

# 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).

# INPUT 2014

papers selected

## Smart City

planning for energy, transportation  
and sustainability of the urban system

## SMART CITY

## PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

Special Issue, June 2014

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# 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.

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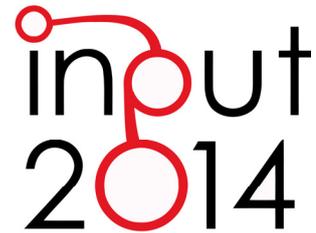
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# TeMA

Journal of  
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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.



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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](http://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](http://www.tema.unina.it)). The codex is not present on the pdf version of the papers.

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

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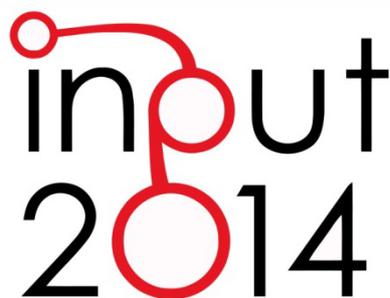
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## SPECIAL ISSUE

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

*Naples, 4-6 June 2014*

The logo for the INPUT 2014 conference. It features the word 'input' in a lowercase, sans-serif font, with the 'i' and 'n' connected by a red line that forms a circle. Below 'input' is the year '2014', where the '0' is a large red circle. The entire logo is rendered in black and red.

## SOCIAL MEDIA GEOGRAPHIC INFORMATION:

RECENT FINDINGS AND OPPORTUNITIES FOR SMART  
SPATIAL PLANNING

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### ABSTRACT

This paper deals with the opportunities of Social Media Geographic Information (SMGI) as valuable support for analysis, design and decision-making in urban and regional planning. In the light of the recent advances in digital geographic information, such as Spatial Data Infrastructures (SDI) and Volunteered Geographic Information (VGI) which are fostering innovation in urban and regional planning, the authors focus on the potentialities of Social Media as source of knowledge for the planning practices. The authors argue SMGI may play an important role to inform 'smart city' strategies extending authoritative and sensor data infrastructure with experiential and pluralist citizens knowledge. To support this thesis, an innovative methodology for the advance of Social Media Geographic Information (SMGI) Analytics is proposed. To this end, the authors present an original user-friendly tool able to extract information from popular Social Media such as Twitter.com and Youtube.com and to apply Spatial-Temporal Textual (STTx) analysis. Some examples are provided at the regional and at the local scale in order to demonstrate the potential of SMGI analytics in regional and urban planning. The results show how SMGI analytics can support design, analysis and decision making in planning, and add the value of pluralism to inform smart city initiatives.

The paper ends with some brief conclusions on the opportunities of SMGI analytics for possibly affecting decision-making dynamics and urban and regional planning processes, through citizens' dialogue and integration of experiential and professional knowledge.

### KEYWORDS

Social Media Geographic Information SMGI – Urban Regional Planning – Volunteered Geographic Information VGI – Computational Social Science

## 1 INTRODUCTION

Nowadays, an unprecedented wealth of digital geographic information is made available to planners to support design, spatial analysis and decision-making. This trend could foster notable innovations in urban and regional planning methodologies. Advances in urban and regional planning practices may represent an opportunity of great potential to eventually enrich 'smart city' strategies with a broader, deeper and more pluralist knowledge of the places. Opportunities for innovation and development of planning practices emerge from the avalanche of "big" geographic information, which Web 2.0 technologies made available to the wider public. First of all, advances in Spatial Data Infrastructures (SDI) enabled the public access and reuse of available Authoritative Geographic Information (A-GI) according to common data, technology, and policy standards. The implementation of the Directive 2007/02/CE, establishing a shared INfrastructure for SPatial InfoRmation in Europe (INSPIRE), leads to the development of Spatial Data Infrastructures (SDI) in Member States and regions. SDIs impact may provide beneficial results for public administration, developers and planning practitioners, and slowly is bringing innovation into the planning practices (Campagna and Craglia 2012). For example, in many regions in Europe, the regional SDIs already represent the de-jure technical platform for the development of regional and local planning processes, by means of supplied data and services. This process is already slowly fostering innovation in the planning practices, although the target of a de-facto planning professional digital uptake is still a long way to go.

Secondly, developments in connectivity, geobrowsers and mobile technologies, enabled by Web 2.0, allow citizens acting as volunteer sensors (Goodchild 2007) to provide GI real-time in a bottom-up fashion. This information encloses both expert knowledge from professional and experiential knowledge from local communities, producing an enormous opportunity for enhancing the available knowledge base in urban and regional planning. Currently, this wealth of digital information, or Volunteered Geographic Information (VGI), can be easily collected, analysed, understood and used to support informed decision-making. These opportunities can both enable a transactive approach (Friedman 1973) in planning practices and foster the democracy and the sustainability in plan-making, according to a communicative process (Innes 1995). In several countries worldwide, the use of VGI is easing and fostering participatory processes, becoming a main source of information in planning emergency response, and in local planning for countries where authoritative data sources are absent at large scale. As a matter of facts, the concept of citizens observatories for environmental protection is an issue enclosed in the EU Framework Programme for Research and Innovation Horizon 2020 (i.e. Call SC5-17-2015).

