qualitative data, identification of the existence of both linear and non-linear relationships among variables, depending on the data used. Both methods are used in cases where the researchers' objective is to reveal the secret structure of a dataset, without distinguishing the variables in dependent and independent and without the existence of strict a priori assumptions or conditions. Correspondence Analysis allows the reveal of correlations among categorical variables which cannot be detected by successive comparisons of pairs of variables. Thus, the method concludes in the graphical data representation or visualization by the use of simple geometric representations (point clouds, factorial lines and levels). Through these, the natural interpretation of possible interactions, correlations, trends, similarities or contrasts among points may be revealed, which are not obvious or easily perceived. Hierarchical Cluster Analysis is complementary to the results of the aforementioned Correspondence analysis. The objective of the method is to create, as much as possible, internally compact and at the same time disparate groups of variables (Blasius and Greenacre, 2006).

CODE	VARIABLE	CLASSIFICATION
XX1	Block Code	1-76
XX2	Ownership type	Private, Public
XX3	Construction period	-1880, 1881-1900, 1901-1920, 1921-1950, 1951-
XX4	Buildings' height	One - storey building, two - storey building, multistorey building
XX5	Original ground floor use	Residential, Public, Commercial
XX6	Current ground floor use	Residential, Public, Commercial
XX7	Original upper floors use	Residential, Public, Commercial
XX8	Current upper floors use	Residential, Public, Commercial
XX9	Structural system's condition	Very good, Good, Average, Bad - Ruined
X10	Façade's condition	Very good, Good, Average, Bad - Ruined
X11	Roof's condition	Very good, Good, Average, Bad - Ruined
X12	Architectural typology	Traditional type, Eclectic influenced type, Vernacular type, Contemporary construction
X13	Additions (of any sort)	Existence, Non - existence
X14	Deteriorations	Non - reversible, Reversible, Non - existence
X15	Decoration - Morphological elements	Existence, Non - existence
X16	Qualitative assessment of buildings	Highly remarkable, Remarkable, Interesting, Neutral, Disharmonious
X17	Legal protection	Existence, Non - existence

Tab.1 Classification of variables

Fig. 2 a) Ownership type; b) Construction period; c) Buildings' height

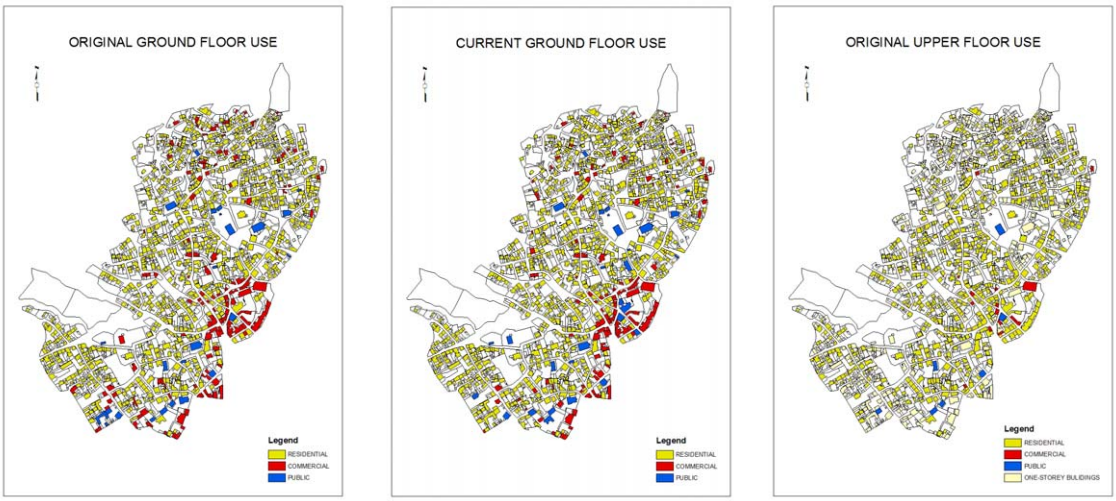


Fig. 3 a) Original ground floor use; b) Current ground floor use; c) Original upper floor use

