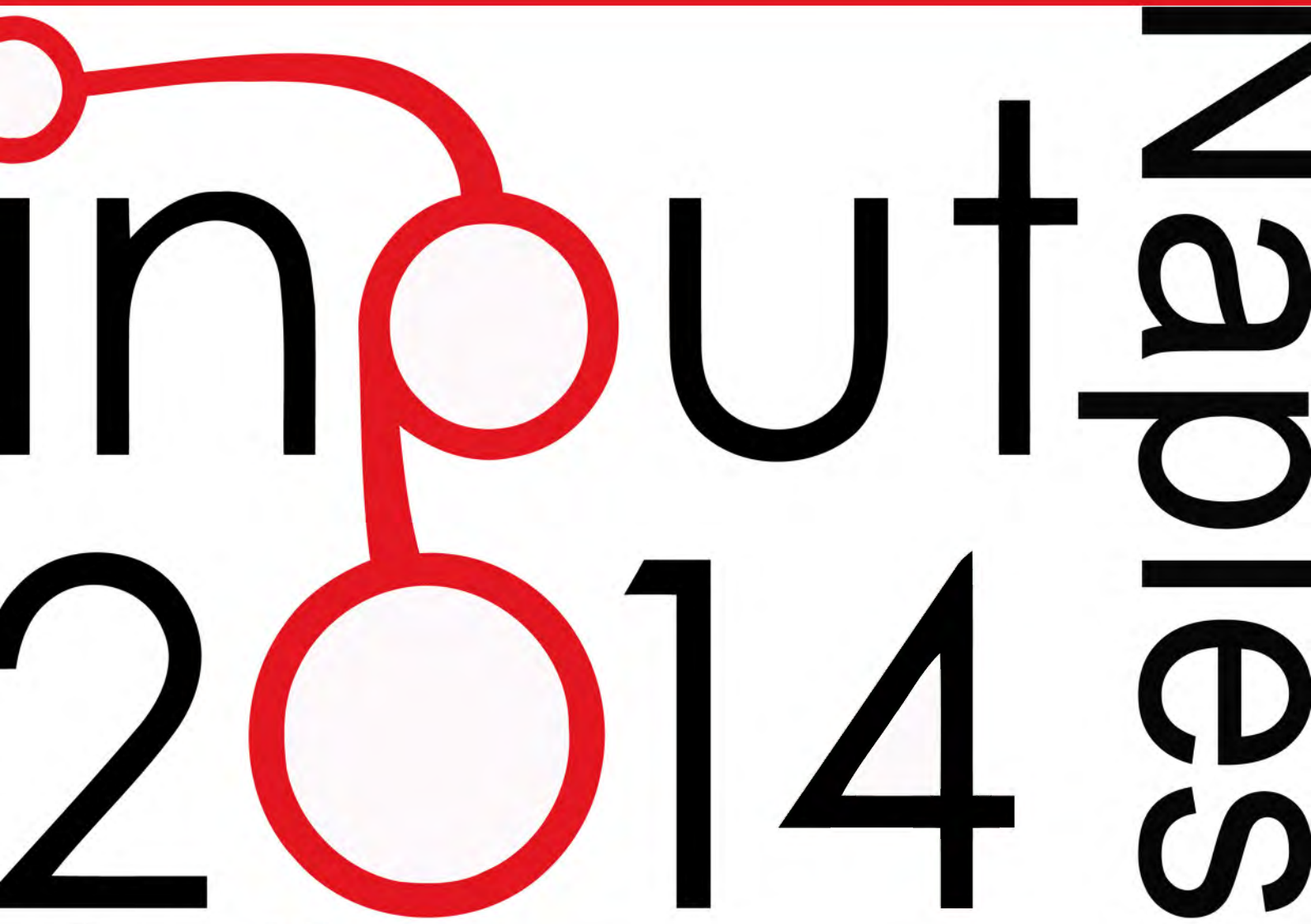
TeMA

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.

Tema is the Journal of Land use, Mobility and Environment and offers papers with a unified approach to planning and mobility. TeMA Journal has also received the Sparc Europe Seal of Open Access Journals released by Scholarly Publishing and Academic Resources Coalition (SPARC Europe) and the Directory of Open Access Journals (DOAJ).



Smart City

planning for energy, transportation and sustainability of the urban system

Special issue, June 2014

print ISSN 1970-9889 e-ISSN 1970-9870
University of Naples Federico II

TeMA Journal of Land Use, Mobility and Environment

SMART CITY

PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

Special Issue, June 2014

Published by
Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"

TeMA is realised by CAB - Center for Libraries at “Federico II” University of Naples using Open Journal System

Editor-in-chief: Rocco Papa
print ISSN 1970-9889 | on line ISSN 1970-9870
Lycence: Cancelleria del Tribunale di Napoli, n° 6 of 29/01/2008

Editorial correspondence
Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.tema.unina.it
e-mail: redazione.tema@unina.it

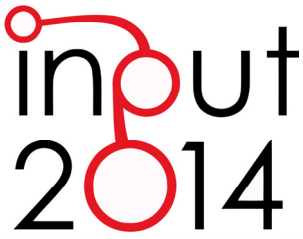
TeMA Journal of Land Use, Mobility and Environment

TeMA. Journal of Land Use, Mobility and Environment offers researches, applications and contributions with a unified approach to planning and mobility and publishes original inter-disciplinary papers on the interaction of transport, land use and environment. Domains include engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science, and complex systems.

