

Smart technologies for cultural landscape and sustainable development

Agata Lo Tauro

(Prof. Arch. Agata Lo Tauro, Formally Trieste University, Viale Libertà 151, 95014, Giarre, Italy, www.ipsia.giarre.ct.it, agatalotauro@istruzione.it)

1 ABSTRACT

The present paper shows the results obtained by the elaboration of “smart” technologies (Spatial Imaging, MMS, Smartphones, etc.) in order to evaluate thematic maps useful for environmental distributed model for the implementation of Landscape Plans and Sustainable Development and in order to support decisions in matter of cultural landscapes and land use analysis. The greatest change will be initiated by the analysis of different innovative techniques joined to the potentialities of RS, GNSS and GIS applications. This will have serious implications in terms of data accuracy and reliability in surveying and mapping. Part of this research was conducted from 2004 to 2007 under the Ph.D Course in “Geomatics and Territorial Information Systems”, coordinated by Full Prof. G. Manzoni at the Trieste University. The project-GIS provides valuable results relevant strategies, concepts and “smart” technologies for planning the landscape and urban future. The present project can stimulate the research of Innovative Educational Programmes¹.

2 BACKGROUND

2.1 The general framework and the normative aspects

The Landscape Plan or “Piani Paesaggistici” are important instruments for the management of all possible strategies for the protection of the environment, the eco-system, biodiversity and cultural heritage in general. This project takes into account the important guidelines of the Code of Cultural Heritage and Landscape or Urbani Code produced by the Urbani Giuliano (the Former Culture Minister) in 2004. An important normative issue of the Landscape Plan is related to the Italian constitutional reform, introduced with constitutional law n. 3/2001². It is difficult to define what is to be meant for protection and for valorization. We can valorize without protecting the territory and *vice versa*. We generally agree that protection consists in the exercise of the duties and in the discipline of the activities addressed, on the basis of an adequate knowledge, to identify the goods constituting cultural heritage and to guarantee preservation and conservation to public enjoyment³. Valorization consists in the exercise of the duties and in the discipline of the activities addressed to promote the cultural heritage knowledge and to ensure the best conditions for exploitation and public enjoyment, included promotion and conservation. Besides it is important to evaluate the capability to activate projects, to start network of European policies, to identify European systems or districts, making explicit the potentiality of the innovative technologies for the cultural heritage protection and valorization. The proposed strategy resides in a strong integration between all the components of the cultural sector at territorial scale (archaeological, architectural heritage and landscape heritage conservation, implementation of enjoyment services, cultural itineraries and greenway plans, historical lava flow, preservation and recovery activities, ancient food quality, wine roads, high quality food roads, distribution of technologies, the reduction of the environmental impact, sustainable development, PV technologies, I.C.T. etc.) and those of the connected sectors: tourism and in particular cultural tourism, marketing, scientific research, professional training and education, the specialised production or the craftsmanship. The objective is the implementation of the research in the field of geomatics including Remote Sensing, Geographic Information Systems (GIS), Global Positioning System (GPS), GNSS and “later on GALILEO” (Manzoni⁴,

¹ The author research may involve the collaboration of the following colleagues and specialists: M. La Spina (Head of the IPSIA Giarre), Dott. N. Costa (GeoCos – Nicosia, EN), Prof. Bugiuni (specialist in Robotics - www.ipsia.giarre.ct.it), Prof. Adele Verga (specialist in Biodiversity and High quality Food), staff at the Photographic Laboratory, Chemistry/Biological Sector and Telecommunication Sector (www.ipsia.giarre.ct.it), National Civil Protection, Arma dei Carabinieri, all Research Centres and **Experts** mentioned in this paper.

² This reform sets the distribution and the differentiation between the powers of the State and those of Regions. The State reserves the exclusive right to protect and safeguard the environment, the eco-system and cultural heritage. The regions are delegated to hold the functions of land and territory governance and management, valorization of cultural and environmental heritage, promotion and management of cultural heritage and activities (Italian Constitution, article 117).

³ Article n. 3 of the legislative decree n. 42/2004.

⁴ Thanks to Full Prof. G. Manzoni for his useful input in terms of survey (GPS Kinematic with Garmin technologies).