In addition, widespread diffusion of social media is fostering the diffusion of geo-referenced multimedia (Sui and Goodchild 2011), or Social Media Geographic Information (SMGI), over the global Internet. Users can easily access information and also be the producers and broadcasters of personal geo-referenced contents on location-based social networks. These capabilities have overtaken past limits in data communication, and are disclosing innovative opportunities for disseminating and gathering geographic information among million of users, fostering the media convergence with GIS (Sui and Goodchild, *ibidem*). The social media contents can be considered an innovative Big Data source (Caverlee 2010), and the traditional spatial analysis methodologies and techniques may be considered not adequate to manage and take advantage of their knowledge potential (Campagna, *forthcoming*). The potential of SMGI may be considered still limited for the public users both in terms of accessibility and of available analytical instruments, and new methods and tools should be developed accordingly. However, petabytes of freely and publicly available information offered through social media may offer opportunities for innovation in spatial planning. SMGI could be detected and used to perform further analysis, in order to provide knowledge for decision-making (Zin *et al.*

2013). The integration of SMGI with A-GI can disclose innovative analysis opportunities in spatial planning, with regards not only to measures of geographic facts but also to users perceptions and opinions on places, localities and daily-routine events (Campagna *et al.* 2013). The management issues for this data avalanche gave rise to the emergence of a new field of research called Computational Social Science (Lazer *et al.* 2009). In literature several studies have been found, offering different approaches for the management and analysis of SMGI in order to provide useful knowledge for decision-making support in different domains.

The results of the elicitation of SMGI knowledge and its integration with A-GI, could foster the development of 'smart city' strategies informed by the local communities needs and opinions in a bottom-up approach. The concept of smart city performs an important and central role in the development of urban policies, as a way for combining innovative technological solutions to provide sustainability and livability in cities (Toppeta 2010). A smart city builds on investments in human and social capital, management of resources, transport infrastructures, and information and communication technologies (ICT) to ensure sustainable development and quality of life (Caragliu *et al.* 2009). Although in the past ICT and Web 2.0 have been considered fundamental for smart initiatives (Wilson 1997), and the Internet and broadband networks were seen as leading enablers of fundamental e-services (Kroes 2010), the smart city strategies should be considered as the organic integration of different systems (Dirks and Keeling 2009) or fundamental concurrent factors (Chourabi *et al.* 2012). For these reasons, the collection and analysis of SMGI should be fostered to inform and enrich the integrated system of a smart city.

In the light of these premises, the remainder of the paper is organised as follows. In section 2 recent trends on social media and the current convergence of social media with GIS are analysed in details, in order to describe opportunities of SMGI as support for design, analysis and decision-making in regional and urban planning. In section 3 the authors present a brief report on the main components related to smart city initiatives, with the aim of identifying the major elements that could be affected by SMGI. In section 4 a novel approach is proposed by the authors for the development of Spatial Multimedia Analytics (SMA) of SMGI in GIS by means of the tool Spatext. In section 5 the authors draw some conclusions, summarising the discussion on the opportunities offered by SMGI to inform smart city strategies and to support urban and regional planning.

## 2 FROM SOCIAL MEDIA TO BIG DATA ANALYTICS

The widespread diffusion in mobile social media applications, enabled by Web 2.0, is producing an unprecedented availability of information over the Internet. An important measure of this avalanche of information can be easily appraised by available statistics on major social platforms (100 Social Networking Statistics & Facts 2012). For example, Facebook exhibits 552 million of daily active users and over 1 billion of registered users, which spend over 6 hours by month on the social platform; YouTube, Twitter, Google+, LinkedIn, Instagram, Pinterest, Flickr, Tumblr, representing only few of the major, despite smaller values in terms of users, show considerably contents production. Statistics depict the social media panorama as a world where every minute 2 million queries are submitted to Google, and every day 340 million tweets are sent, 300 million pictures are uploaded via Instagram, and 48 hour of videos are uploaded on YouTube, getting over 600 million views. These values show how petabytes of digital contents about any topic could be found through available internet services, fostering new opportunities for analysis and research. Social media platforms can be considered as the natural evolution of microblogging systems, that offered opportunities for the management, creation and diffusion of information in a recursive cycle of production and consumption (Vieweg *et al.* 2010). In addition, the current capabilities of social networks allow users to

include geographic information into their own generated contents, driving geography into daily routines, and fostering the convergence of GIS and social media as argued by Sui and Goodchild (2011). As such, social networks could be considered as affordable and potentially boundless sources for information about daily life, events and also opinions, feelings and needs of users, related to geographical locations and facts. However, information provided by social platforms, should deal with several major issues for an useful use: data reliability, data management and knowledge extraction.