The Italian National Agency for the Evaluation of Universities and Research Institutes (ANVUR) classified TeMA as scientific journals in the Areas 08. TeMA has also received the Sparc Europe Seal for Open Access Journals released by Scholarly Publishing and Academic Resources Coalition (SPARC Europe) and the Directory of Open Access Journals (DOAJ). TeMA is published under a Creative Commons Attribution 3.0 License and is blind peer reviewed at least by two referees selected among high-profile scientists by their competences. TeMA has been published since 2007 and is indexed in the main bibliographical databases and it is present in the catalogues of hundreds of academic and research libraries worldwide.

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

TeMA Journal of Land Use, Mobility and Environment

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.

TeMA
Journal of
Land Use, Mobility and
Environment

SMART CITY
PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM
Special Issue, June 2014

Contents

TeMA Journal of Land Use, Mobility and Environment

TeMA Journal of Land Use, Mobility and Environment

TeMA Journal of Land Use, Mobility and Environment

TeMA Journal of Land Use, Mobility and Environment

TeMA Journal of Land Use, Mobility and Environment

TeMA
Journal of
Land Use, Mobility and
Environment

TeMA
Journal of
Land Use, Mobility and
Environment

TeMA
Journal of
Land Use, Mobility and Environment

TeMA INPUT 2014
Print ISSN 1970-9889, e- ISSN 1970-9870

DOI codex visible on on-line version

SPECIAL ISSUE

Eighth International Conference INPUT
Smart City - Planning for Energy, Transportation and Sustainability of the Urban System

Naples, 4-6 June 2014

A GIS APPROACH TO SUPPORTING NIGHTLIFE IMPACT MANAGEMENT

THE CASE OF MILAN

GIORGIO LIMONTA

Laboratorio URB&COM, Politecnico di Milano, (DAStU)
e-mail: giorgio.limonta@yahoo.it
URL: http://www.urbecom.polimi.it/

ABSTRACT

Following the increasing liberalisation of commercial activities, which have taken place in the last few decades, the power of municipal authorities to schedule retail and leisure-based businesses has been reduced in its spatial extent; it now applies only to specific 'Protection Zones' (*Zone da sottoporre a tutela*). In these areas, due to environmental, social and/or traffic sustainability reasons, the freedom of private business is limited by the need to respect the right of residents to normal liveability and mobility standards.

This paper describes a research by Laboratorio URB&COM (Politecnico di Milano), aimed at supporting the City of Milan in detecting those spatial contexts whose conditions suggest the application of a specific regulation, in order to control nightlife leisure's negative externalities. A GIS-based analysis approach has proved fundamental in defining an objective and transparent evaluation path, towards the mapping of critical areas where regulation is needed.

In addition, within the proposal of policy monitoring methods, a particular approach has been suggested, based entirely on the use of Information and Communication Technology (ICT).

KEYWORDS

Retail planning, Protection Zones, GIS, KDE, monitoring, ICT

1 INTRODUCTION

Present-day Italian legislation, which follows an incremental business liberalisation process, which has occurred in the past twenty years (D.Lgs. 59/2010, L. 248/2006, D.Lgs. 114/98), allows municipal authorities to programme the start-up of retail and leisure-based businesses only within specific spatial contexts called 'Protection Zones' (*Zone da sottoporre a tutela*[1]). Such zones are established in order to control the impact of highly attractive activities, ensuring public order, security and calm for residents and granting a basic sustainability level on social, environmental and liveability grounds. Therefore, the release of permits to free business is dependent on the achievement of a minimum level of service quality (Tamini 2011).

Since the possibility of scheduling and regulating retailing activities has become an exception, municipalities and other public authorities engaged in such policies are now asked to support their decisions through an objective and scientifically rigorous acknowledgment process.

Politecnico di Milano's Laboratorio URB&COM has supported the City of Milan in the definition of its Protection Zones, and how to apply and define a municipal guideline aimed at managing the externalities of nightlife leisure activities (which are particularly problematic in the case of Milan). This regulation is intended mainly to introduce some qualitative evaluation criteria for the opening of food and drink supply activities (bars, pubs and restaurants), in order to minimise their impact on the urban context in terms of noise pollution, public decency and mobility.

For the mapping of critical areas needing special regulation we have proposed an approach entirely based on GIS technology, useful in defining an objective and transparent evaluation process, achieving the best possible result sharing.

In particular, the evaluation process was divided into two main phases:

The first identified areas "potentially subject to nightlife phenomenon", by analyzing the geography of bars/pubs/restaurants and detecting areas with a high offer density.

In the second phase the "most sensitive municipal areas" were detected, as a result of demographic, environmental and social variable interaction.

Accessibility features and public transport infrastructure were also studied, in a synthesis of public transport service level in the municipal area (which has to be considered as a further indicator).

2 THE DETECTION OF AREAS SUSCEPTIBLE TO NIGHTLIFE PHENOMENON

2.1 MAPPING FOOD & DRINK SUPPLY ACTIVITIES

In order to identify those areas where nightlife-related food & drink supply activities tend to cluster, it was first necessary to define their geography by processing some basic municipal data[2] through a Geocoding[3] method.

---

1 Literally: 'zones to be subdued to protection schemes'. This protection regime is created within a 2010 national decree (D.lgs n. 59/2010, "Attuazione della direttiva 2006/123/CE relativa ai servizi nel mercato interno". Art. n. 64, c. 3.).