2006), radio-transmission technologies (such as Voip systems, WI-FI, RFID, etc.), laser scanner⁵, spatial imaging (Lo Tauro, 2006), and related forms of 3D mapping for new innovation technologies, applications and cultural landscape programmes. Such technologies should be involved concretely through terms of territorial cooperation that could produce positive outcomes in Europe and world wide. The value of this research is a consequence of a long process started in Europe with the debate on environmental and cultural resources and culminate with ICOMOS codification that extends and defines the environmental and cultural goods classification. The project also concerns the realization of a geodatabase and the implementation of the appropriate technological support for the conservation of cultural heritage specifically oriented to the strategies of the Landscape Plan. This study analyses the territory of Catania Province⁶. The Etna Park represents the *test-field* for all possible events related to Landscape Plan for which the geodatabase has been already implemented. The first phase of the job concerns the accurate knowledge of the territory and research related to the definition of the technological support within the GIS platform that joined to the potentialities of RS⁷. In this phase we take into account the most important guidelines (already available *or in itinere*⁸), in order to analyse the modality of the geographic database related to the implementation of the Landscape Plan (legislative decree n. 42/2004), the philosophy of landscape protection of Galasso Law, the UNESCO lists⁹ and the documentation produced by the INSPIRE Programme¹⁰. This project takes into account the important guidelines for the Conservation of Cultural Heritage (L. 137/2002 and L.R. nr. 14/1998)¹¹ and was partially financed in the framework of the P.O.R. Sicilia 2000-2006¹², Department of Cultural and Environmental Heritage. Furthermore, in this phase we analyse the more important guidelines in order to define the modality of the geographic database related to the implementation of the Regional Landscape Plan of the Autonomous Region of Sicilia and the documentation produced by the "Intesa Stato-Regioni- Enti Locali" for the realization of the Geographic Information System. In my opinion, the Landscape Plan Achievements may include boosting the image of IUCN at global gatherings such as the World Summit on Sustainable Development, promoting more interactive events at IUCN gatherings, and support to global Conventions such as CBD, Ramsar and UNFCCC. In Particular, Dr Taghi Farvar, Chair of the Commission on Environmental, Economic and Social Policy (CEESP), outlined the context of the world today and the challenge for the Union – to understand the complexities of the current situation and the implications for the conservation of cultural heritage and biodiversity. CEESP has prioritized five programme components including: sustainable livelihoods; co-management of natural resources; environment, trade and investment; environment and security; and indigenous and local communities, equity and protected areas. CEESP aims to provide information among members. CEESP's mandate for 2005–2008 includes governance of natural resources, equity and rights; economics, markets, trade and investment; sustainable livelihoods and pro-poor conservation; culture and conservation; human and environmental security; and social and environmental accountability of the private sector. It is also important to remember that the 30 January 2009 more than 200 scientists from around the world have attended the weeklong POLinSAR 2009 workshop hosted at ESRIN, ESA's Earth Observation centre in Frascati, Italy. "Discussions among the participants include new techniques for providing vital information on our planet

⁵ "Corso di aggiornamento SIFET 2005" - Topic: "Tecniche Innovative di rilievo e rappresentazione dei Beni Culturali", tutor Full Prof. Benedetto Villa.

⁶ The studied area is located in the Catania Province already interested by Regional Landscape Planning studies. The area is featured by important cultural and naturalistic elements and, at the same time, by critical and contradictory elements due to dense human (industrial, infrastructural, etc.) settlements not always in balance with the landscape.

⁷ Thanks to Dott. Communi, CNR (Istituto Inquinamento Atmosferico) LARA Programme, P.O.N. "Sicurezza per lo Sviluppo del Mezzogiorno d'Italia", Ministero dell'Interno. CD-ROM. Thanks to INGV (Centre for Research on Remote Sensing at Rome) and in particular to Fabrizia Buongiorno for providing MIVIS data.

⁸ The application of the protection set of rules settled by Law n.1089. In particular the so called Bottai Laws were: Law n. 1089 about the protection of the things of artistic and historical interest and Law n. 1497 about the conservation of natural beauties. Both passed in 1939.

⁹ The World Heritage Committee meeting in Vienna has approved a memorandum aiming at regulating both the future approach to the protection of the cities just members of UNESCO lists and new process of registration of new cultural environment (the Management Plan).

¹⁰ The INSPIRE – Infrastructure for Spatial Information in Europe is a large current initiative of the European Commission to promote the multipurpose availability of feasible geographic information. Smith et al (2002)

¹¹ Other guidelines are the Cultural Heritage Master Plan (CHMP) would be tools that supplies the fundamental information about the presence, the typology, the form of protection and preservation of Heritage existing in a territory.

Thanks to R. Maesano and staff at the Acicatena Town Hall.

