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ID 1472 | SOCIAL MEDIA GEOGRAPHIC INFORMATION IN SPATIAL PLANNING

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1 INTRODUCTION

The term Geodesign has recently emerged among spatial planners and GIS scholars identifying an approach to planning and design deeply rooted in geographic analysis and able to inform collaborative decision-making. As an integrated and multidisciplinary process, Geodesign includes project conceptualization, knowledge building, analysis, alternative design, impact simulation and assessment, decision-making, collaboration and participation, involving political and social actors and relying on scientific geographic knowledge support. The main innovation in Geodesign compared to previous similar approaches may be found in the extensive use of digital spatial data, processing, and communication resources, such as Information and Communication Technologies (ICTs) and GIS, which in principles may enable a more effective use of scientific and societal knowledge in planning, design and decision-making (ERVIN 2011). As claimed by several scholars, planning professionals and industry experts, the current technology may be considered mature enough to exploit the ICTs support in the planning practices, overcoming many of the barriers which until now have limited de facto the usage of new geographic information technologies. In addition, since the last decade a growing wealth of both authoritative and user generated spatial data resources has started to be freely accessible, slowly shaping into reality the concept of Digital Earth (GORE 1998). The latter can be considered a driver for the creation of a working infrastructure able to facilitate the diffusion of Geodesign methods for it substantially hinder the traditional issues of lack of digital data availability.

Currently, two major categories of spatial data resources may be considered suitable for Geodesign approaches, namely Authoritative Geographic Information (A-GI) from Spatial Data Infrastructures (NEBERT 2004) and spatial User Generated Contents (UGC), commonly referred to as Volunteered Geographic Information (VGI) (GOODCHILD 2007). These two types of spatial information are notably different in nature, but together they might foster advances in planning and design practices exploiting informed decision-making and eventually contributing to more sustainable development processes. Particularly, a subset of VGI, namely Social Media Geographic Information (SMGI), which is the information produced and shared through social media platforms, might enhance the opportunities to collect not only geographic information representing the current conditions of the study area but also the perceptions of users about spatial phenomena.

In the light of these premises, the authors present a critical review of their research findings on the integrated use of A-GI and spatial UGC in Geodesign. The remainder of the paper is organized as follows. In the next section a brief comparative review about the nature of A-GI, VGI and SMGI is given, outlining similarities and differences in production and use of these resources. Then the authors introduce a novel approach to SMGI analytics, proposing its application as support in spatial planning and design with reference to different case studies. The paper ends by a critical discussion on these results arguing for the relevance of SMGI for Geodesign and proposes issues for a research agenda in this field.

2 FROM AUTHORITATIVE TO SOCIAL MEDIA GI

Current advances in the ICTs, the Internet, and more recently, Web 2.0 technologies are affecting diverse domains of interest, increasingly channeling digital Geographic Infor-mation (GI) into daily life of a wider public. This phenomenon represents a paradigmatic shift in GI production and dissemination, as well as, in its contents and characteristics (ELWOOD et al. 2012), exploiting a new generation of digital GI. This wealth of public accessible digital GI may foster innovations in the spatial planning domain and most notably in Geodesign methodologies and practices, for the majority of information required to support analysis, design and decision-making is inherently spatial in nature. The major opportunities for innovation and development of methodologies emerge from the avalanche of "big" GI, which Web 2.0 technologies are making available to planners.

First of all, since the late 1990s, advances in Spatial Data Infrastructures (SDI) granted the access to digital geographic data, produced and maintained by public or private organizations for institutional or business purposes. Many countries worldwide started the development of SDIs in order to ease the access and sharing of spatial information between stakeholders involved in spatial governance and planning, in order to support decision-making. Along this stream, the implementation of the Directive 2007/02/CE, establishing a shared INfrastructure for SPatial InfoRmation in Europe (INSPIRE), is leading to the development of SDIs in Member States and Regions, granting the public access and reuse of available A-GI, according to common data, technology, and policy standards. INSPIRE addresses 34 key spatial data themes, such as administrative units, land-use, or buildings to name few, which are of great value for spatial planning, inasmuch planners may proficiently take advantage of these spatial data resources to analyze and understand territorial system dynamics. Secondly, innumerable initiatives and platforms continue to thrive through the Internet thanks to continuous advances in Web 2.0 technologies, which support the production, collection and diffusion of UGC (KRUMM et al. 2008). Most of these contents may embed a geospatial reference, leading the transformation of the Web in a potential innovative source of spatial data (ELWOOD et al. 2012). This novel type of GI is commonly labeled as VGI, emphasizing the role of users, which act as volunteer sensors to collect and contribute information content related to the geographic world (GOODCHILD 2007). The concept of VGI encompasses a wide range of activities and practices, which in spatial planning processes may provide pluralist sources of both experiential knowledge from local communities and expert knowledge from professionals in a bottom-up approach. In the last decade, the use of VGI has been proven useful in many application domains such as emergency management, crisis management, environmental monitoring and spatial planning (POSER & DRANSCH 2010), as well as, participatory processes and Citizen Science initia-tives (KNUDSEN & KAHILA 2012).