2 Open Data are directly or indirectly produced by public administration authorities and shared through their websites in a digital format, as 'usable' data. The City of Milan activated its Open Data service in 2012 at the following URL: http://dati.comune.milano.it/.

3 ESRI ArcGIS' Geocode Addresses was used as a geocoding procedure, which allowed an automatic mapping of database records, finding variably precise matches with the geo-referenced house numbers' layer.

Information about 'opening hours' and 'business type' (as two distinct fields) is provided within the municipal database, which helped to improve the geographical description of the phenomenon, with the possibility of defining both 'by-day' and 'by-night' maps of food & drink supply.

As we can observe, the complete by-day map is made up of 7.192 stores[4], whereas 3.408 businesses keep open after 12 p.m., thus appearing in the general by-night map ('night geography'). This number is further reduced to 1.940, if we include only nightlife leisure-related typologies (bars, pubs, discos, etc.), without catering food service like restaurants (Fig. 1).

Fig. 1 Spatial distribution of food and drink supply activities. Maps refer to: by-day activities, by-night activities (after 12.00 p.m.) and 'nightlife business' specific typologies

2.2 KERNEL DENSITY ESTIMATION FOR THE IDENTIFICATION OF CLUSTERING AREAS

Following the geographical description (first mapping phase), it was necessary to propose a geostatistical interpretation of business spatial distribution, with the aim of identifying the main clustering phenomena (that is, those areas where nightlife entertainment tends to reach a 'critical' level).

The applied geostatistical technique, Kernel Density Estimation (KDE), was widely experimented in the geographic interpretation of social and economic phenomena (Adolphson 2010, Batty *et al.* 2004, Borruso 2004), including the behaviour of retailing businesses (Porta *et al.* 2007).

The choice of this particular spatial interpretation technique for a preliminary selection of critical areas related to nightlife business distribution, was made on the basis of KDE method's specific interpretation approach, which represents a certain density of 'events' (elements being represented in a given space) as a continuous field. In other words, it converts two or more events into a single graphic element, allowing their interpretation and relational analysis. The result corresponds to areas with a variable size and expressing different values, which include the autocorrelated dots and whose value is proportional to the dots' concentration (which means that lower value areas can be found as we move away from the density peak).

Kernel Density Estimation therefore applies on a hypothetical homogeneous plane, setting a given Euclidean distance in order to identify an 'inquiry window'. For this reason it is not yet clear whether this method is really effective in the interpretation of events strongly connected with urban space and its peculiar geometric shapes. Indeed, some published studies showed misleading results when applying KDE to phenomena occurring mainly along streets (Borruso 2005). In previous surveys by Laboratorio URB&COM, some good interpretation results had been obtained in KDE application to retailing by using lines (the linear extension of shop windows) instead of dots (shop entries), as basic analytical elements. The will was that of correlating retail with public space facing it, as well as of introducing variations in window extension as an additional evaluation element (Limonta 2012). This methodological device had proved very effective, although

[4] Data are referred to June 2012.

requiring the precise measurement of each shop window extension, which can be rather complicated in the analysis of large and articulated contexts such as Milan.

In line with these premises, we have proposed an analytical approach based on associating the study of retail phenomena to the one dimensional linear space of the street (network), in order to provide a geographic interpretation of food & drink supply activities. This option was suggested by the output of NKDE[5] application, already tested within several inquiries (Dai *et al.* 2010, Okabe *et al.* 2009, Yamada and Thill 2004).

In our case, maps were analysed and interpreted by using a NKDE version implemented in SANET (Spatial Analysis along Networks)[6], a specific analysis tool designed for ESRI ArcGIS software.

A crucial phase of KDE analysis (both in ordinary and Network version) is the choice of bandwidth, that is, the reference search radius for the interpretation of spatial correlation between dots (businesses, in our case). This choice should be made according to the context and to the analysed phenomenon peculiarities, as it emerges from various experiments and applications (Brunsdon 1995).

In the direct application of this methodology to other contexts, bandwidth sizing had been made in relation to people movements across urban space (Limonta 2012). This criterion was once more adopted, by selecting a spatial range of 370 m, which is the distance a pedestrian can cover in 5 minutes at a speed of 1,25 m/s (an intermediate value between 1 and 1,5 m/s, commonly used in walking speed simulations). The result was divided into 5 classes (density levels) after excluding zero values, according to Natural Break classification method (the Jenks algorithm) used for non-normal distributions (once their number is set, data group divisions/classes are made starting from gaps in the distribution of values, before applying Jenks' algorithm[7]).