Social platforms offer different ways for management, sharing and extraction of contents, provoking a degree of uncertainty for the knowledge processing. Unlike traditional geographic information, SMGI either concerns dynamic processes on the Earth surface or users perceptions of them related to a specific time period, and requires advanced tools to support real-time monitoring, analysis and decision-making. The reliability and quality offered by SMGI for research and practice, as it is the case for VGI, are being discussed, and further efforts and investigations are required to define the reliability of this information (Jennex, 2010). VGI could be processed to elicit useful knowledge in relationship with specific degrees of uncertainty, in order to overtake credibility issues (Spinsanti and Osterman 2013).

Moreover, several hurdles arise in finding suitable practices and procedures to manage the available avalanche of information. Advanced Big Data analysis could represent a suitable solution to extract and manage social media information. Indeed, a direct extraction of the content (what?) rather than the causality (why?) from data (Pohl and Pohl 2013) could be performed, in order to avoid information volume issues and take advantage of current computing capabilities. In several domains, advanced Big Data analysis have been proposed and explored to manage the wealth of digital information, exposing interesting results for diverse analysis purposes.

Similarly, issues related to knowledge extraction can be addressed by the application of Big Data analysis techniques, Social Computing analysis, and also by the integration of crowd-sourced with authoritative data. The current rise of social media and computational capabilities can allow the process of several multimedia contents (text, video, image, sound), disclosing innovative opportunities for the study of human beings and society (Manovich 2011).

In literature, several studies conducted through analysis of SMGI have been found, embracing several fields of interest, such as: disaster events response, political events, media events, social studies and urban planning. Innovative instruments and analysis have been applied to detect events and information related to disasters both by means of analysis on Twitter (Li *et al.* 2012) or Twitter and YouTube (Zin *et al.* 2013). Flickr tags have been used in semantic analysis for the development of social studies (Rattenbury *et al.* 2007), or for investigating people movement and landmarks preferences in urban environment (Jankowski *et al.* 2010). In addition, the temporal component of Twitter contents has been used to determine urban land uses according to human dynamics (Frias-Martinez *et al.* 2012).

These considerations provide an overview on the wide diffusion of SMGI in several domains. However, despite the interesting results for elicitation of knowledge, further studies and advancements should be required for investigating views, needs, and opinions of individuals and communities. The wealth of information available from social media about facts, opinions and feelings of users could affect the current practices in design, analysis and decision-making, and could inform smart strategies with a real-time monitoring of needs and requirements of local communities.

A brief overview on the main components of smart city initiatives and the opportunities for integration of SMGI knowledge in such strategies is presented in the next section.

### 3 AN OVERVIEW ON 'SMART CITY' STRATEGIES

The label 'smart city' recently emerged as a broad term to identify several strategies for dealing with problems generated by rapid urbanization and population growth in cities. A smart city strategy builds on the central role of the Internet and Web 2.0 to deal with several societal challenges, as well as urban welfare, societal participation, environmental sustainability and quality of life (Schaffers *et al.* 2011). In literature, several definitions of smart city can be found, concerning diverse elements that should be considered for the success of such kind of strategy. According to Hall (2000), a smart city should monitor and enhance the condition of its infrastructures, plan activities and increase the offer of services to its citizens. ICT and Web 2.0 should be considered fundamental to integrate, connect and make efficient the global system of infrastructures and services (Washburn and Sindhu 2010), or to improve livability and sustainability in the urban systems (Toppeta 2010). Moreover, the physical, IT, social, and business infrastructures are seen as fundamental components to foster the intelligence of the city (Harrison *et al.* 2010). Technology may be fundamental to achieve 'smart cities' as sources of spatial enablement for citizens, in order to improve access, sharing and integration of spatial data with services (Roche *et al.* 2012). Despite the increasing and common use of term 'smart', the concept behind these strategies has been investigated and considered from different points of view in literature, offering several clues and challenges for further investigation.

The technological component offered by ICT and Web 2.0 should not be considered as the only success key for advancements, but rather successful results of smart initiatives should depend upon the integration of technological components with managerial, political and contextual dimensions of the city (Nam and Pardo 2011). ICT should be merged, integrated and used to coordinate traditional infrastructures and services, easing the comprehension and analysis of urban complexity. At the same time, technologies should allow innovative forms of communication, governance and organization for the community engagement in evaluating and solving urban key problems (Batty *et al.* 2012). These dimensions can be further defined by a comprehensive set of factors (Chourabi *et al.* *ibidem*). In the study eight factors have been considered fundamental for shaping smart city strategies: management, technology, governance, policy, community, economy, physic infrastructure and natural environment. This set of components can be related to the requirements for collaboration, networking and coordinate interaction, as argued by Adam (1996) with regards to e-governance initiatives success factors. A similar classification of elements has been provided also by a study conducted on smart initiatives worldwide (Lindskog 2005), wherein synergy among components has been identified as the main success key factor.