Lastly, the huge popularity recently gained by social media platforms and location-based social networks is fostering the diffusion of geo-referenced multimedia (SUI et al. 2012), or SMGI, among millions of users over the global Internet. SMGI may be easily accessed and shared by users, which become seamlessly producers and consumers of personal geo-referenced contents. This kind of information may be considered a special subset of VGI, inasmuch the voluntary production and sharing of GI is not the main purpose of the users. Any multimedia content or information with explicit (i.e. coordinates) or implicit (i.e. place names or toponyms expressed in natural language) geographic reference collected or produced by the users through location based social networks or mobile applications may be considered as SMGI. Moreover, depending on the production modes, SMGI may be actively or passively contributed: applications specifically developed or used to collect SMGI in participatory initiatives originate "Active SMGI", while the harvesting of information from general purpose social networks (e.g. Twitter, Flickr, Instagram, Facebook) originate "Passive SMGI". Despite the production differences, the major interest for spatial planning raised by SMGI concerns the opportunity to study not only the geographic facts on the

Earth surface but the people themselves, allowing investigations on humans' movements, patterns, behaviors, preferences and needs in social and urban systems.

Nevertheless, SMGI features Big Data nature due to the impetuous and fast cycles of production and consumption and, consequently, traditional spatial analysis methodologies and techniques may be not fully adequate to exploit the enclosed knowledge potential. Hence, new methods for the management of geographic Big Data, the integration with A-GI and for the development of advanced analytics are needed to enable the extraction of relevant knowledge to support Geodesign workflows, which would benefit of a broader and deeper pluralistic real-time understanding of the sense of places.

3 TOWARDS SMGI ANALYTICS

The wealth of georeferenced VGI and SMGI regarding facts, opinions, and concerns of users, freely accessible through the Internet, may strongly affect current Geodesign methods and practices, albeit several major issues may limit this opportunity. The main hurdles limiting a wider use of SMGI may be found both in the lack of user-friendly tools to collect and to manage huge and heterogeneous data volumes, and in the particular data model of this information, which barely may be processed through traditional methods without losing precious information. While the former issue is starting to be addressed by novel approaches offered by Computational Social Science, an emerging field concerned in developing methods to tackle the 'big data' complexity, the latter issue should require the development of advanced analytics methods able to manage the particular SMGI data structure. As a matter of fact, VGI and more notably SMGI are different from traditional vector spatial datasets, such as A-GI from institutional SDIs, with which though it may be integrated for eliciting useful knowledge useful for supporting spatial planning practices. Currently, traditional GI datasets feature a spatial and a thematic component, or dimension; conversely SMGI usually consists of a richer data model that includes both temporal and multimedia components (i.e. image, text, video, audio). In addition, SMGI owns a user dimension, which may include an identifier or other data useful to obtain information about the user's profile. From a semantic perspective this dimension is notably important and enables opportunities for further analyses. Moreover, the appreciation of a SMGI by the social network community, expressed through scores, stars, likes/dislikes, to name few, may increase the analytical dimensions supporting the study of popularity, preferences and opinions of users. The different data models of A-GI and SMGI are shown in Figure 1.

Consequently, any SMGI analytical framework should include not only traditional spatial analysis but also temporal, multimedia, and user behavioral analyses methods. These methods should be tightly integrated in order to fully take advantage of the knowledge potential embedded in data. From a Geodesign perspective, the integration of these methods within a GIS application would be an enormous advantage, for GIS may be considered the common platform for the planning profession due to the increasing role played by maps and spatial data in expressing the knowledge in this domain.