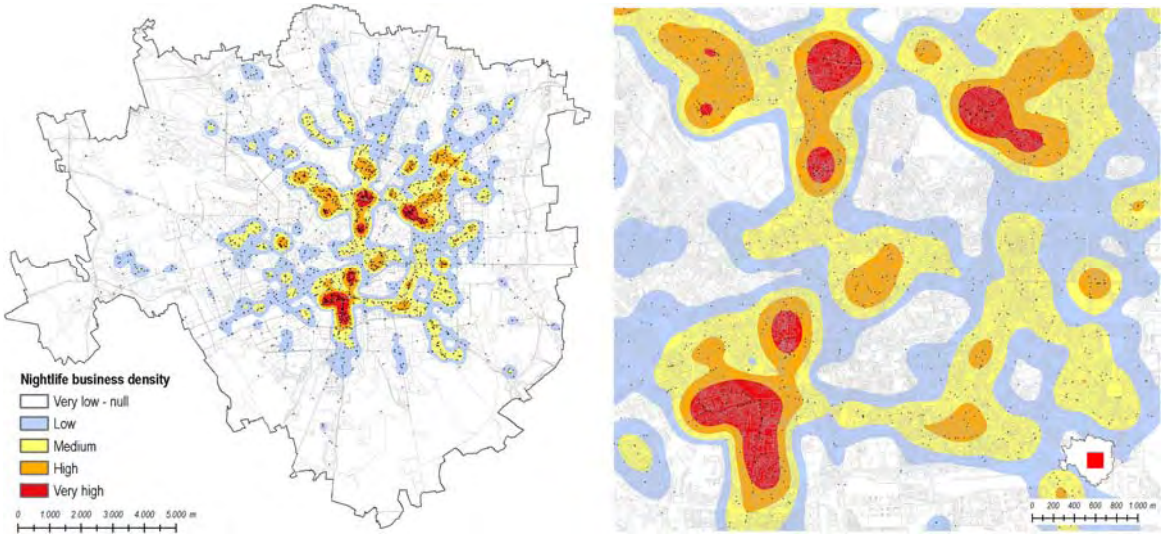


Fig. 2 KDE application: nightlife-related business density levels

5 Network versions of KDE.

6 SANET. A Spatial Analysis along Networks (Ver.4.1). Atsu Okabe, Kei-ichi Okunuki and SANET Team, Tokyo, Japan. SANET software is available at the following URL: *http://sanet.csis.u-tokyo.ac.jp/.*

7 The algorithm aims at determining the best arrangement of values into different classes. It consists in: calculating the sum of squared deviations between each class (SDBC), calculating the sum of squared deviations from the global average (SDAM), then subtracting the SDBC from the SDAM and maximising the result.

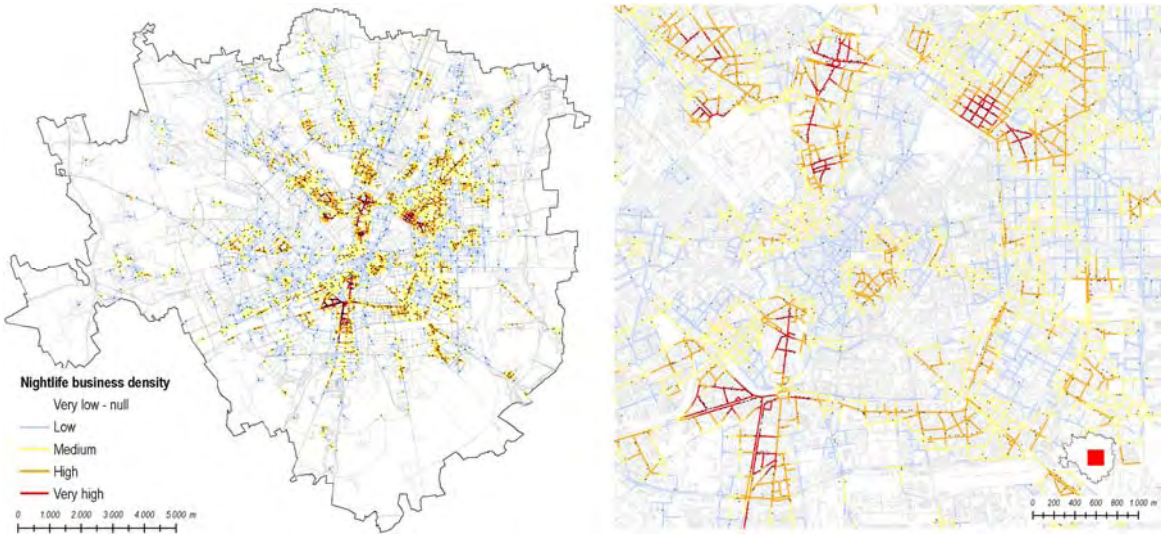


Fig. 3 NKDE application: nightlife-related business density levels

As can be seen from the comparison of the results of the two analytical procedures (Fig. 2 and Fig. 3), NKDE has allowed an improvement in mapping accuracy, since street segments with a very high density of nightlife businesses could be more clearly highlighted. The joint use of the two outputs helped to delimit the Protection Zones.

3 IDENTIFICATION OF MOST SENSITIVE MUNICIPAL AREAS

The second phase identified the "most sensitive municipal areas" (*ambiti comunali maggiormente sensibili*) through certain indicators showing greater or lesser sensitivity to nightlife externalities.

The aim was to identify the most sensitive areas and buildings, as a result of particular environmental and social variable interaction. Variables are the following:

- Distribution and characteristics of resident population;
- Presence of artistic/historical/architectural/environmental heritage;
- Acoustic vulnerability of the municipal area (exposure to noise pollution).

At a later stage, a spatial proximity belt was defined around potentially sensitive areas, according to certain considerations on outdoor sound propagation.

3.1 DEMOGRAPHIC INDICATORS

The study on population distribution started from resident analysis, based on an extract from the Milan civil registry office's database (December 31st 2011). The records were mapped through the same Geocoding procedure previously carried out for mapping food & drink supply businesses (paragraph 2.1). In order to be analysed and represented, the result was aggregated into spatial units corresponding to 2011 census units[8]. It was nevertheless necessary to update and partially change block and parcel perimeters, mainly because of recent urban transformations and, as a consequence, a new residential layout. In some cases, units were re-defined, due to the presence of large open spaces (both public and private), which would have altered the statistical significance of the results.