Among the several factors, governance, policy and community, enclosed in the political dimension, could perform an important and central role for a 'smart' development. Several stakeholders are involved in the implementation of smart city strategies, and a deep exchange of information and tight relationships are required to avoid the failure of projects (Scholl *et al.* 2009). Policies establish laws and regulations and accordingly can supply the enabling conditions for integration of technology in urban development (Dawes and Pardo 2002). People and communities address a critical role in the development of smart cities, due to the fact that strategies directly affect the quality of citizens life. Furthermore, citizens and local communities supply a central role, with their needs and opinions, in the interests of smart cities for participation and transparency during the development of process.

Hence, the opportunities of SMGI for supplying a depiction of opinions, needs and perceptions of local communities real-time could represent a valuable source of information. Actually, scarcity of reliable and user-friendly methods for knowledge extraction from SMGI could prevent to exploit the full potential from these sources. In order to contribute to this challenge, a novel approach is proposed below for the Spatial

Multimedia Analytics (SMA) of SMGI. The method has been applied to a case study example using a tool called Spatext, that features several functionalities to analyze SMGI in GIS environment.

## 4 A NOVEL APPROACH TO SMGI ANALYTICS

Considerations on the widespread diffusion of SMGI over the global Internet, and the requirements of smart cities, lead toward the investigation of opportunities that SMGI may disclose in urban and regional planning. The investigation aims to demonstrate the opportunities of SMGI as support for design, analysis and decision making in planning, and the consequent value to inform smart city initiatives. The novel approach builds on the use of an ad-hoc instrument called Spatext for coupling the extraction, the management and the analysis of SMGI in GIS environment.

### 4.1 THE SPATEXT TOOL

The Spatext STTx suite is implemented as add-in for ESRI ArcGIS©. It includes ten tools, which can be used to achieve three main goals for analysis: (1) social media data retrieval from Twitter and YouTube, (2) data geocoding, and (3) tag clouding of textual content. These supplied features rely on four open Python modules, namely *tweetersearch* and *YouTubeExtractor* for data harvesting, *geopy* for the geocoding, and *pytagcloud* for the tag clouding, and ad-hoc scripts. The coupling of Spatext functionalities with standard GIS spatial analysis tools can ease the integration of SMGI with authoritative data, for analysis, design and support of decision-making in urban and regional planning. In the remainder of the paper, the application of Spatext is briefly described with relevance to an original approach for the analysis of YouTube contents in GIS environment.

### 4.2 METHODOLOGY AND CASE STUDY

The approach builds on a preliminary exploratory analysis of YouTube contents of Sardinia (Italy) searching for most used and shared topics among user videos, without imposing any research filter. The analysis has been conducted by means of textual analysis in form of tag cloud and spatial analysis through GIS tools, on the textual contents embedded in videos metadata. The aim of the textual analysis is to identify words, which can be considered directly related to toponyms, activities or feelings, for depicting users perception of Sardinia and for allowing further analysis on detected topics.

The second step of the approach focuses on the analysis of a specific topic with relevance for urban and regional planning of Sardinia, namely: 'landscape', investigating potential meaningful spatial patterns by means of a textual analysis on harvested contents, and the integration of videos dataset with authoritative geographic information. Indeed, the integration of A-GI with SMGI provided by users and local communities could disclose useful patterns and information both for design and decision-making.

The last step of the approach has been based on the analysis of datasets extracted from YouTube for several neighborhoods in the municipality of Cagliari (Sardinia, Italy) and the urban park of 'Molentargius'. The goal of the analysis is the investigation of perceptions and opinions of users on the neighborhoods and the park area, in the light of the topics emerging by the textual analysis of videos contents. All together these analysis are able to cover different scales of spatial planning.

In the next sections, the results of data retrieval, preliminary exploration, and spatial and textual analysis for the different steps of the approach are proposed. The results aim to demonstrate both the capabilities of the methodology for analysis at different scales and the opportunities for SMGI use in spatial planning.

#### 4.3 DATA RETRIEVAL AND EXPLORATORY ANALYSIS AT THE REGIONAL SCALE

In Spatext the retrieval of contents from YouTube is performed by the *YouTube Extractor* tool, which allows the collection of data by a keyword search within a given radius around a specific location. Initially, for the purposes of the exploratory investigation, the dataset has been collected by setting the geographic area of extraction for the whole Sardinia, while no keyword has been set to avoid any constraint in the data extraction. The data retrieval allowed the extraction of the most relevant 3507 videos for Sardinia from YouTube and the automatic generation of a point feature dataset, based on the location attribute stored in the video metadata. The resulting dataset includes attributes providing information on title, author, description, data of publication and URL link, offering opportunities for the development of further analysis in combination with other spatial data layers.

The exploratory analysis of the dataset has been conducted through both the observation of spatial distribution of videos in Sardinia and the tag cloud analysis of textual contents. The dataset exposed an uniform spatial distribution over the Sardinian territory, so fostering opportunities for a general comprehension of user contents and trends at the regional scale.

A textual analysis was also conducted on the title and on the description of videos to discover the most frequent words in the dataset. The tag-cloud is the visualization of word frequency in a weighted list and graphical form, and it is suitable to depict the topicalities of a text and to recognize possible underlying information. The textual analysis searched the 200 most used words both on the titles and on the descriptions to investigate potential dissimilarities in contents and to improve the understanding of detected words. The resulting tag cloud shows different words for the considered textual contents, but a semantic analysis leads toward the identification of an underlying set of common categories.