¹² POR Sicilia 2000-2006.

that could help to combat global warming through carbon accounting, wetland preservation and improve climate models. Using the novel polarimetric mode of the PALSAR synthetic aperture radar (SAR) aboard Japan's ALOS satellite, Dr Shane Cloude of the UK-based AEL Consultants has mapped the biomass of Scotland's forests. This marks the first time biomass data has been extracted over a large area using this sensor mode" (www.esa.int). "Along with applications, scientists discussed the latest developments in SAR polarimetry and polarimetric interferometry and the need for the next generation of radar satellites to be equipped with advanced polarimetric modes". In this paper I describe methodologies for the implementation of a specialised GIS (Geographic Information Systems), for the production of thematic cartography and for the management of the heritage. The project also concerns the realization of a project-GIS and the implementation of the appropriate technological support. The project makes it possible for those who deal with the management of Landscape Plan to take more efficient decisions thanks to the interconnection of european and national contact points and the sharing and exchange of information at the regional and local level, inside which all other sector plans (for instance tourism plan, transportation plan, industrial plans, commerce plans, etc.) must be included. The present project can stimulate the research of didactic approaches for new educational programmes (Lo Tauro, 2008d) in the field of telegeomatics.

3 GIS TECHNOLOGIES FOR THE LANDSCAPE PLAN

The planning and the realization of a prototype for a dynamic GIS is specifically oriented to the activities of the Protection and Valorization of Heritage for the Landscape Plan. This prototype can also support the management of possible protection and valorization strategies (such as Cultural Tourism and ICT, Lo Tauro, A. 2003) for heritage not only in Catania Province but in other European Provinces and world wide. The GIS Technologies implements models of simulation for landscape plans both with natural or man-made features and with specific required conditions (brownfield analysis, change detection analysis, succession of historical and cultural stratifications) but also the economic resources that contribute to characterize and to identify a test-field.

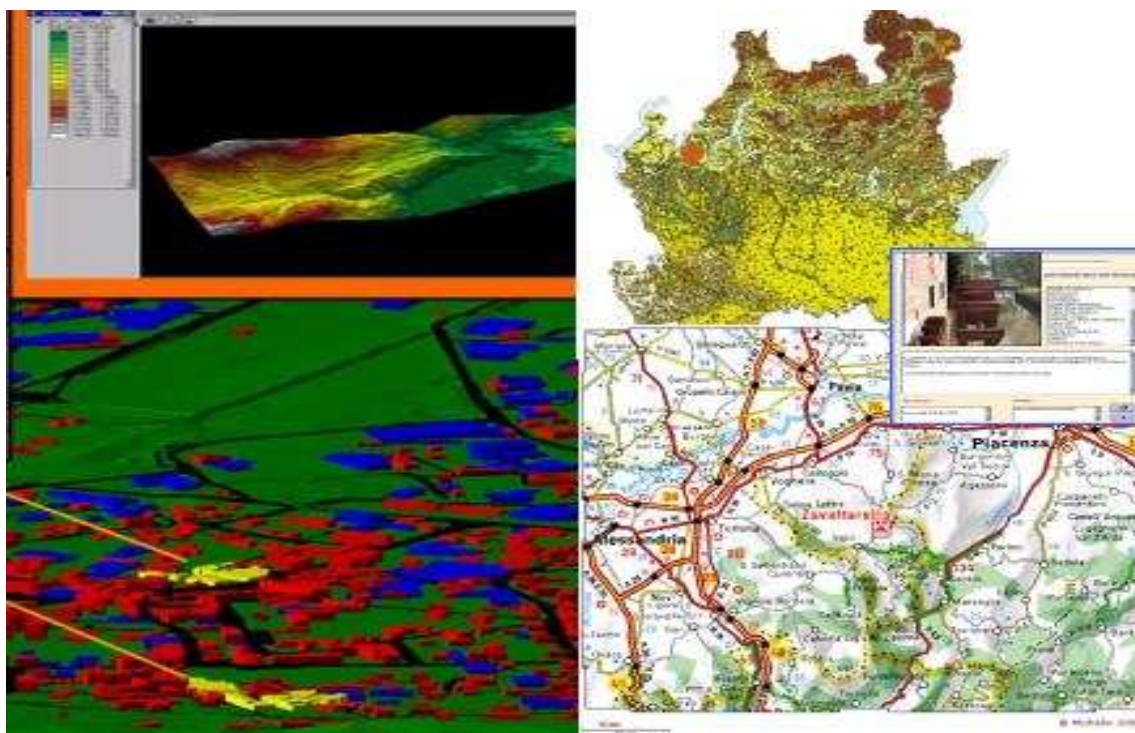


Fig. 1: Project-GIS for a Cultural Heritage Master Plan

They also apply to the Regional Landscape Plan of Autonomous Region in Sicily and a Cultural Heritage Master Plan in Lombardia and define both the immediate definition of pre and post-event analysis (such as natural and cultural heritage analysis, conservation strategies, various disastrous human interventions, such as flow variations, excavation works and dike building etc.), and the slow evolution of the time-scale event

(such as economy sectors and cultural tourism) directly involved with it, safeguarding public welfare and the diversity of life (responding to the challenge of human well-being).