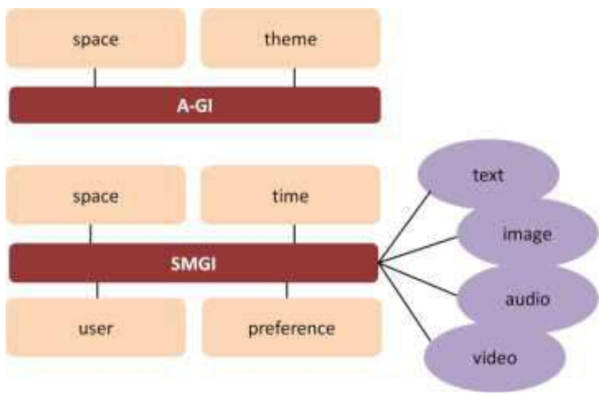

Fig. 1: Differences between A-GI (up) and SMGI (down) data models.

In the light of these assumptions, the authors developed a framework for SMGI Analytics to exploit this new GI resource in order to enrich the knowledge base about the local context from a pluralist perspective, to be used in spatial planning and governance. To this end, the framework called SMGI Analytics, relies on the particular SMGI data model and includes several analytic methods, which may be applied in different use cases for investigating spatial and temporal patterns, users' movements, opinions and behaviors, as well as, preferences on places and events.

The SMGI Analytics framework developed so far consists of the following methods:

- Spatial analysis of users' interest: SMGI and its comments may enable to investi-gate the patterns of users' interest in space by density and clustering functions. The overlay with A¬GI such as administrative boundaries, transport infrastructure, buildings or land uses, may offer useful hints to public authorities to understand which places are important to the local communities and how those areas are perceived by them. An example of such analysis is shown in Figure 2 (left), wherein popular public spaces for the local community are identified through the clustering of Instagram data.
- Spatial statistics on user preferences: collecting posts by spatial units may enable planners to analyze patterns in users' interest at different scales. An example is given in Figure 2 (right), where the hot-spot analysis of tourist satisfaction in Sardinia (Italy). Booking.com and TripAdvisor data enabled to study the distribution by municipality of positive user' assessments, and to investigate why different tourist typologies prefer certain areas or destinations rather than others.

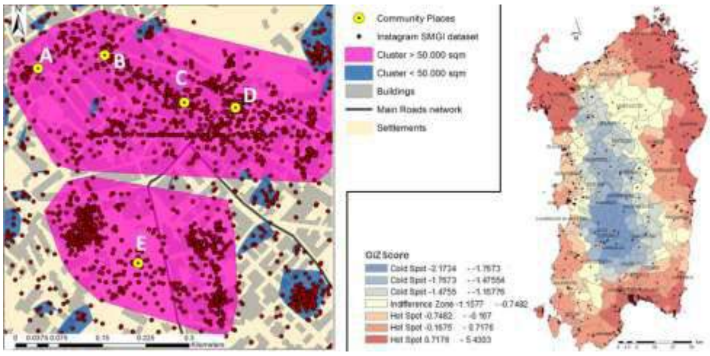

Fig. 2: Most popular public spaces in Iglesias by Instagram users (left). Tourist positive ratings in Sardinia (Italy) (right).

- Multimedia content analysis on texts, images, audios, or videos: this typology of analysis relies on simple or advanced texts analytics to extract useful information from texts (currently it is more difficult to automatically extract useful information from images, video or audio).
- Temporal analysis of users' interests: time reference is usually available for SMGI, enabling to study when specific regional destinations, urban districts, public spaces, or other services are used during different time periods. An example is shown in Figure 3, where the temporal trends of Instagram SMGI contributions are depicted in the Iglesias (Italy) to investigate the municipal temporal patterns.
- User behavioral analysis: querying SMGI by user enables to study users' behavior in space and time. This information can be also used to analyze, for example, if a public space is visited by tourists or by local people. Furthermore, this attribute can be used to apply user profiling techniques.
- Combination of two or more of the previous analyses: such combination may enable to elicit what people discuss in space and time, their behaviors and movements. Tightly coupling different analytics may ease the elicitation of further knowledge that may be proficiently used for spatial planning analysis.

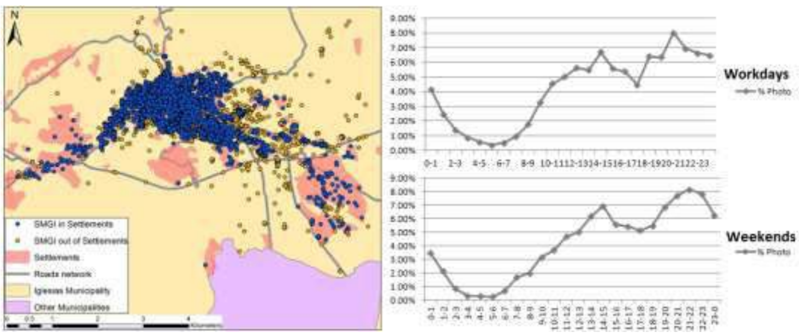

Fig. 3: Temporal patterns in the Iglesias municipality during workdays and weekends.