Hence, the words have been classified accordingly. Several words can be considered as 'noise' caused by different languages and sentence structures, however, most of the words belongs to four main categories: (1) toponyms/places, (2) activities, (3) values, (4) links/URL. In the first category the words referring to specific toponyms (city name) or physical places (urban location) are considered, while in the second category the words related to events or objects are grouped. The third category encloses the words related to adjectives used for personal evaluation of places and events, and in last category the words relative to external links, persons, blog or URL are enclosed.

The 5 most used words for each category are provided in the next figures and tables, respectively for text of titles (fig. 1, tab. 1) and descriptions (fig. 2, tab. 2).

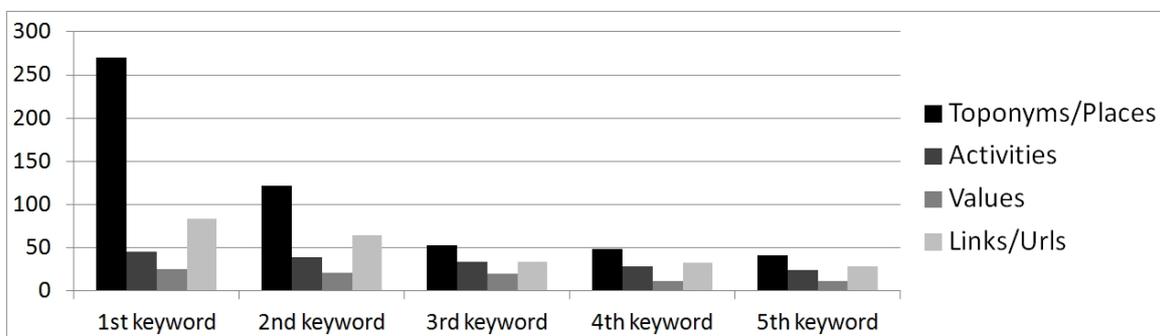


Fig. 1 Top 5 words for category in Title

CATEGORY	WORDS [frequency]
Toponyms/Places	Sardegna [270], Sardinia [122], Cagliari [53], Nuoro [49], Porto [41]
Activities	Eventi [45], Festa [39], Ballu* [34], Carnevale [29], Rally [24]
Values	Folk [25], Official [21], Verde [20], Italian [12], Lost [12]
Links/URL	By [84], Of [65], On [34], To [33], wmv [28]

Tab. 1 Top 5 words for category in Title. (\*) Word expressed in Sardinian language

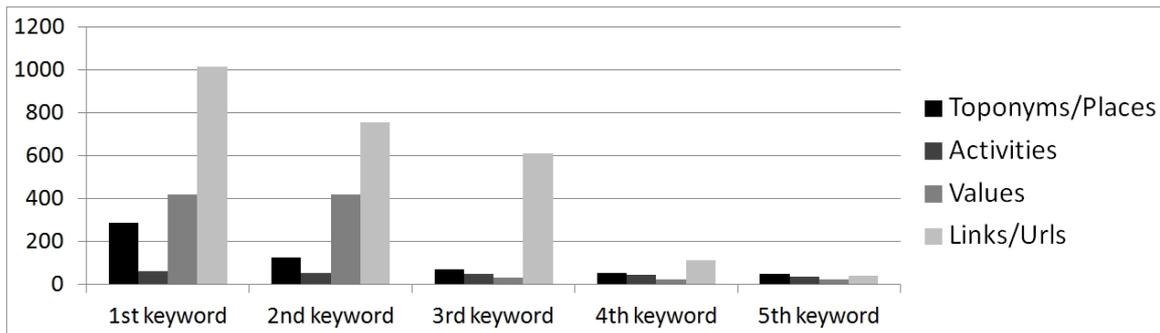


Fig. 2 Top 5 words for category in Description

CATEGORY	WORDS [frequency]
Toponyms/Places	Sardegna [290], Sardinia [126], Cagliari [72], Nuoro [54], Italy [49]
Activities	Music [65], Chitarra [55], Festa [51], Concerto [45], Musica [39]
Values	Updated [422], Published [422], Sito [33], Beatiful [26], Great [23]
Links/URL	http [1015], Youtube [756], www [612], Facebook [114], https [42]

Tab. 2 Top 5 words for category in Description

The exploratory analysis identifies several words that are used in the textual description of videos for each category. The results explain the different typologies, purposes and trends of videos related to Sardinian territory. On the one hand, several videos can be considered untied from physical places and exclusively related to daily routines of users. On the other hand, several videos can be considered strictly related to perceptions of users on events and physical places of the territory, introducing opportunities for further analysis support.