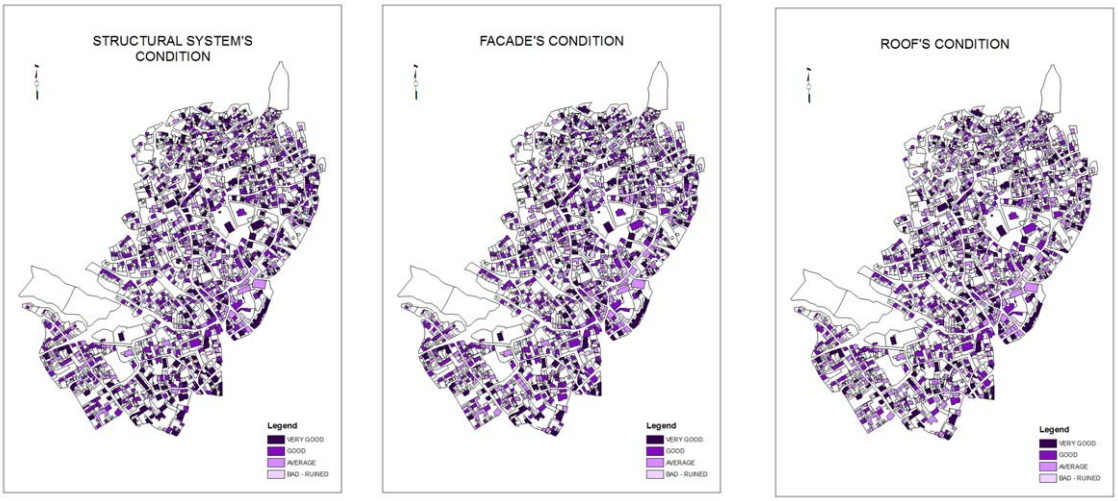


Fig. 4 a) Structural system's condition; b) Façade's condition; c) Roof's condition

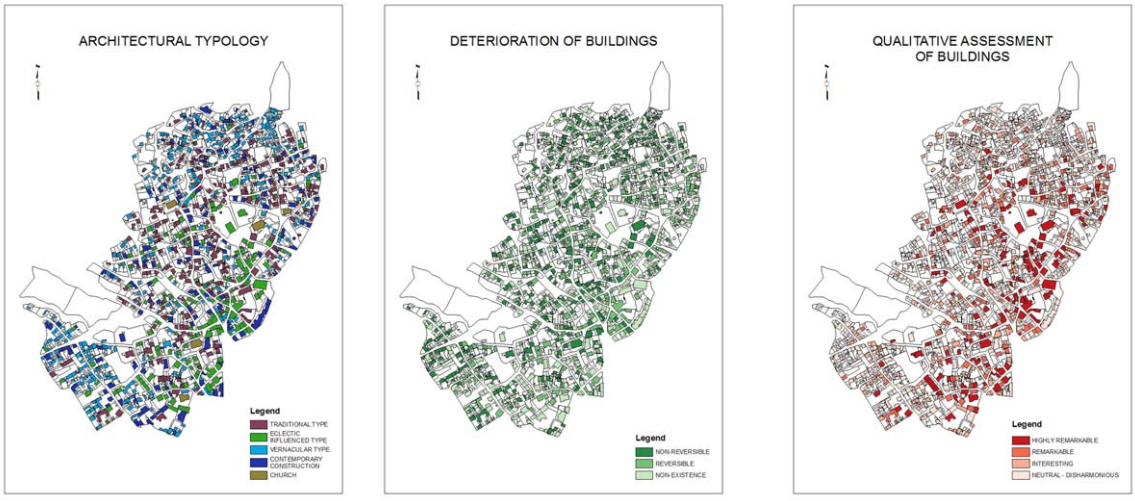


Fig. 5 a) Architectural typology; b) Deterioration of buildings, c) Qualitative assessment of buildings

4 RESULTS AND DISCUSSION

The Hierarchical Cluster Analysis with the aid of Correspondence Analysis has shown the existence of four (A, B, C, D) distinctive and very interesting groups which are presented at Table 2 and are analyzed in the following part. Every group has its own specific characteristics.