[8] Census units' grid is freely available on the website of the Italian National Statistical Institute (ISTAT) http://www.istat.it

Once the population had been mapped in connection with revised spatial units, it became possible to identify the following demographic sensitivity indicators:

- Resident population density;
- Population density aged over 60 years;
- Population density aged under 10 years.

For these three demographic indicators was applied different classification methods[9], producing 5 classes (1-very low; 2-low; 3-medium, 4-high; 5-very high).

The interaction of these three demographic indicators identified those areas of Milan potentially susceptible to nightlife externalities. By selecting the highest classes (5) of each indicator, we identified the buildings located in such units as elements to be 'protected'.

3.2 VULNERABILITY TO NOISE POLLUTION AND PLACES OF ARTISTIC, HISTORICAL AND ENVIRONMENTAL INTEREST

Noise pollution is a serious and widespread problem in big cities around the world, affecting human behaviour, welfare, productivity and the long-term health of people. Environmental noise is a major environmental problem at the local level in Europe and the source of an increasing number of complaints from the public. For this reason, we decided to include urban areas defined as "Specially Protected Areas" (*Aree particolarmente protette*) by the Italian legislation[10], besides 'sensitive buildings' detected through demographic indicator analysis. These areas include all the functions whose "assumes quiet as a basic element: hospitals, schools, sites for rest and leisure, rural residential areas, areas of particular interest for planning, public parks , etc".

For the same reason, elements related to the city's artistic, cultural and environmental heritage were also considered as susceptible to potential nightlife externalities. In particular, we included:

- Monuments, buildings and other elements of architectural and historical value;
- Protected historical gardens and parks;
- Protected natural and agricultural areas (namely, Parco Agricolo Sud and Parco Nord Milano).

All architectural elements and areas identified in the previous phases were shown together on a map, as the city's areas "most sensitive to externalities generated by nightlife phenomenon". Many buildings and areas

[9] *Residential density (m2 per inhabitant)*. The output values showed an abnormal statistical distribution, due to substantial variations in housing features. For this reason, before classifying values, it was necessary to exclude census units with a zero density value. Subsequently, values were processed through a base-10 logarithmic transformation, in order to reduce their variance and therefore relatively to normalise the statistical distribution. At a later stage, a quantile classification method was applied, producing 5 classes. In this method, each class contains the same number of features.
Concentration of population older than 60 years. A normal statistical distribution permitted the classification of output values without previously transforming them. However, it was necessary to exclude from classification those census units with too low levels of resident population ("very low" density class shown at the previous indicator) and with a zero percentage of over-60 residents. In such cases, poor statistical evidence would have generated a misleading interpretation of results. The highest class (class 5) identifies census units with an over-60 population amounting to 70% or more.
Concentration of population younger than 10 years. As in the previous analysis, the observed statistical distribution here was normal, but some exclusions were nevertheless necessary. In this case, census units with zero percentages of under-12 population were ignored, besides insufficiently populated ones. In this case, class 5 corresponds to units where under-12 residents amount to more than 16%.

[10] Reference to the DPCM (Prime Ministerial Decree) of March 1st, 1991 ("Limiti massimi di esposizione al rumore negli ambienti abitativi e nell'ambiente esterno") and the DPCM of November 14th, 1997 ("Determinazione dei valori limite delle sorgenti sonore").

proved sensitive to more than one indicator, as in the case of religious buildings or hospitals, both classifiable as historical heritage and services.

3.3 DETECTING THE 'INTERACTION BAND'

At a later stage, it was possible to identify an 'interaction band', meaning the space within which noise - a major nightlife externality - comes into contact with objects and areas previously classified as 'sensitive'.
For the sizing of interaction bands, the measurement of noise was made by merely considering customers' outdoor clamour, since the legislation already submits nightlife businesses to specific sound-proofing standards. The aim was to determine the desirable minimum distance from a 'noisy' sound source, in order to reduce the level of sound pressure regardless of the acoustic climate value of the specific urban context (Fig. 4).
To do this we used a calculation procedure considering sound propagation from omnidirectional point sources[11] in free field, according to UNI ISO 9613 *Attenuation of sound during propagation outdoors* (Part Two). The purpose of ISO 9613-2 standard is to provide an engineering method for calculating the equivalent continuous A-weighted sound pressure level under meteorological conditions favourable to sound propagation (for downwind propagation or in moderate ground-based inversion conditions). The basic equation shown in UNI ISO 9613-2 is the following:

$$Lp(f) = Lw(f) + ID(f) – A(f)$$

Where:

- Lp is the equivalent octave-band sound pressure level, in decibels, generated at a given point (p) by a given source (w) at a given frequency (f);
- Lw is the octave-band sound power level produced at the given f frequency (in dB) by the point sound source (w) relative to a reference sound power;
- ID corresponds to the directivity index of the sound source (w), in case of directional sound source (e.g. for car motors, air treatment plants, etc.);
- A is the octave-band attenuation (in dB) at the given f frequency, that occurs during propagation from the sound source (w) to the receiver (p). Attenuation A is formed by the summation of several sound attenuations, due to several factors (geometric divergence, atmospheric absorption, etc.).

For the purposes of our study, we applied certain simplifications in respect of the determination of values indicating environmental conditions and ways of propagation:

- Background noise was not considered, due to variability depending on the urban context;
- The only estimated sound attenuation factor was that of geometric divergence, since at this stage it was not considered either possible or appropriate fully to evaluate other factors impacting on the extent of sound wave propagation;
- The clamour originated from groups of people, as a set of omnidirectional point sources, was regarded as a sound source, ignoring the amplification value due to D index of directivity.