#### 4.4 IN SEARCH FOR 'LANDSCAPE' AT THE REGIONAL SCALE

The second step of the approach focuses on the spatial and textual analysis of YouTube contents related to a specific topic of interest within a specific geographic area. For the purpose of this analysis the words *landscape* and the Italian translation '*paesaggio*' have been set as keywords for the extraction of videos in the Sardinian territory. The keyword has been set both in English and Italian to avoid eventual lacks of useful contents because of the language constraint. The resulting dataset contains 180 entries and allows the investigation of locations, activities and values, which can be considered tightly related to the topic according to user opinions. The investigation of the contents has been performed by means of tag cloud analysis and the words have been classified according to the 4 categories. Moreover, spatial analysis were carried on to evaluate the spatial distribution of videos. The first analysis aims to investigate potential underlying spatial patterns or relationships between the spatial distribution of on *landscape* and the different land uses expressed by the CORINE land cover. The second analysis was performed to evaluate the

percentage of videos occurring in the coastal area as defined by Regional Landscape Plan of Sardinia, firstly adopted in 2006. The goal of this analysis is the evaluation of where the thought 'landscape' of users is located in space.

The 10 most used words for each category are shown in figure (fig.3) and table (tab.3).

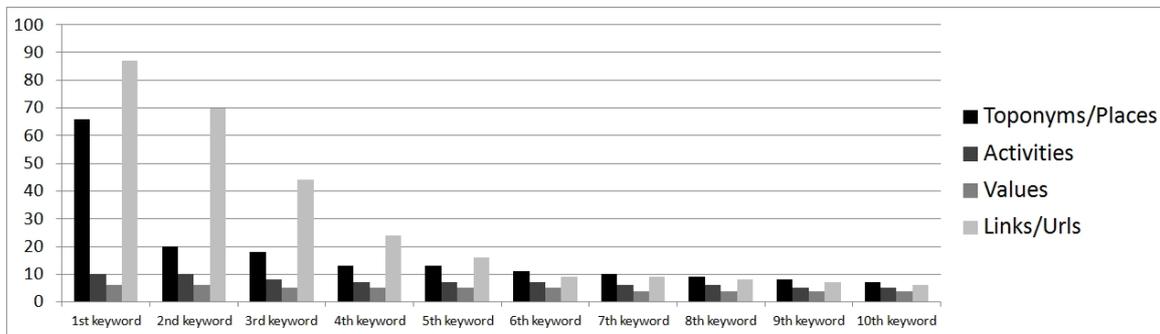


Fig. 3 Top 10 words related to 'Landscape'

CATEGORY	WORDS [frequency]
Toponyms/Places	Sardegna [66], Terra [20], Hotel [18], Nuoro [13], Cagliari [13], Italy [11], Mare [10], Cabras [9], Parco [8], Cala [7]
Activities	Musica [10], Marcia [10], Foto [8], Servizio [7], Idee [7], Progetto [7], Pittura [6], Ecocampus [6], Festival [5], Valorizzazione [5]
Values	Dedicata [6], Realizzato [6], Bella [5], Patrimonio [5], Grande [5], Panoramica [5], Interno [4], Animato [4], Verde [4], Eolico [4]
Links/URL	http [87], youtube [70], www [44], google [24], mp4 [16], on [9], by [9], for [8], to [7], wmv [6]

Tab. 3 Top 10 words related to 'Landscape'

Results of tag cloud analysis show similarities with the exploratory analysis outcomes in the distribution of terms among the different categories. The words related to toponyms/places and links/URL exhibit high frequency, while the activities category exposes a constant trend.

Results of the analysis on spatial distribution of videos with regards to the CORINE land cover classes display interesting results. The videos percentage for land class shows how 50% of videos falls in artificial surfaces areas (urban territory), but this value can be easily explained by two main reasons. The first reason, it is YouTube service allows users to upload personal contents either in real-time or not, causing anomalies in geographic location that can be consequently shifted from the location of video to the location of user during upload. In this case, the location usually refers to the hardware platform in the urban territory. The second reason concerns the development of several events related to the landscape in the urban territory, with massive participation of users. Several questions could arise for the 15.56% of videos occurring in agricultural areas, but a large scale spatial analysis explained the inclusion of artificial grassland in this land use class, and also the proximity of these areas with the urban centers. The percentage of videos in forest and semi-natural areas, wetlands and water bodies can be explained considering the tight relationships between these areas and the term landscape.

The analysis on the distribution of videos in coastal area shows the following percentages: 58.33% for internal areas, 37.22% for coastal areas, 4.45% for sea areas. The outcome displays an almost uniform distribution among the categories, but interesting results can be obtained analyzing the spatial distribution

for specific province and separately for each category. On the one hand, the Province of Cagliari provides 41.8% of videos for the coastal area and 6.67% for internal area; and similarly the Province of Olbia-Tempio exhibits 19.4% for coastal area and 4.76% for internal area. On the other hand, the Province of Nuoro supplies 5.97% of videos for coastal area and 36.19% for internal area, while the Province of Oristano provides 22.38% for coastal area and 20.95% for internal area.