CODE	GROUP A	GROUP B	GROUP C	GROUP D
XX1	8, 9, 7, 91, 16, 64, 13, 21, 97, 92, 14, 68, 1, 83, 61, 96, 63, 66, 10, 15, 12, 95, 48, 45, 82, 59, 60, 81, 41, 47, 18, 69, 87, 70, 72, 17	90, 76, 20, 94, 93, 50, 86, 77, 79, 71, 80, 52, 67, 44, 53, 51, 54, 74, 98, 73, 88, 55, 42, 78, 75	65, 57, 43, 2, 6, 62, 49, 3, 4, 5	46, 40, 39, 37, 38
XX2	Private	-	Public	-
XX3	-1880, 1881-1900	1901-1920, 1921-1950	-	1951-1970, 1971-1993
XX4	Two - storey building	One - storey building	-	Multi - storey building
XX5	Residential	-	Public, Commercial	-
XX6	Residential	-	Public, Commercial	-
XX7	Residential	-	Commercial	-
XX8	Residential	-	Commercial	-
XX9	Average	Good	Bad - Ruined	Very good
X10	Average	Good	Bad - Ruined	Very good
X11	Average	Good	Bad - Ruined	Very good
X12	Traditional type	Vernacular type	Eclectic influenced type	Contemporary construction
X13	Non - existence	Existence	-	-
X14	Reversible	Non - reversible	-	Non - existence
X15	Non - existence	-	Existence	-
X16	Highly remarkable, interesting	Neutral	Remarkable	Disharmonious
X17	Non - existence	-	Existence	-

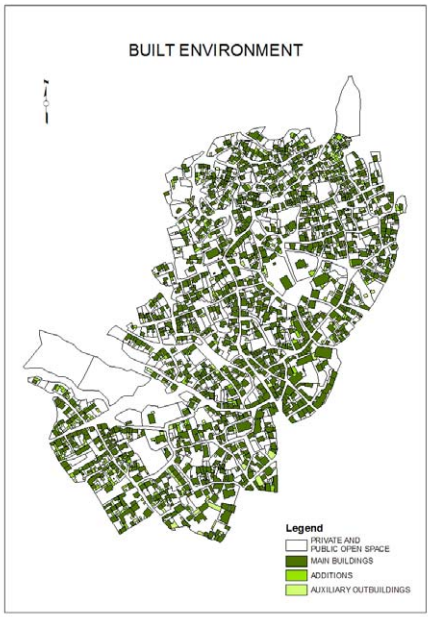
Tab. 2 Clustering of the built environment

Group A occupies an important part of the historic center which includes remarkable buildings with interesting morphological and typological elements, which represent the architectural production of the second half of the 19th century. Interesting buildings of a more vernacular architectural production with simpler characteristics, which nevertheless are linked harmoniously with the aforementioned ones, are situated in the outskirts of the area.

The traditional type of two-storey house dominates the area, in which category the earliest constructions of the Old Town belong and the use of which is almost exclusively residential.

From a constructional and morphological perspective, this building type incorporates the elements of the common architectural tradition of the northern Greek and Balkan area during the Ottoman period, with great freedom in order, which allows for excellent adaptation of the block's shape and of good orientation requirements, as well as for a noteworthy series of variations. This type also suffers from several maintenance problems at the main structure, the roof as well as at a large part of the façades.