The tourism, in particular the cultural tourism, and the induced economy derived from the valorization of heritage represents one of the important industries, in which a wise use of the territory with the support of innovative technologies must be calibrated on the respect for the environment and the achievement of sustainable development¹³. The primary issues of this study are also related to the definition and implementation of methodologies and models. Within the study of those models and their implementation on the GIS platform, the project included the detailed definition of the features of the cartographic data (available or in phase of acquisition) and all the necessary elements (both topological and informative) for the specialised GIS. The prototype GIS¹⁴ tool was created using different free GIS. In order to facilitate the ever-expansion of new data, thematic layers were developed for all data input into the database for the *Project-GIS*. The cartographic research¹⁵ explores the use of thematic maps for landscape plan with the emphasis on extracting specific pieces of information and physiographic elements for the “map of the landscape values” in 2D/ 3D dimension and RS analysis such as: ancient costal plains with contour line (50 meters from the bottom of the sea) and implementation of listing methodology (Surace, L. 2008 and Lo Tauro, A. 2001¹⁶); ancient lava flow; sides of the rivers and the typical vegetation of fluvial environments which characterized the rivers (Lo Tauro, A. 2007b); rows of oak-trees, hedges and mulberries which still testify the past activity of silkwarm breeding; plains (of about 10 ha); typical agrarian environment including areas of D.O.P and IGP production, protected vegetation, green monuments, agricultural parks, protected areas (such as “Siti di Interesse Comunitario” and “Zone di Protezione Speciale”), ecoagriculture; approaches to biodiversity conservation and high-seas biodiversity, analysis of geology and geomorphology; estimation of population density related to districts and ISTAT (Italian Statistic Institute) data; land use analysis to be taken into account in land-use planning with new RS image classification (Lo Tauro, 2007b and Lo Tauro, A. 2008b). The research also involves in meteorological analysis: climatic variability and the temporal variability, climatic data network spread across the territory with the support of RS analysis (such as EarthCARE, ESA’s Cloud and Aerosol mission www.esa.int). Historical centres, archaeological sites (Lo Tauro, A. 2008c), architectural heritage analysis also involve MMS (Manzoni, G. 2006) and Spatial Imaging technologies (www.trimble.com). Landscape heritage layers, identification of enjoyment services, cultural itineraries and greenway plan, activity of preservation and recovery activities, important faunal areas distribution of technologies for the reduction of the environmental impact (Lo Tauro, A. 2005), important naturalistic point of view, Cultural Web-GIS Portal and ICT under European Standards (Lo Tauro, A. 2003). The analysis also includes innovative PV applications (Lo Tauro, A. 2008c) for the coordination of sustainable development programmes for energy.

4 CONCLUSION

The research comes from the realization of the Regional Landscape Plan (“Piano Paesaggistico Regionale”) of Autonomous Region of Sicilia, and in particular of the Catania Province¹⁷.

Sicilia is one of the first Italian regions that is endowing with the Landscape Plan according to the legislative decree n. 42/2004. Within the strategic development guidelines of the Landscape Plan has been started, as preliminary study, a research on cultural systems that aims to identify areas of common cultural identity and

¹³ An other important contribution to the sustainable development programme is the Global Monitoring for Environment and Security (GMES <http://www.gmes.info/>).

¹⁴ Part of the research was realised in collaboration with the Provincia Regionale di Catania, Nicolosi Civil Protection Centre, Ente Parco dell’Etna and enterprises (such as Teseo Sistemi, Trimble Regione Sicilia and GISAT, www.gisat.it)

¹⁵ Readers are referred Kraak, M J and Ormeling F.J (1996) for further study.