4 DISCUSSION: SMGI IN GEODESIGN

In the light of the opportunities offered by the SMGI analytics framework, two different categories of spatial data may thus nowadays be used in a complementary way during a planning process. Having as reference the Steinitz framework (Steinitz 2012), which may be used to apply the geodesign approach in spatial planning, in the assessment part (i.e. representation, process and evaluation models) SMGI can be used to complement the knowledge base given by traditional data sources. Unlike A-GI, which is traditionally used in planning, the user generated content may enclose experiential information that is usually missing in the official one, supporting a more pluralist vision of the geographical, social and cultural systems. On the one hand, the A-GI may offer official information about quantitative measurements, while on the other hand, SMGI, as expression of user preferences and behaviors may help in identifying particular social and cultural dynamics affecting the geographic context, as well as the community values and needs.

Operatively, A-GI and spatial UGC might be combined and processed during the process models in order to investigate how spatial phenomena evolve in time. Unlike A-GI which is usually produced and maintained through periodic workflows, SMGI provides updated and (near) real-time information, which may be used to feed predictive models and analyses aimed at identifying trends and phenomena affecting the area in the representation and process model. Moreover, thanks to SMGI analytics A-GI, VGI and SMGI together might disclose notable opportunities to evaluate the current situation of the geographic context, providing further knowledge concerning the preferences and needs of the community which may give valuable information for creation of socially-informed evaluation models. The integration of technical and experiential knowledge may represent a way to gain insights about social and cultural dynamics, which may help decision-makers to promote a constructive dialogue about the future of places, proposing informed alternatives through the help of local community's experience (MARCH 1994). Commonly, the local knowledge of the residents is considered exclusively as opinion in planning processes (FISCHER 2000), but the technical knowledge of the experts, providing only a part of the required knowledge basis, may be not sufficient to properly guide decision-making (LINDBLOM 1990). Hence, the spatial UGC may be fruitfully used to support the assessment of the impacts of the design alternatives, supplying useful knowledge about potential benefits and risks (RANTANEN & KAHILA 2009).

In addition, despite the experiential knowledge is difficult to articulate and convert into useful and explicit information (NONAKA & TAKEUCHI 1995), it can be used to stimulate the interaction among participants (TSOUKAS 2006). In this respect, planning should foster a communicative process, wherein the interlacing between expert and experiential knowledge is crucial in creating collective meanings and consensus (KHAKEE et al. 2000). The integration of A-GI, VGI and SMGI may support this process, providing knowledge about geographic and social context, which may affect the decision-making processes. Hence, the use of Social Media may be not only limited to integrating information about physical or social systems and their assessment, but also by using Social Media applications to support the intervention steps (i.e. change, impact and decision models) of a Geodesign study (STEINITZ 2012), Active social media platforms can be used to involve the local community both in the planning discourse and in the design (ERÄRANTA et al. 2015).

From a slightly different perspective, the novel Geodesign Hub (www.geodesignhub.com), could be considered a social media app for trough it participants interact collaborating to the core part of collaborative conceptual design. Also in this case, all the data produced along the collaborative design studies can be saved, retrieved and analyzed – in a similar manner as with more usual social networking app -to understand both participants' preferences and behaviors, in this case not in the real world but in the design space. This way, both technical knowledge and experiential knowledge may be used in order to build a shared and sustainable development process for the territory among the different involved actors.

5 CONCLUSIONS

This paper discusses current innovation potential concerning the use of User Generated Content and more specifically, Social Media Geographic Information in Geodesign. Through selected examples, it is demonstrated how the analysis of social media data is inherently geographic in nature and may complement official GI produced by public authorities and by the private sector in order to represent, analyse, and assess the current state of geographical systems. Moreover, this new type of information represents a unique source of information to understand people preferences and needs which express the requisites for future territorial transformation. In addition, social media platforms may be used actively to involve citizens in the planning and design discourse. Indeed for a widespread diffusion of SMGI analytics techniques in Geodesign a number of issues should be further investigated and better understood including the issue of privacy, the influence of individuals on the overall discourse both in terms of information, preferences, and contribution to decision-making; the representativeness of the sample; the further test of operative ways and protocols to collect and include this new and peculiar type of information resources in the construction of the Geodesign frameworks models both in the assessment and intervention part of the process. However, early research results may be considered very promising and this research domain is attracting a growing community of scientists, opening alleys for the development of more transparent, pluralist and democratic decision-making in Geodesign.

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