Changes or deteriorations of the initial shell are not reported, while the deterioration of the façades is reversible and mainly refers to the replacement of the original wooden frames with metal ones, the addition of medal sheds, staircases and barriers, the blocking of old openings and the creation of new ones.
The protection of the building's shell and façades is proposed; currently, the majority of buildings are not under official protection by any relevant public authority.
Group B is situated at the northern and south-western part of the Old Town. It is characterised by simple ground floor buildings with small size and cheap materials, without any special morphological elements, well – maintained, which follow types and constructional ways of the local tradition of the first half of the 20th century. They may belong to the period between 1900 and 1920 as well as 1920 – 1950.
They are architecturally indifferent buildings, greatly distorted by contemporary changes and conversions which are not limited to auxiliary buildings and additional residential spaces, but also include illegally built independent units. Moreover, they are combined with radical deterioration or demolition of the façades and the original buildings, which makes them incompatible with the general character of the area.
Group C is located in the central core and the south-eastern part of the Old Town and includes buildings which represent the most remarkable examples of mainly neoclassical forms. The buildings' typology and morphology follow the relevant western patterns of the end of 19th century and they are distinguished from the traditional ones due to the use of industrialised materials (industrial bricks, tiles, metal reinforcements).
The main characteristics of the traditional eclectic styles are the symmetry in the organisation of the façade and the plan, the emphasis on the central axis, the strict geometric outline etc.



Figg. 6, 7 (6) Built environment; (7) Clustering of the built environment

Elements borrowed from different architectonic styles, basically neoclassic but also eclectic, decorate the buildings' facets, while several buildings are decorated by paintings. The majority of them are residential buildings with a commercial store at the ground floor or commercial or public buildings.
The public buildings' category involves buildings with administrative, religious, educational use, or buildings which currently accommodate public functions (city hall, nursery school etc.). The commercial buildings' category includes commercial stores, work crafts, leisure and social gathering spaces and is characterised by a special morphology directly related to customer service and the space function. The bad condition of

buildings does not represent the whole group but it is due to the recording of certain cases of remarkable and rare buildings which have undergone significant but reparable changes and deteriorations.

Group D enters linearly the southern part of the Old Town and includes buildings of the latest period that were built using reinforced concrete. They are three or four – storey buildings, disharmonious with the region's image, which have not been subject to further changes or deteriorations.

The spatial allocation of the aforementioned Groups of buildings reveals a noteworthy concentration of remarkable buildings at the largest part of the traditional area, which, in combination with the presence of intermediate buildings that play a connective role, gives clusters of single character and high quality architecture. Certain cores with less remarkable buildings, but in general interesting character and only a few negative interventions, are located mostly at the foothills of the remarkable areas and as result the traditional character of the historic centre is preserved.

The deteriorated and indifferent areas are gathered exclusively at the northern and western part, with only exception a linear intervention of new buildings in the southern part that is directly linked to the surrounding area of the city center.

5 CONCLUSIONS

The complexity and interaction of information issues posed by modern urban planning needs, especially when considering urban heritage regions, require the use of Geographical Information Systems technology. The use of an integrated 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 policies' implementation.

Therefore, the adoption of a GIS system has direct qualitative and quantitative benefits, due to the facilitation of access to and updating of the archive data during the development of urban planning processes, while at the same time the historic data that refers to the same region of interest is maintained. In the present paper, the information database of an existing GIS system was enriched in the context of the upgrading process of the Old Town of Xanthi, by the introduction of its administrative continuity.

The final results and the created geodatabase will be used for further analysis and research in the field of application of GIS for conservation of urban heritage areas. Ideas for further research include the collaboration with specialised software which would facilitate the thorough examination, analysis and correlation of parameters involved, towards the principles of sustainable and smart city development. More specifically, Multiattribute Decision Analysis Models (e.g. Analytical Hierarchy Process and Ideal Point Methods) could be used concerning urban planning policy issues in order to extend the analytical framework of historic centers' GIS.

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