¹⁶ Rif. Surace, L. (2008, SIFET 2008, *oral presentation*), Lo Tauro, A. (2001) and GOCE Programme. Goce is the first in the series of Earth Explorer missions being developed within ESA’s Living Planet Programme. Earth Explorer missions form the science and research element of the Living Planet Programme and focus on the atmosphere, biosphere, hydrosphere, cryosphere and the Earth’s interior, with the overall emphasis on learning more about the interactions between these components and the impact that human activity is having on natural Earth processes. The sleek high-tech GOCE satellite embodies many firsts in terms of its design and use of new technology in space to map Earth’s gravity field in unprecedented detail. Over its lifetime of about 20 months, GOCE will map these global variations in the gravity field with extreme detail and accuracy. This will result in a unique model of the geoid, which is the surface of equal gravitational potential defined by the gravity field – crucial for deriving accurate measurements of ocean circulation and sea-level change, both of which are affected by climate change (www.esa.int).

¹⁷ Thanks to Dott. Geol. S. Fazzina e Dott. Geol. Franco La Fico (Soprintendenza per i beni culturali e Ambientali di Catania - Rif. P.O.R Sicilia 2000-2006 misura 2.02 Azione C – CD ROM).

to evaluate relationship systems to found cultural-dimension-oriented development strategies with innovative applications. Test-fields established criteria for the creation of a database related to the implementation of Landscape Plan in Europe (such as Sicily, Lombardia, Calabria¹⁸ and Friuli Venezia Giulia, Great Britain, Swiss districts¹⁹). In Particular the Implementation of “Piani Paesaggistici” of Catania Province used the opportunities offered by information and communication technologies to encourage and support the delivery of cross-border public sector services and education activities to citizens in Europe and to improve efficiency and collaboration between Italian and international public administrations and to contribute to making environment an attractive place for new strategies under “Piani Paesaggistici” Programme including other planning tools such as “Sistemi Turistici Locali” and new methodologies for “Piani Particolareggiati” and historical centre conservation (Lo Tauro, 2007a). In particular the research had the objective to preserve and valorize cultural and natural resources event of major emergencies, or the imminent threat thereof, which may require urgent response action for new cultural heritage survey and conservation. The proposed strategy resides in a strong integration between all the components of the cultural sector at territorial scale (archaeological, architectural heritage and landscape heritage conservation, implementation of enjoyment services, cultural itineraries and greenway plan, activity of preservation and recovery activities for the forecast and the prevention of risk phenomena such as the volcanic risk, distribution of technologies for the reduction of the environmental impact, etc.) and those of the connected sectors: the tourism, the marketing, the scientific research, the professional training and education, the specialised production or the craftsmanship. Such sectors should be involved concretely through terms of territorial cooperation that could produce positive outcomes in Europe and world wide. In particular the implementation of “Piani Paesaggistico” of Catania Province adopted in the test-field all the available technologies (traditional and innovative topographic survey and mapping technologies, in situ spectroscopy, innovative MMS combined with thermographic imaging²⁰ and laser scanning (for building and road inspections), VRS²¹, RS, real-time GIS and Web-GIS, telecommunication applications, robotics, ICT) on reinforcing the landscape plan and cultural heritage conservation, which also focused on how to pool intervention teams and resources during a major disaster related to natural and man-made risks in the most effective way. The telecommunication identified a number of information gaps. It is those cities and agglomerations that are undoubtedly the source of a large share of the greenhouse gas emissions that underlie climate change; at the same time, these are the places that are often the most vulnerable to its effects. The thorough methodologies of buildings readings, integrated with geographic correlated techniques, research of novel application (GPS, Assisted Global Positioning System, smarthphone and Personal Digital Assistant), wireless connections (such as WiMax, H3G, HSDPA) and novel telecommunications applications such as HDTV, 3D, Mobile TV in S-band, Web TV, IPTV, Trimple Play (www.satexpo.it) moves in belief that it will be possible to represent the complex cultural and natural heritage with the support of Google Maps Technologies, ESA RS data, Galileo Joint Undertaking (www.esa.int) and the new KA band orbital positions. Those technologies will help to reduce this effect, improving the safety, promoting the use of efficient Sustainable Development, Energy Plans and energy efficiency and therefore reducing costs. It also highlighted the need for more training and interoperability and the need to improve telegeomatics, as highlighted by Manzoni, G, (2006).

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¹⁸ Thanks to SIT Staff, Regione Lombardia, “Ufficio Territoriale per la Biodiversità” (Cosenza) and “Corpo Forestale dello Stato”.

¹⁹ Comet and Erasmus Programme (1992-1996). Thanks to Emanuele Traversari, Customer Support Engineer (Erdas, The Earth to Business Company) for providing RS data.

²⁰ Thanks to Roberto Rinaldi FLIR System S.r.l. (www.flirthermography.com).

²¹ Thanks to CGT. S.r.L. www.cgtsrl.it

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