These results can be considered significant of a different perception of landscape by users according to different geographic zone. Values for the Province of Cagliari and Olbia-Tempio could depict an high vocation toward the relationship of landscape with coastal area for these zones; in an opposite way the mountain Province of Nuoro could display an high vocation toward the internal zone landscape. The result of the analysis for other Provinces presents an uniform pattern in the distribution of videos. The results of the analysis are provided in figure 4.

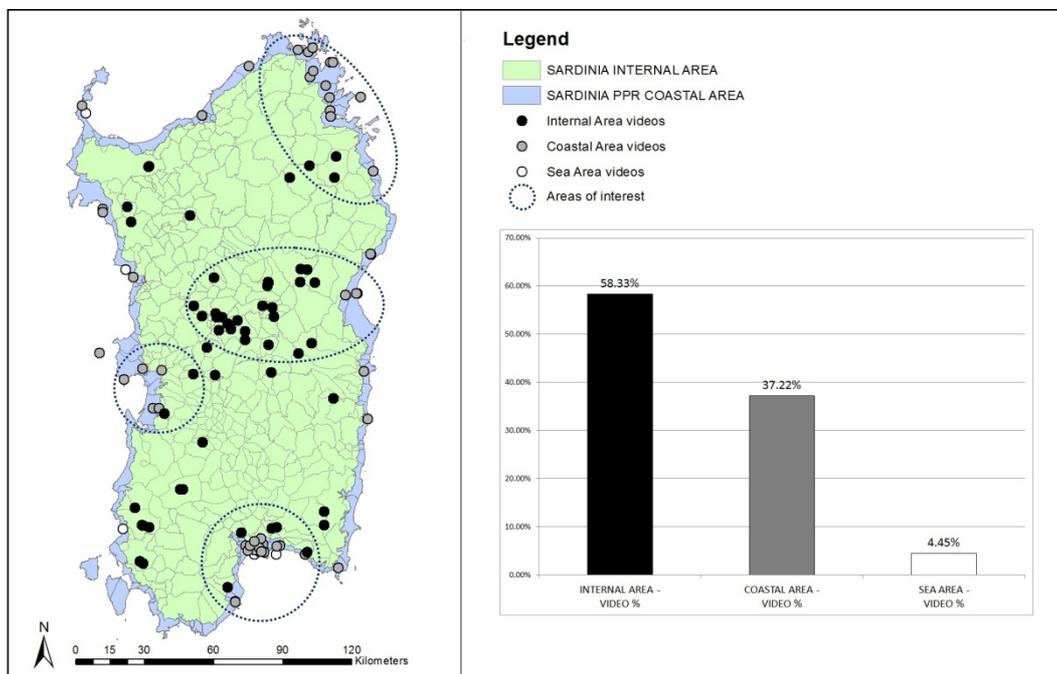


Fig. 4 Spatial distribution of videos for PPR coastal areas

#### 4.5 ANALYSIS ON PERCEPTION OF NEIGHBORHOODS AND PARKS AT THE LOCAL SCALE

The last step of the approach focuses on the spatial and textual analysis of video contents for specific neighborhoods in the municipality of Cagliari (Sardinia, Italy) and for the 'Molentargius' Regional park. The aim of the analysis is the investigation of the differences in perceptions and opinions provided by users for the neighborhoods of 'Castello', 'Marina', 'Is Mirrionis' and the 'Molentargius' park area.

These neighborhoods have been chosen because of their physical, functional and social differences. Castello is the innermost historic central area, Marina is a commercial district that links the historic centre to the harbor of Cagliari, and Is Mirrionis is a community poor-housing area at the edge of the centre, built during the 1960s city sprawl. The Regional Natural Park of Molentargius, instituted in 1999, is a wetland, neighboring heavily populated urban areas. The park provides an ideal habitat for several animal species including flamingo. The most significant words related to places, events and values have been identified by means of tag cloud analysis for each neighborhood and for the park. The results can be useful for take a

glimpse of the perception of users, showing information that usually is not provided in land use documents. The results of the textual analysis and spatial analysis are displayed respectively in table 4 and figure 5.

NEIGHBORHOODS	WORDS [frequency]
CASTELLO	Cagliari [48], Metropolitan [10], Sicuro [10], Concerto [6], Marmora [6], Palazzo [5], Regio [5], Storico [4], Cattedrale [2], Bastione [2]
IS MIRRIONIS	Cagliari [40], Torneo [10], Monteclaro [7], Cus [6], Calcio [4], FC [4], Sound [4], Finale [4], Music [3], Parco [2],
MARINA	Cagliari [61], Santa Lucia [13], Concerto [9], Capodanno [6], Festa [6], Sepolcro [5], Musica [5], Festival [4], Porto [4], Chiesa [4]
MOLENTARGIUS	Cagliari [62], Quartu Sant'Elena [15], Saline [10], Fenicotteri [8], Parco [8],
NATURAL PARK	Poetto [5], Conferenza [5], Servizio [5], Stagno [4], Monte Urpinu [3]