[11] There are two types of sound source: point s. and line s. Point sources are those of small size compared to the receiver's distance (voices of people, machine noise, etc.). A linear source is narrowed in one direction and lengthened in another, in comparison to the receiver's distance. It can be made up by a series of point sources acting simultaneously along a line (for example a flow of motor vehicles).

Adopting these premises, the following equation permitted the calculation of the distance (r) allowing the abatement of the reference sound source value, in free field:

$$Lp = Lw - 20 \log r - 11 \text{ (dB)}$$

The sound source reference value (Lw) was deduced by using standard levels normally used to assess sound pressure in daily life.

LP (in DB)	EXAMPLES	SUBJECTIVE EVALUATION
130	Pain threshold	PAIN
125	Aircraft take-off 50 metres away	INTOLERABLE
120	Siren at short distance	INTOLERABLE
110	Jackhammer	VERY NOISY
100	Transiting train, disco,	VERY NOISY
90	Heavy truck, scream	VERY NOISY
80	Heavy truck 1 metre away	NOISY
70	Loud radio, whistle	NOISY
60	Noisy office, conversation	NOISY
50	Normal conversation 1 m away	QUIET
40	Inhabited neighborhood at night	QUIET
30	Whispers 1 m away	VERY QUIET
20	Rustle of leaves, human breath	VERY QUIET
0	Absolute threshold of hearing	NON-AUDIBLE

Tab. 1 Sound pressure levels in daily life

The considered sound pressure (produced by two or more persons) was amplified in respect of a hypothetical group of fifty customers positioned outdoors. Supposing that each customers in pairs can produce a borderline-level of 60 dB sound pressure (Tab. 1), we calculated a reference value of 77 dB[12].
The estimation of a buffer-distance of 20 metres, abating sound pressure down to 40 dB, was made only according to this reference value, without considering background noise (though this is typical in real urban environments).

3.4 IDENTIFICATION OF DIFFERENT ACCESSIBILITIES BY PUBLIC TRANSPORT

A further insight into contextual criticalities looks at varying accessibility levels in relation to the public transport network serving the City of Milan. The study of this issue entailed a certain degree of simplification, given its undeniable complexity. In fact, the only accessibility indicator considered was proximity to a station/stop of the rail transport network (underground, ordinary train and suburban rail bypass), either of a major ATM[13] line.

[12] Multiple-source sound pressure level derives from an addition which cannot correspond to a simple arithmetic sum of decibels, due to their logarithmic nature. In this case, decibels were converted into the line value of each individual source, thence summed and converted again.
[13] Azienda Trasporti Milanesi.

'Proximity' attribute was assigned within a given time/distance range (starting from the stop) walkable at a speed of 1,25 m/s[14], which was calculated through a GIS approach in reference to the overall municipal road network. For underground and railway stations a maximum distance of 5 minutes was assigned, falling to 3 minutes for other major ATM network stops. It was subsequently possible to subdivide the overall municipal area into a number of accessibility classes, through a superimposition of stops and station gravitation zones. The higher accessibility score was conferred to underground stations, the intermediate one to train stations and the lowest to remaining ATM stops.

The synthesis map divides the city area into five classes, from low/null accessibility (ordinary ATM stops) up to spots near to both underground and train or to all three analyzed types (Fig. 4).

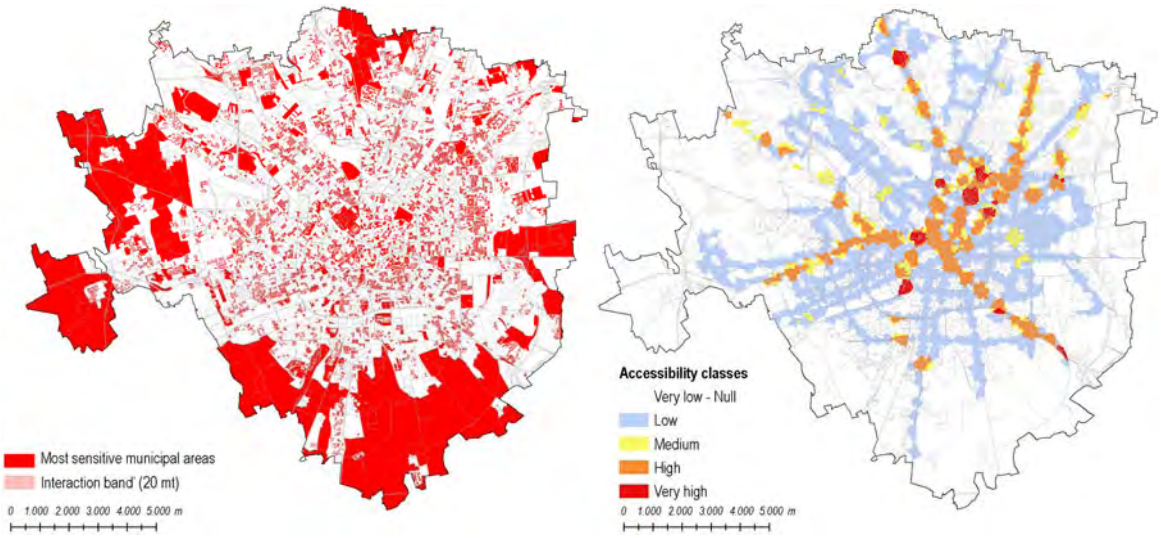


Fig. 4 Most sensitive municipal areas and pertaining interaction band (left figure) and classification of the municipal area according to public transport accessibility (right figure)

4 IDENTIFYING PROTECTION ZONES

Finally, it was possible to identify the Protection Zones within the municipal boundary, an outcome deriving from the synthetic superimposition of maps created at the end of each analysis phase.