Tab. 4 Most significant words for neighborhood

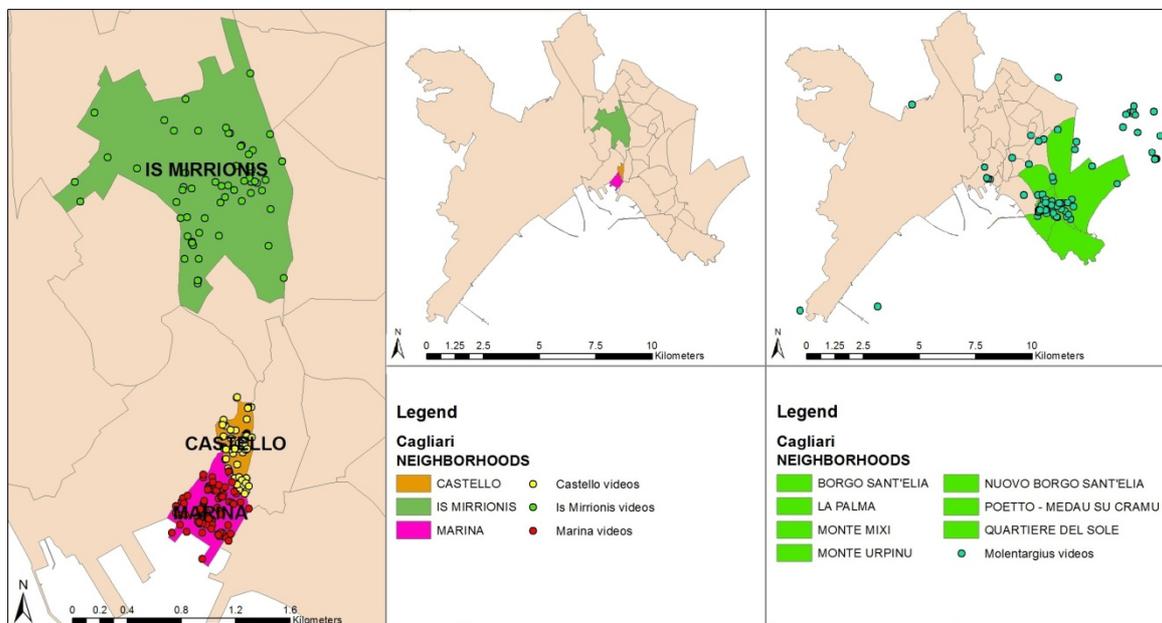


Fig. 5 Spatial distribution of videos for examined neighborhoods of Cagliari

The results define a clear image of the overall perception of users for each considered placemark. Several keywords obtained by tag cloud analysis of title and description of videos depict the main features of the neighborhoods. The words related to Castello concern historical buildings, places, ways and typical events, while for Marina the words are related both to celebrations and specific buildings, such as church and harbor. Results of analysis on Is Mirrionis show a current habit of users to identify the district as supplier of football-related activities, and highlight the presence of the urban park of Monteclaro. In addition, the analysis on Molentargius focuses on the presence of the park, the several features of the place, and the specific toponym of Quartu Sant'Elena, that is another municipality surrounding the park.

The resulting overall opinion of the neighborhoods is particularly interesting because of its similarity with the results of another specific study developed on the same areas. Despite the differences in datasets, SMGI origin, users, and time period, the results of the study conducted through the platform Place, I Care! (PIC) and Cagliari, I Care! (CIC) (Campagna *et al.* 2013) show similar results both in opinion and interest of users

for the examined neighborhoods. This phenomenon raises interesting questions on SMGI and on opportunities for analysis, and will be further investigated in future studies.

## 5 CONCLUSION

In this paper the authors present a novel approach for the advance of Social Media Geographic Information analytics based on the Spatial-Temporal Textual Analysis (STTx) of tweets and youtube posts. The insights obtained through this novel approach offer stimulating challenges towards the development of more specific analysis, concerning people spatial and thematic perception of places. Several analysis are provided to demonstrate how SMGI may be directly used and integrated with traditional authoritative spatial data layers in GIS environment. The results of analysis carried out by coupling SMGI and A-GI from open SDI show the potential in terms of provision of a novel kind of information which may add value to traditional planning knowledge bases so informing decision-making by community pluralism. As a matter of facts, SMGI may disclose opportunities for further analysis scenarios in urban and regional planning, and may offer useful suggestions for smart city strategies. In an integrated planning support framework, SMGI analytics might help to understand user observations, perspectives, interests, feelings, or needs, and possibly affect decision-making dynamics and urban and regional planning processes with customer oriented strategies. Moreover, the SMGI potentialities to generate useful knowledge for urban and regional planning, might foster citizens' dialogue about places and events giving the opportunity of being heard so further facilitating the integration of experiential and pluralist information with professional knowledge.

In conclusion, the knowledge of SMGI if proficiently elicited might be used to support analysis, design and decision-making in urban and regional planning, fostering the public participation in processes about the present and the future of places. Further experiments need to be carried on, and issues to be tested. Nevertheless, current advances in computational social science already demonstrate challenging and stimulating research opportunities which may eventually bring innovation to spatial planning, design and decision-making.

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## IMAGES SOURCES

All the images are originals developed by the authors.

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