Protection Zones emerged from the overlapping of potential criticalities (Fig. 5). The red perimeters (that is, areas with a "very high" businesses' density) are to be considered as the starting geometric elements for their definition. Progressively, the perimeters were broadened, including the "high" density along with the "most sensitive" municipal areas, and possibly considering a scarce or zero accessibility by public transport. "Most sensitive" areas were excluded from the perimeter, in case the density level was less than "high". The perimeter itself was always approximated, and it coincided with a varying spatial element – the street border or centre line, a park or a neighbourhood boundary, etc. - according to the situation.

At last, two distinct Protection Zones (one of which with a higher protection level) were identified, depending on the actual nightlife criticality. These were defined after a measurement campaign carried out by the Regional Environmental Protection Agency (ARPA)[15].

[14] In specialist literature, the average speed for pedestrians is typically comprised between 1 and 1.5 m/s.

[15] ARPA made a Noise measurement campaign within the Protection Zones between September 2011 and August 2012, in order to verify the amount of noise and its seasonal variability.

It is inside these perimeters that the City of Milan provides a 'qualitative' programming, meaning a regulation of permits aimed at limiting the negative impacts of existing night leisure businesses.

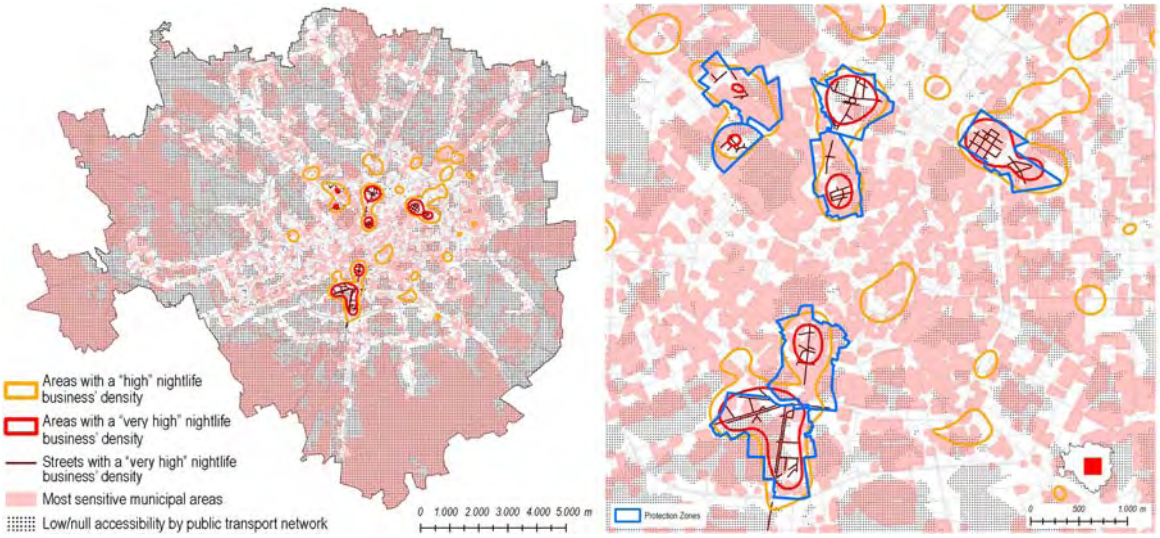


Fig.5 Synthesis map: overall and detail views with the Identified Protection Zones

5 ICT AS A TOOL FOR MONITORING THE EFFECTS OF REGULATORY POLICIES

In proposing a qualitative approach to regulatory policies addressed at nighttime leisure activities[16], it is strongly recommended to consider innovative procedures for both evaluation and monitoring of the proposed solutions. In particular, the use of Information and Communication Technologies is suggested in order to monitor noise pollution, undoubtedly the most critical externalities of nightlife and at the same time the most suitable indicator for assessing the effect of implemented policies, or the respect of municipal criteria. Currently, two main approaches are employed in the detection and monitoring of noise pollution in a given spatial range: through *sensor networks*, and through *direct measurement campaigns*.

5.1 SENSOR NETWORKS

The installation of sound sensors in a given urban context and the setup of sensor network allows for real-time monitoring of environmental phenomena such as noise, weather conditions, air quality, etc.. Installations can take advantage of existing fixed networks, such as public lighting. In this way it is possible constantly to monitor the effects of noise pollution regulation and to detect possible violations.
Among the advantages of this system there is the possibility of a rigorous and precise monitoring, guaranteed by the presence of specifically assigned personnel, plus the option of periodic reports and timely violation warning. High costs are definitely the main disadvantage (although the exploitation if existing lighting network allows fair economies). In addition, the outdoor location of sensors does not help to assess the real impact of noise in home environments.

5.2 MEASUREMENT CAMPAIGNS

This investigation method involves qualified personnel equipped with appropriate instruments, with which to measure noise pollution in specific areas and time periods. The procedure does not allow a constant noise

[16] This category clearly includes daytime businesses that keep open during the night or part of it.

monitoring if not through the direct involvement of the resident population, as was the case in the UK with some interesting "community mapping" experiences[17]. One of the main efforts required is people's training to the use of technical equipment such as sound level meters and GPS for the geolocation of outcomes. This can prove a strong constraining factor, due to unaffordable costs of equipping and training a large number of participants. Furthermore, the probing of measurements requires continuous support by technical personnel.

5.3 MOBILE NOISE MONITORING AND NOISETUBE PROJECT

Besides these two approaches, there is also a third mode, definable as 'mobile tracking', which proposes a particular way of monitoring of noise mitigation policies that can prove very useful in the containment of nightlife negative externalities.

This approach is based on the direct involvement of 'ordinary' people through Web 2.0 tools and practices. Web 2.0. implies new ways of active participation and expression of citizens allowed by today's web platforms, which transform the role of the public from passive information consumers into active users of social connection tools (e.g. social networks) and authoring tools (e.g. wikis, blogs, etc.).

In many European countries there is wondering about the possibility to use these instruments to improve the citizens' quality of life, and particularly whether it is possible to employ digital world's User-Generated Content (UGC) in the monitoring and evaluation of real world's phenomena and practices (Maisonneuve et al, 2009). In recent years there have been interesting experiences of measurement and monitoring of urban problems through the use of Smartphone applications[18].

Taking the cue from one of these experiences, aimed at monitoring noise pollution, we propose a practical and low-cost procedure for assessing and monitoring the impacts of nightlife.

NoiseTube[19] project consists in an application for Smartphones that converts mobile phones into sound sensors, thus making their owners contribute to the mapping of noise pollution in specific parts of the city (Fig. 6). A pilot experiment was conducted in Antwerp (Belgium), bringing to a mapping of local noise pollution dynamics (D'Hondt et al., 2012).

Fig. 6 Example of acoustic mapping by NoiseTube app (Milan, "Lazzaretto" neighbourhood)

[17] http://www.mappingforchange.org.uk/.

[18] An interesting example is given by Italian WeDU! Decoro Urbano, an application used by citizens to publicly denounce damages or dysfunctions of urban furniture and urban fabric. http://www.decorourbano.org/.

[19] http://noisetube.net.

6 CONCLUSIONS

We decided to provide a detailed report of this research path in order to propose a possible methodology for the analysis of complex urban contexts, not only to identify critical areas where to apply regulations and programming, but also to identify the excellences and strengths of specific retailing systems. Retail can be considered to all effects as a service to the city, both on a local and on a regional scale. Actually, high concentrations of shops and stores may qualify the city itself, by supplying it with attractive environments and equipments. For this reason, urban development plans or local regulations (regardless of their specific goals) are highly recommended to acknowledge and endorse the role of retail in the organization of city centres and in the enhancement of public spaces.

REFERENCES

Adolphson, M. (2010), "Kernel densities and mixed functionality in a multicentred urban region", *Environment and Planning B: Planning and Design*, 37.

Borruso, G. (2004), "Network density and the delimitation of urban areas", *Transactions in GIS*, 7.

Borruso, G. (2005), "Network Density Estimation: Analysis of Point Patterns over a Network", in Gervasi, O. (cur.), *Computational Science And Its Applications - Iccsa 2005 (Part III)*, Springer-Verlag Berlin Heidelberg.

Brunsdon, C. (1995), "Estimating probability surfaces for geographical point data: An adaptive kernel algorithm", *Computers and Geosciences*, 21.

Dai, D., et al. (2010), "The impact of built environment on pedestrian crashes and the identification of crash clusters on an urban university campus", *Western Journal of Emergency Medicine*, 11.

D'Hondt, E., et al. (2012), "Participatory noise mapping works! An evaluation of participatory sensing as an alternative to standard techniques for environmental monitoring", *Pervasive and Mobile Computing*, doi:10.1016/j.pmcj.2012.09.002.

London 21. *Mapping Change for Sustainable Communities project, London, UK*. Information available at http://www.london21.org/page/79/project/show/mcsc (retrieved Februari 20th, 2010).

Maisonneuve, N., et al. (2009), "NoiseTube: Measuring and mapping noise pollution with mobile phones", in Athanasiadis I.N., *Information Technologies in Environmental Engineering*.

Okabe, A., Satoh, T., Sugihara, K. (2009), "A kernel density estimation method for networks, its computational method and a GIS-based tool", *International Journal of Geographical Information Science*, 23.

Okabe, A, Okunuki, K, Shiode, S. (2006), "SANET: A toolbox for spatial analysis on a network", *Geographical Analysis*, 38.

Porta, S., et al (2007), "Correlating densities of centrality and activities in cities: the cases of Bologna (IT) and Barcelona (ES)", in *Planning, Complexity and New ICT*, Alinea Editrice, Firenze.

Tamini, L. (2011), *Il progetto di centralità. La regolazione urbanistica degli aggregati commerciali*, Rimini, Maggioli.

Yamada, I., Thill, J-C. (2004), "Comparison of planar and network K-function in traffic accident analysis", *Journal of Transport Geography*, 12, pp 149-158.

AUTHORS' PROFILE

Giorgio Limonta

Urban planner and a member of Laboratorio URB&COM a research group of Politecnico di Milano's Department of Architecture and Urban Studies (DAStU). He contributes to the unit's research and consulting activities, specifically focusing on the geographic analysis and representation of retailing phenomena through GIS software.